Sept. 17, 1963 E. V. DICKSON ETAL 3,103,796

REFRIGERATION SYSTEM

Filed July 15, 1960 5 Sheets-Sheet 1

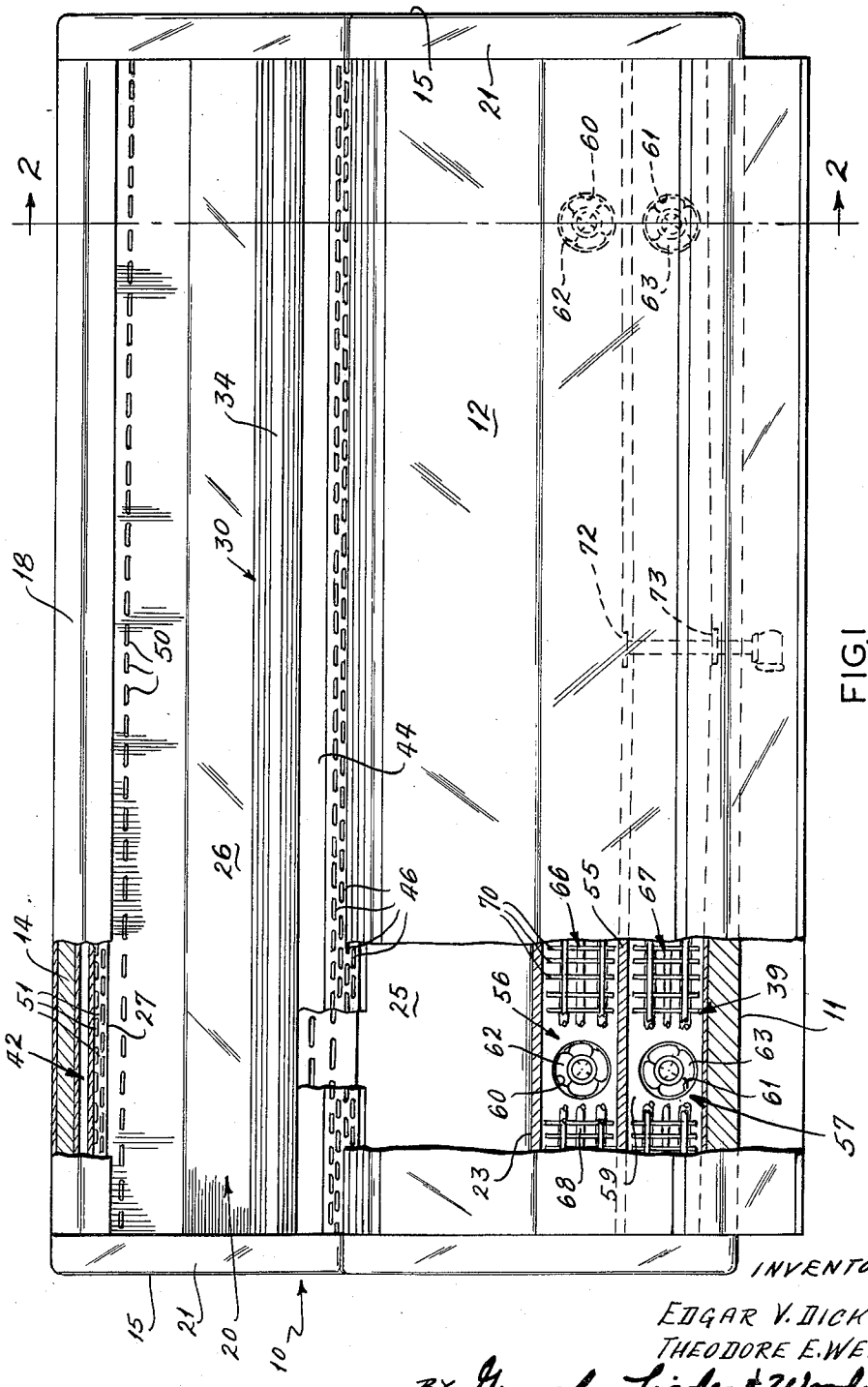


FIG. 1

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REFRIGERATION SYSTEM

Filed July 15, 1960 5 Sheets-Sheet 2

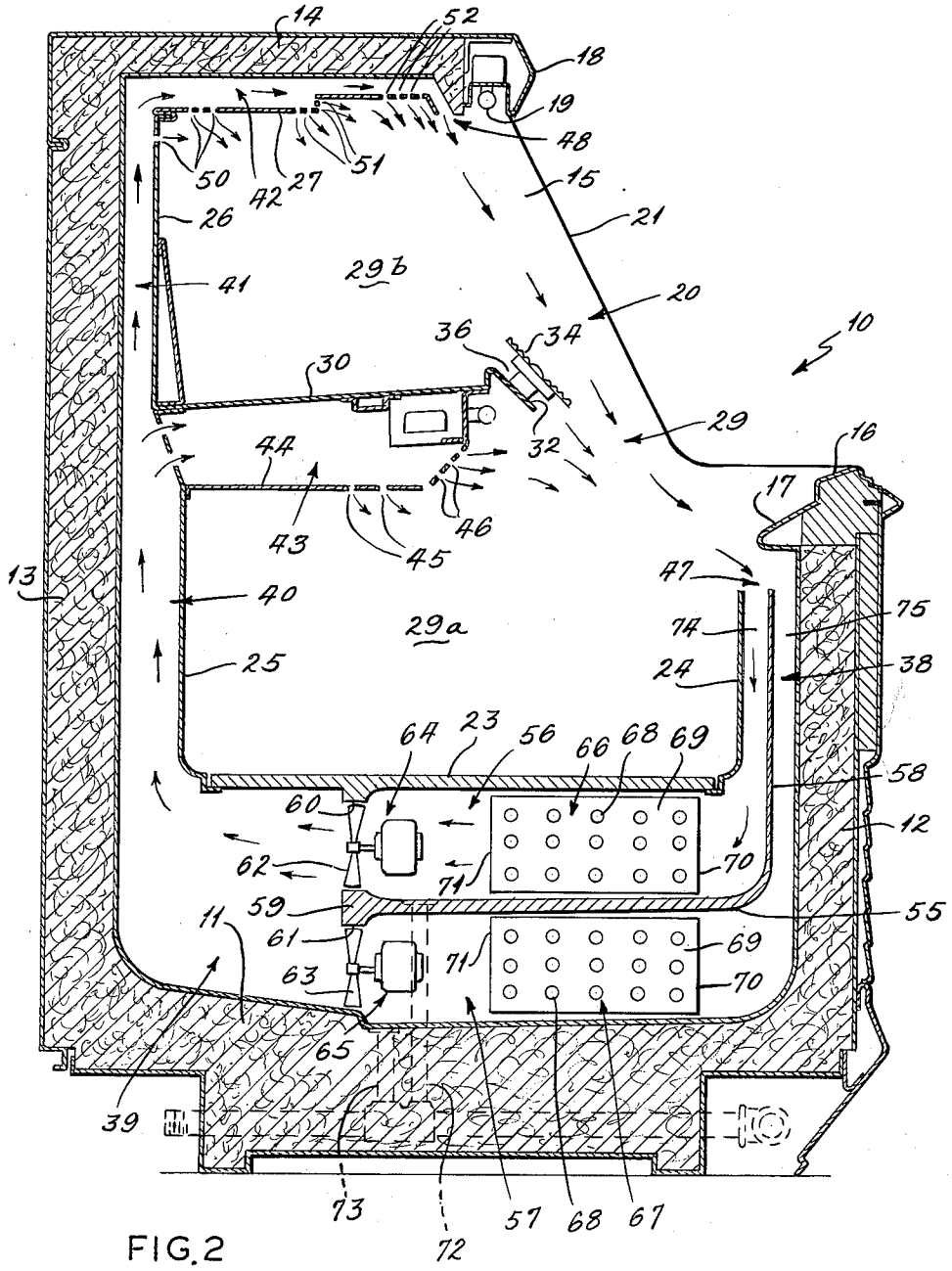


FIG. 2

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REFRIGERATION SYSTEM

Filed July 15, 1960 5 Sheets-Sheet 3

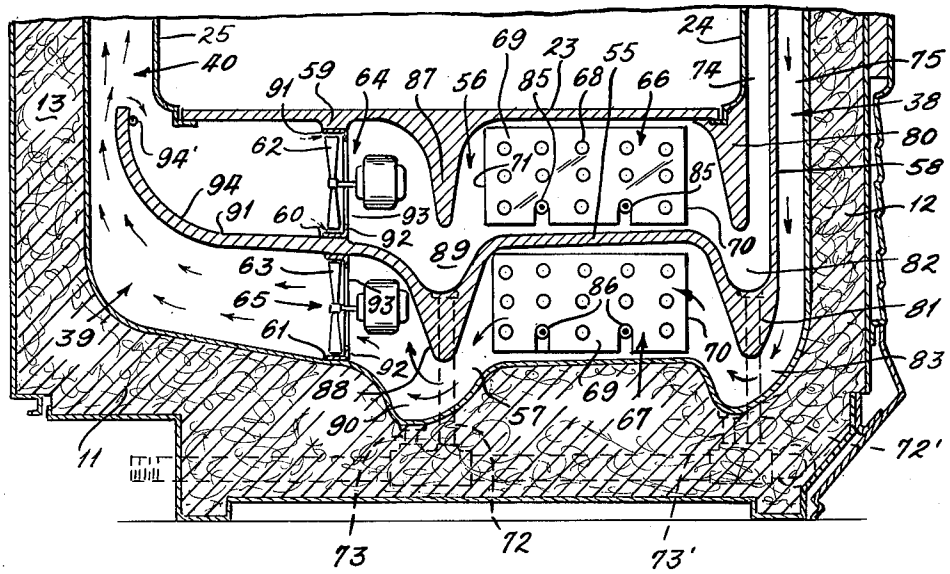


FIG. 3

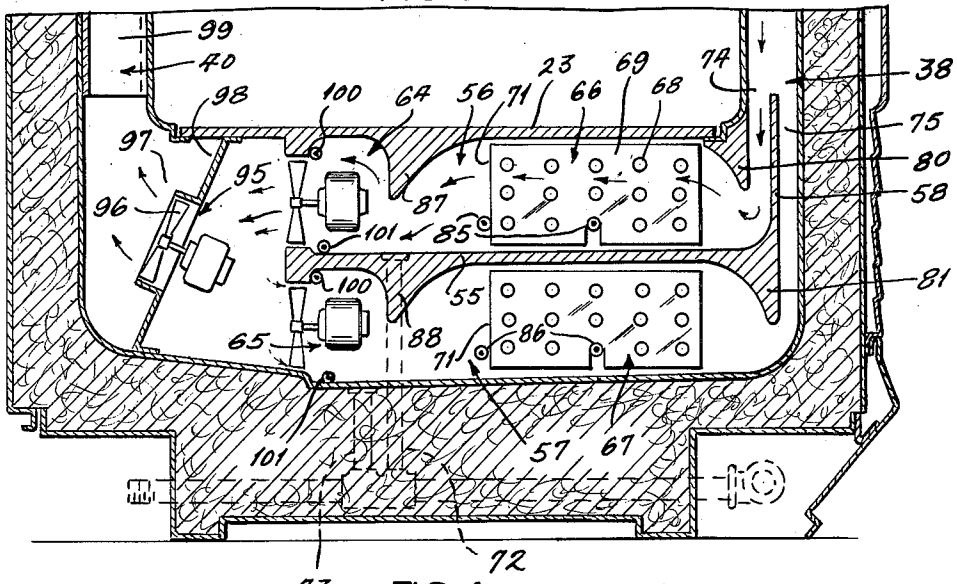


FIG. 4

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REFRIGERATION SYSTEM

Filed July 15, 1960 5 Sheets-Sheet 4

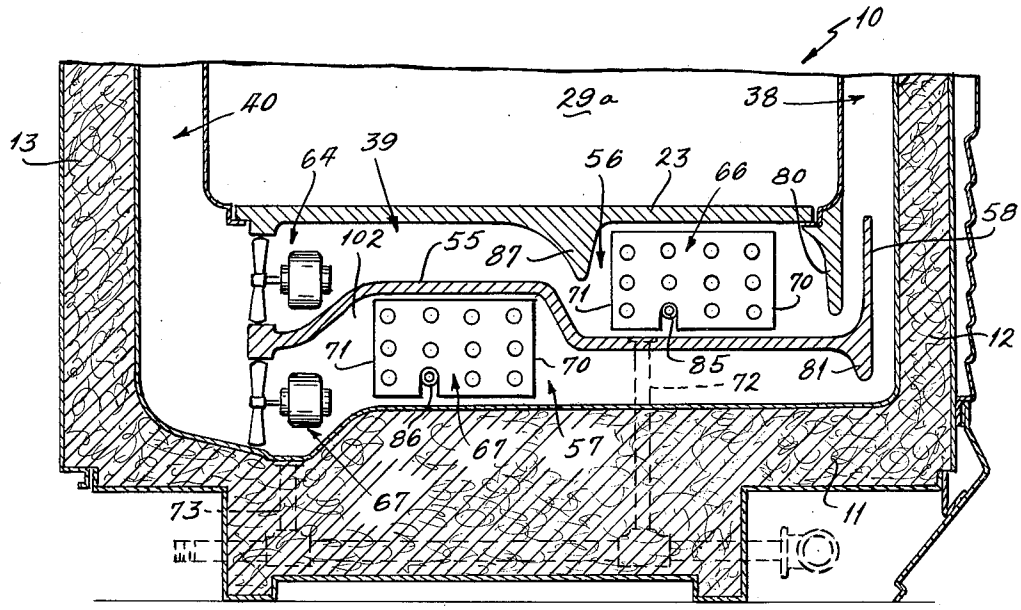


FIG. 5

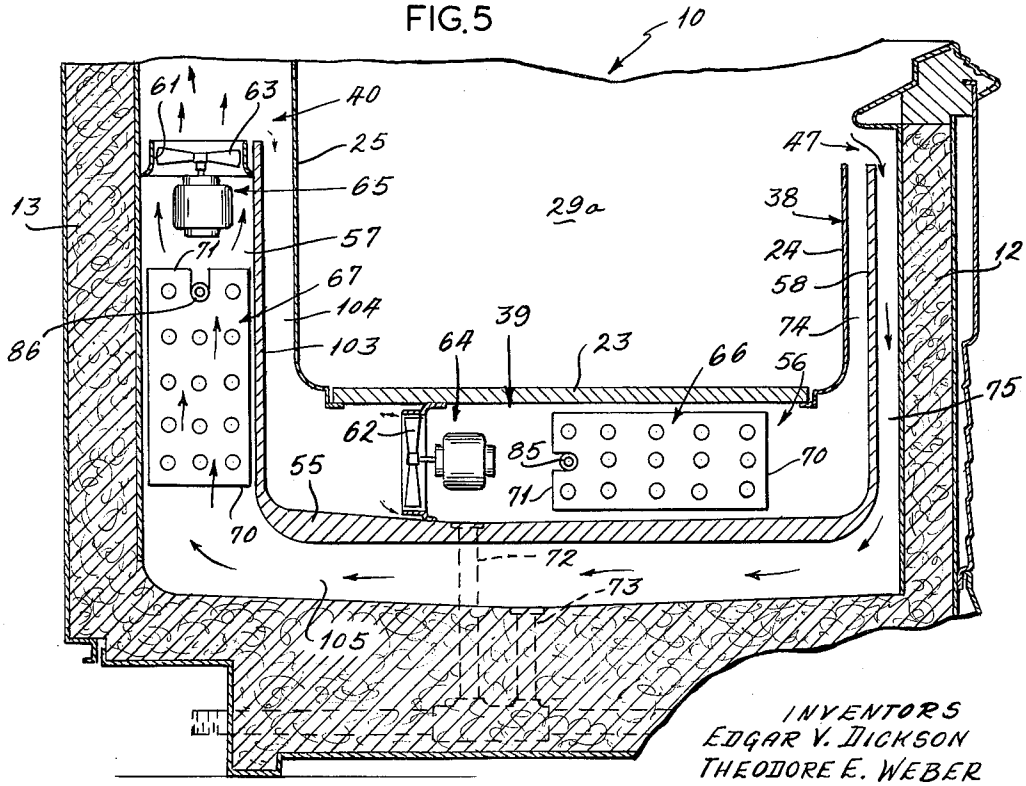


FIG. 6

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REFRIGERATION SYSTEM

Filed July 15, 1960 5 Sheets-Sheet 5

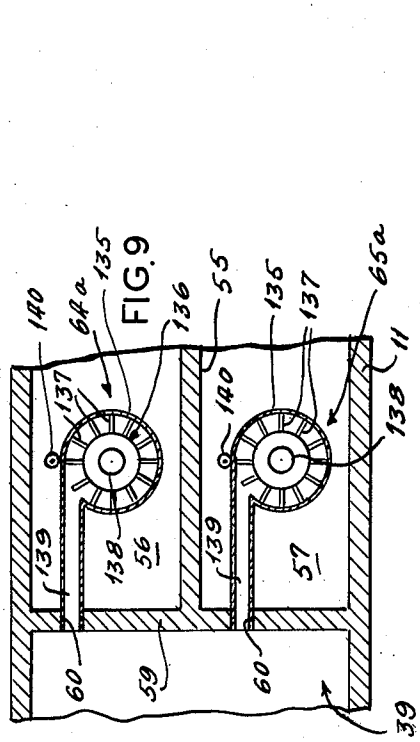


FIG. 9

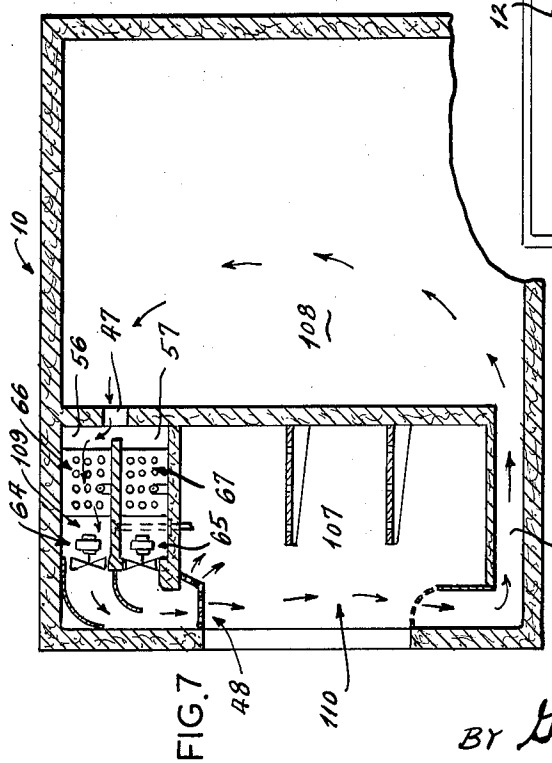


FIG. 7

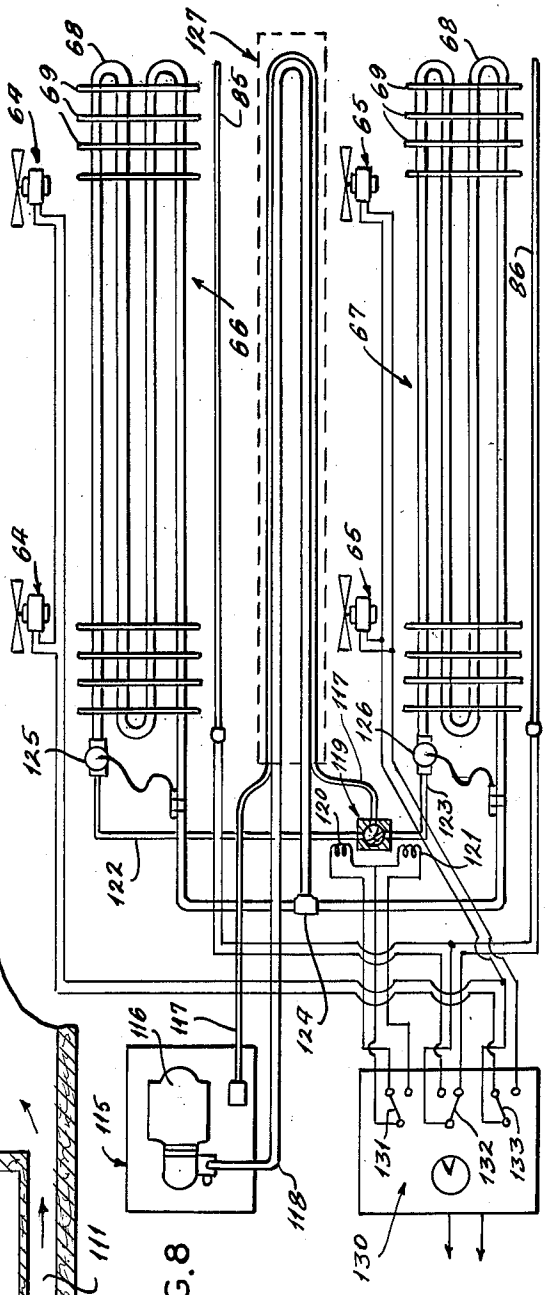


FIG. 8

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United States Patent Office 3,103,796 Patented Sept. 17, 1963

3,103,796

REFRIGERATION SYSTEM

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Filed July 15, 1960, Ser. No. 43,031
18 Claims. (Cl. 62—234)

This invention relates generally to the refrigeration art, and more particularly to a system for a refrigerated case for cooling products to predetermined temperatures.

The following listed terms are defined for disclosure purposes:

"Low temperature refrigeration" will refer to the refrigeration of food products, medicines or other products at temperatures below the freezing point of water and generally in the range from about 10° F. down to —10° F. or colder and preferably about 0° F.

"Open front" will be used in reference to refrigeration equipment having a product area with a generally vertical opening for access thereto.

"Case" according to usage in the refrigeration industry means any type of equipment in which products are displayed, but the term "case" shall be used herein as a generic term for any type of refrigerated fixture or equipment including coolers, cabinets and display cases which will be designated as such for specificity.

"Case defrost" means a defrosting operation in which all cooling means in a refrigerated case or fixture are heated in some manner to remove frost or ice accumulations therefrom, and during which the product area is not cooled.

"Evaporator defrost" or "defrost" (per se) will be used with reference to a defrosting operation for removing frost or ice accumulations from the area surrounding and including the cooling means.

"Constant temperature," with reference to product temperatures, will be used to encompass minor fluctuations in the temperature of products such as a range of 5° F. more or less around a predetermined desired temperature, which fluctuation is not a critical temperature change and substantially uniform. Variations in product temperature of 12° F. or more are undesirable and considered outside the definition of a substantially constant temperature.

"Continuous cooling" will be used in reference to cases having a product area maintained at a substantially constant temperature over preselected relatively long periods, such as weeks or months, as compared with cases requiring at least daily case defrosts in which all refrigeration is substantially stopped and product temperature is affected.

"Thermal trap" will refer to any means for retaining substantially all defrost heat in a predetermined area.

"Initial load" means the heat load that must be removed to bring a case and all contents thereof from the temperature of the ambient atmosphere to the desired operating temperature.

"Pull-down load" means the heat load present in a case and its contents incident to a defrost or case defrost, which heat load must be removed to bring the case and contents to the desired operating temperature.

"Operating load" is used in reference to the required capacity of a refrigeration system to maintain a case and its contents at a substantially constant predetermined temperature.

It is to be understood that even through the invention is particularly useful in low temperature, open front refrigerated equipment, it may be utilized in any refrigeration equipment having cooling means operating at frosting temperatures and requiring defrosts periodically.

It the past the refrigeration industry has obviated many problems in providing cases that are economically manufactured and efficient in operation, but industry and governmental controls established for refrigeration equipment together with the economies of production and limitations imposed by physical laws relating to refrigeration make it difficult to meet the continuous demand for more efficient refrigeration equipment. In co-pending application, Serial No. 21,457 of Dickson and Weber filed April 11, 1960 for "Low Temperature Refrigerated Case," now Patent No. 3,063,253, some of the problems prevalent in the refrigeration industry for many years are discussed and the problem of providing low cost equipment which will efficiently operate at low refrigeration temperatures over long periods of time continues to be of principal concern.

The principal problem in refrigeration equipment having cooling means operating at frosting temperatures has been the presence of moisture in the case and ambient air, which moisture is picked up by cold air or migrates to the colder parts of the case and refrigeration system and condenses as frost or ice on mechanical moving parts as well as on the cooling coils with the result that the equipment rapidly becomes inoperative. Of course, the evaporator and other equipment in low temperature equipment at colder temperatures creates a greater problem of controlling moisture pick-up on moving parts and coils in order to provide an operating cycle of several hours before requiring a defrost period to remove frost or ice from the evaporator, moving parts, flues and even the display case or product area. Heretofore all refrigeration equipment has required total case defrosts at least once a day and some equipment has required several case defrosts each day. During a case defrost, the entire coil mass and air temperature must rise about 32° F. and larger coils require more total heat than smaller coils and all defrost heat must be removed from the case and its products after a defrost period before the normal cooling temperature of the case is reached. Furthermore, during a case defrost the temperature of products in a low temperature case having an open display area without refrigeration and subject to ambient temperatures may rise a substantial amount such as 15° F. or more and such changes in product temperature are considered undersirable particularly in frozen food products. Accordingly, it is desirable to remove this defrost heat rapidly to shorten the defrost period and keep down the rise in product temperature, but defrost heat may be removed in a shortened period only by increasing the volume of refrigerated air flow or by lowering the temperature of the air. Increasing the volume of air means creating more tubulence and intermixture of ambient air whereby additional moisture may be carried into the case, and lowering the air temperature requires increasing the size of the evaporator and both of these means require a larger condensing unit and other refrigeration system components and having higher operating costs and more frequent defrost cycles. From the merchandiser's standpoint the most objectionable feature of prior art equipment is the formation of frost or ice in the display area and on products which may occur by reason of temperature or vapor pressure differentials between the case and its products and the ambient air or warmed case air carrying moisture from the evaporator zone. Too frequent defrost periods will increase this moisture problem as well as the temperature problem. Refrigeration components for prior equipment have been large enough to meet the initial load of the equipment as well as rapidly handle the pull-down load of the equipment to lower the temperature to the normal operating temperature after each case defrost re-

gardless of the degree of rise in product temperature during such defrost. Accordingly, refrigeration systems have been over-sized heretofore since the initial and pull-down loads of a given product zone exceeds the normal operating load imposed on the refrigeration system to maintain the predetermined product temperature.

The present invention is embodied in a refrigeration system adapted to provide continuous cooling of a product area to maintain a substantially predetermined constant temperature therein, this continuous case operation extending over a period of several days, weeks or even months without an entire case defrost. It has been discovered that the necessity for frequent case defrosts can be avoided by providing at least two air cooling and circulating means and operating one of these means while defrosting the other, and also to effect the changeover or alternation between these means without utilizing dampers or like mechanical means which are known to freeze and become inoperative if located in juxtaposition with the cooling means to be controlled. By providing localized defrosting of the cooling means and avoiding a case defrost, there is no substantial pull-down load imposed by the case or product area on the instant refrigeration system and the initial or starting load may be met by auxiliary temporary cooling means or by operating both cooling means at the same time to provide a slow pull-down period. Accordingly, the present refrigeration system may utilize smaller, better designed and more efficient components, the cooling means preferably being just larger than the minimum size required to hold the preselected temperature in the product area. The invention also consists in an improved method of cooling a product area.

The principal object of the present invention is to provide substantially continuous cooling of a product area to maintain a predetermined constant temperature of products therein.

An object of the invention is to provide an improved refrigeration system and method of continuously cooling a product area to predetermined refrigeration temperatures and controlling moisture in the product area and system for efficient operation.

Another object is to provide a case having an improved refrigeration system, with cyclic defrosting and having controlled air flow providing continuous operation of the case at low refrigeration temperatures.

Another object is to provide a refrigeration system for delivering a more uniform and constant temperature air flow in a distribution system for a case thereby reducing turbulence of air flow in the product area by minimizing air pressure variations.

Another object is to provide an economically manufactured refrigeration case utilizing smaller refrigeration system components reducing operating costs and providing more responsive temperature control.

These and still other objects and advantages will become more apparent hereinafter.

The invention also consists in the parts and combinations and arrangements of parts, and in the conditions and steps hereinafter described and claimed. In the accompanying drawings which from a part of this specification and wherein like numerals refer to like parts where ever they occur:

FIG. 1 is a front elevational view, partly broken away, of a refrigerated case having a system embodying the present invention,

FIG. 2 is a vertical transverse sectional view of the refrigerated case taken substantially along lines 2—2 of FIG. 1,

FIG. 3 is a fragmentary cross-sectional view showing a modified arrangement of a refrigeration system in a refrigerated case,

FIG. 4 is a view similar to FIG. 3 of another modified refrigeration system arrangement in a refrigerated case,

FIG. 5 is a view similar to FIG 3 showing still another modified arrangement embodying the invention,

FIG. 6 is a view similar to FIG. 3 showing another refrigeration system arrangement in a refrigerated case,

FIG. 7 is a diagrammatic vertical sectional view of a display cooler embodying the invention.

FIG. 8 is a schematic view showing a refrigeration system embodying the invention, and

FIG. 9 is a fragmentary cross-sectional view illustrating air moving means for a refrigeration system.

This application is a continuation-in-part of co-pending Dickson et al. application Serial No. 21,457 filed April 11, 1960 for "Low Temperature Refrigerated Case," now Patent No. 3,063,253.

Referring now to FIGS. 1 and 2 wherein a typical display case **10** is shown for purposes of illustrating the present invention, the case **10** includes an insulated outer cabinet or housing having a base **11**, a low front wall **12**, a relatively high rear wall **13**, a top wall **14** extending forwardly from the rear wall **13**, and end walls **15**. The upper margin of the front wall **12** is unrestricted by glass panels or other air retaining barriers for direct visibility and accessibility to the interior of the cabinet, and a rail or molding **16** may be provided over the top of the front wall and extend rearwardly to form an overhanging shield portion **17**. The forward margin of the top wall **14** is capped by a suitable molding or facing **18** defining a typical housing for illuminating means **19** therebehind. The molding **18** of the upper wall **14** is positioned to the rear of the front wall **12** and a substantial distance above the molding **16** thereof to form a front opening, shown generally at **20**, defining the upper portion of the front side of the cabinet. The end walls **15** have front margins **21** sloping downwardly and forwardly from the front of the top wall **14** to the top of the front wall **12** and generally define the sides of the front opening **20**.

The display case **10** also includes an inner cabinet extending longitudinally between the end walls **15** and having an insulated bottom wall **23**, a front panel **24**, lower and upper rear panels **25** and **26**, and a top wall or panel **27**. The walls and panels of the inner cabinet are spaced from the respective walls of the outer cabinet to define therebetween portions of an air distribution and recirculation system and a housing for elements of a refrigeration system. The inner cabinet defines a display or product area **29** having a lower well portion **29*a*** and an upper shelf portion **29*b*** extending vertically above the front wall **12** and which is directly accessible through the front opening **20**. A shelf **30** is mounted on the rear panel **26** for supporting products to be refrigerated in the shelf area **29*b***. The shelf **30** may be provided with a flange **32** positioned in an angular plane directed toward a point behind the upper edge of the front panel **24**. A vane **34** is secured in substantially parallel spaced relation with the flange **32** to define a flue or air flow passage **36** therebetween, and the vane **34** may also function as a price tag molding.

Still referring to FIGS. 1 and 2, the air distribution system shown for purposes of illustration includes a vertical front air duct or return flue **38** between the front wall **12** and front panel **24**, a lower chamber shown generally at **39** between the bottom wall **11** and bottom panel **23**, lower and upper rear chambers or ducts **40** and **41** between the rear wall **13** and the lower and upper rear panels **25** and **26**, respectively, and a horizontal duct or air delivery flue **42** between the top wall **14** and the top panel **27**. The air circulation system includes means for distributing air into the product area which includes the ducts **40**, **41** and **42** and may include another horizontal delivery duct **43** beneath the shelf **30** formed by a panel **44** having air discharge openings **45** and **46**. The ducts and chambers are in communication and the air distribution system also includes a return opening **47** to the return flue **38** and a discharge opening **48** from the duct **42** between which an air wall may be formed across the front opening **20**, and other air openings **50**, **51** and **52** may be provided

at the top of the product area for distributing air from the ducts 41 and 42 to the product area.

The refrigeration system includes air cooling and air moving means constructed and arranged in association with the air distribution system to refrigerate air to predetermined temperatures for cooling of the product area 29, as will be described presently. It will be apparent that refrigerated air is distributed into the product area 29 from the ducts 40, 41, 42 and 43 through the openings 45, 46, 48, 50, 51 and 52 and a substantial portion of the refrigerated air is drawn into the return opening 47 to the front flue 38 for recooling and recirculation to the product area 29. Complete recirculation of previously refrigerated air produces optimum efficiency by reducing heat and moisture pick-up to a minimum, but even an open front, low temperature case embodying the present invention will operate efficiently with the recirculation of less than the total amount or a substantial portion of the refrigerated air even in a humid ambient environment. It is manifest that the moisture and heat exchange problems of an open front case are not so prevalent in a closed case or cooler whereby the present invention may be utilized in such cases or coolers, if desired, to provide efficient continuous operation thereof. Accordingly, the present invention is particularly useful in open front, low temperature cases as shown for purposes of disclosure, and even in a multi-deck case such as is disclosed in co-pending application Serial No. 714,374 of Dickson and Weber filed February 10, 1958 for "Food Merchandiser," now abandoned. In fact, the present system is efficient in operation even when no secondary air wall is formed across the front opening of such a case, and is useful in open front or other equipment having cooling coils operating at frosting temperatures.

Still referring to FIGS. 1 and 2, the refrigeration means may be housed in the lower chamber 39 divided by a horizontal insulated panel or partition 55 into first and second cooling chambers 56 and 57. A partition 58 is secured to the entrance end of the chambers 56 and 57 adjacent to the return flue 38, and the partition 58 may extend upwardly in the flue 38 part or all of the way to the return opening 47. A vertical partition 59 closes the exit end of the chambers 56 and 57 extending between the end walls 15 of the case 10 and having openings 60 and 61 in which the fan blades 62 and 63 of fan and motor units 64 and 65 are positioned. The fan blades 62 and 63 are constructed to substantially fill or cover the openings 60 and 61 and serve to block air flow therethrough when the fan units 64 and 65 are inoperative. The fan units 64 and 65 comprise the air moving or circulating means in the air distribution system, and a pair of fans are shown for each of the first and second chambers 56 and 57. The number of fans and the sizes thereof may be changed to provide the desired air movement or capacity, and the air moving means including the relative sizes of the fan blades and openings provide the only control for air movement through the refrigeration system of the case 10, as will become more apparent hereinafter.

The chambers 56 and 57 contain evaporator means or coils 66 and 67 including serpentine or like refrigeration tubing 68 having a plurality of spaced fins 69 secured thereon, the fins having leading edges 70 and trailing edges 71 in relation to normal air flow therethrough. In addition, the chambers 56 and 57 are provided with drain means 72 and 73, respectively, for carrying off water from the chambers during defrost periods of the evaporators 66 and 67.

According to the invention, the refrigerated case 10 has alternate air flow paths in which air drawn into the return flue 38 for circulation through the distribution system and product area 29 is cooled to low refrigeration temperatures. In FIG. 2, the upper air flow path comprises the first chamber 56 and an inner portion 74 of the return flue 38 formed between the divider 58 and front panel 24. The lower air flow path comprises the second chamber 57 and an outer portion 75 of the return flue 38 formed between the divider 38 and the front wall 12. The fan units 64 and the evaporator 66 have successive operative and inoperative periods to provide a refrigeration or cooling cycle and an off or defrosting cycle. Similarly, the fan units 65 and the evaporator 67 are operative and inoperative in successive cycles. The refrigeration cycle of the air moving and cooling means 64, 66 in the upper air path coincides substantially with the defrosting cycle of the air moving and cooling means 65, 67 in the lower air flow path, and alternate operation of these first and second chamber means takes place to provide substantially continuous circulation of cooled air through the display area 29.

The circulation of air through the upper or first chamber 56 condenses moisture from the circulating air onto the tubing 68 and fins 69 of the evaporator 66, particularly on the leading edges 70 of the fins 69, in the form of frost and the temperature of the air is lowered to the required low temperature to maintain the product area 29 at the preselected temperature desired therein. To provide a product temperature from about 10° F. to −10° F. the evaporator will have to operate at about −40° F. and, of course, the lower the desired temperature, the greater the moisture and frosting problem. The relatively dry air passing from the evaporator 66 is drawn through the fan blades 62 and pushed upwardly in the rear ducts for distribution to the display area. During the inoperative period during which the evaporator 66 defrosts, the fan units 65 and evaporator 67 are operative to circulate and refrigerate air in the lower or second chamber 57 in the manner just described.

In operation each of the evaporators 66, 67 are adapted to carry the operating load of the product area by dehumidifying the circulating air and cooling it to a temperature adapted to meet the normal heat load characteristics of the case 10 for a predetermined product temperature. It is understood that a part of the heat load of the case 10 that must be absorbed or dissipated by the operative evaporator is the heat present in the inoperative evaporator during its defrosting cycle. The amount of heat required to defrost the evaporators 66, 67 during alternate inoperative periods thereof is preferably retained in the area of the defrosting evaporator by the fan associated therewith and direct heat exchange between chambers 56 and 57 is minimized and controlled by insulation whereby the total heat required to completely melt all frost from the evaporator is kept at a minimum as is the heat load produced incident to the defrost.

The circulation or movement of air through the evaporators 66 and 67 and in the distribution system is controlled by the fan units 64 and 65 and the openings 60 and 61 forming discharge outlets from the chambers 56 and 57. A small fan blade 62, 63, or one having a larger hub area, positioned in a close tolerance opening 60, 61 provides better volumetric control and a more constant air pressure output than a larger fan unit having a similar air capacity or a fan blade positioned in a larger opening inasmuch as induced air movement will be minimized during initial frost free operation of the evaporator following each inoperative period. During the alternate inoperative period of the fan units 64 and 65, the fan blades 62 and 63 may function like a thermal trap and block or close off the openings 60 and 61, respectively, and effectively render the operative chamber an air flow path in which only unidirectional air movement is provided. However, it is presently preferred to provide for the recirculation of a minimum portion of dry, low temperature air discharged from the operative chamber in a reverse flow movement through the inoperative chamber and front flue portion thereto back to the operative chamber.

A problem of low temperature case operation has been the presence of moisture and frosting in the flues, particularly in the rear flue through which air is distributed to the product zone. It has been proposed to use dampers or like mechanical means to completely prevent air movement through a defrosting coil and such means are objectionable either because of failure to operate due to freezing or because residual moisture around the evaporator is blown into the flues when such means is opened after a defrost. According to the present invention, the reverse flow of air minimizes this moisture problem by circulating the humid air in the inoperative chamber during defrost and back through the operative coil where the moisture is deposited as frost. During defrost the major portion of frost accumulations melt and are drained off through drains **72** and **73**, but the warmed air in the inoperative chamber holds more moisture than the refrigerated air in circulation during normal operation. The fan blades **62**, **63** and openings **60**, **61** are sized to discharge a predetermined amount of air during operation thereby providing a positive pressure in the distribution flues **40**, **41**, **42** and **43**. The relationship of blade and opening sizes are also sized to balance the system and obtain a reverse air flow through the inoperative chamber as a result of the negative pressures created around the fan and opening and in the front flue portions **74**, **75** of both operative and inoperative chambers. The portion of reverse air flow is proportioned so that the heat load on the operative coil is small enough to be absorbed without affecting the desired air temperature off the coil. It should be noted that the parallel flow arrangement of the chambers **56** and **57**, each being in series flow communication with the front flue **38** or front flue opening **47** in a restricted zone and also being in series flow communication with the lower chamber **39** or rear flue **40** in a restricted or closed zone, provides a typical air pressure environment for the reverse flow operation.

It is apparent that reverse air movement during defrost minimizes moisture migration toward the rear flue **40**, assists in the defrosting of the inoperative coil and produces warmed air flow in the front flue portion to prevent any frost build-up therein. In the event unidirectional air flow through the evaporators **66**, **67** is desired, the evaporators may be made operative for a short interval prior to beginning the fan operation after a defrost period to rapidly lower the temperature of the evaporator so that residual moisture in the chamber is deposited as frost.

It is understood that a balance is provided between the fan units **64** and **65**, the cooling means **66** and **67** and other air passages depending on the heat loads, temperatures and pressures to obtain a system operating at optimum efficiency. Each evaporator **66**, **67** and associated fan unit **64**, **65** have successive operating and non-operating periods alternately arranged with respect to the other evaporator and fan unit so that one is operative while the other is inoperative. The periods of operation and non-operation are of substantially equal duration which is predetermined according to the balance of the system so that the desired low temperature air flow moved alternately through the parallel flow paths therefor will remain substantially constant and the product area will be maintained at a constant temperature with a minimum of air turbulence therein. The duration of each period of operation and non-operation may be from one to six hours, for instance, and the balance of the system and time of operation should be such that excessive frost will not accumulate on the operative coil or evaporator **66**, **67**. Accordingly, a smaller and better evaporator with closer spacing of the fins **69** on the tubing **68** may be utilized to produce air temperatures in the chambers **56** and **57** which approximate the coil temperature whereby better control of temperatures throughout the case are possible. Also, an evaporator with less mass will be able to change temperatures faster thereby requiring less heat for a complete defrost and more quickly loosing this heat when the evaporator is put into operation. The evaporators **66** and **67**, although having less mass than evaporators heretofore, each meet the operating load requirements of the case **10** as described. It is apparent that the case **10** herein disclosed is not intended to be a freezing cabinet, but merely a display or storage case for products that are already frozen.

Referring now to FIG. 3, the chambers **56** and **57** may be provided with thermal traps in order to assist in the retention of heat in the immediate area of the evaporators **66** and **67** during the alternate inoperative periods thereof during which defrosting takes place. To prevent the rise of heated air in the front flue portions **74** and **75**, the upper walls **23** and **55** of the chambers **56** and **57** have barriers or partitions **80** and **81**, respectively, which extend downwardly to a point substantially even with the lower margins of the fins **69**. Unrestricted circuitious air passages **82** and **83** are thus formed between the front flues **74** and **75** and the chambers **56** and **57**, respectively, to facilitate the free flow of return air to the evaporators **66** and **67** and auxiliary drains **72'** and **73'** are provided at the lowest point of these passages **82** and **83**. Heated air is trapped above the level of the lower fin margin and retained in the evaporator area to increase defrosting efficiency and minimize the heat loss in the front flue **38**. It will be seen that defrost heaters **85**, **86** may be provided for the evaporators **66**, **67** to shorten the time required for a complete defrost of each evaporator during its respective defrosting cycle, as will become apparent. Other partitions or barriers **87** and **88** extend downwardly from the walls **23** and **55** on the exit side of the evaporators **66** and **67** to provide circuitous air passages **89** and **90**, respectively, below the level of the lower margins of the evaporator fins **69** and the drains **72** and **73** are located at these low points toward which the floor of the evaporator chambers **56** and **57** slope.

As previously set out, more efficient fan operation in providing a substantially constant air pressure in the distribution system, including flues **40**, **41**, **42** and **43** to the product area, will be provided by eliminating induced air flow or air movement which occurs during initial operation of each air cooling and circulating means after a defrost when the evaporator is substantially frost free. As shown in FIG. 3, the fan blades **62** and **63** are positioned in housings **91** fitted in the openings **60** and **61** and comprising collars having flanges **92** defining restricted openings **93** on the input or leading side of the fan blades **62** and **63**. The fan capacity is balanced with or limited by the size of the opening **93** to obtain a substantially constant pressure of air circulated therethrough, and induced air flow may effectively be eliminated. Accordingly, it is apparent that the fan housing **91** provides less total variation in air pressure output of the fans **64** and **65** during the operative period of each than if the fans are positioned in free openings **60** and **61** of the partition **59**. The size of the restrictions or openings **93** is a factor in controlling the air pressure output of the fans **64** and **65** and, in addition, the spacing of the flanges **92** axially from the fan blades **62** and **63** may provide a control regulating the amount of reverse flow air admitted through the inoperative chamber **56**, **57**. If desired, the housings **91** may be axially adjustable relative to the fans for reducing the clearance relative to the circumferential spacing of the blades in the collar or housing bore. Accordingly, although the fan blades **62** and **63** block the passage of air from the chambers **56** and **57** almost completely, heat during defrost is better retained in the coil area by the thermal trap means **80**, **87** and **81**, **88** and moisture migration into the flues **38** and **40** is reduced. An insulated partition **94** may be used as a divider extending toward or into the rear flue **40** to direct the relatively dry, low temperature air discharged by the fan units **64** and **65** in alternate cycles into the rear flue **40** and maintain an even pressure while minimizing turbulence. A small warming heater **94'** may be positioned on the upper surface of the

divider 94 for operation during defrost in the upper chamber 56 of the evaporator 66, as will be described.

Still referring to FIG. 3, it will be seen that the defrost heaters 85, 86 are positioned intermediate the leading and trailing edges 70 and 71 of the evaporator fins 69 even though normal air flow during operation tends to deposit more frost on the leading edges 70. During the inoperative period of the evaporator 66, the defrost heaters 85 induce heat into the coil area where it is substantially retained by the thermal trap arrangement of barriers 80, 87 and including the fan blade 62 relation to the restricted opening 93. A balance in the system to effect reverse flow draws a controlled minor portion of discharge air from the fan 65 of the lower air flow path forward in counterflow relation to the normal upper air flow path thereof past the warming heater 94', which may be energized with the heaters 85 to remove any unusual frost deposits occurring on the divider 94 as when the case 10 is installed in a place having high humidity. The small amount of heat from the heater 94' will be carried forwardly past the fan 64, and reverse air movement occurs in the evaporator whereby warmed air is moved toward the leading edges 70 of the fins 69 to melt ice or frost accumulations therefrom. The minor warm air movement upwardly in the flue portion 74 prevents frost build-up therein, and the reverse air flow then merges with recirculating refrigerated air from the product zone to the operative evaporator 67 in which the latent and sensible heat is absorbed. Reverse air flow is also provided through the lower air flow path during its inoperative period in a similar manner, and suitable warming heaters may be energized if desired.

Referring to FIG. 4 it will be seen that the features of invention may be combined in another modification. Partial thermal traps are formed by the partitions 80, 87 and 81, 88 to reduce heat loss from the chambers 56 and 57 during alternate defrost cycles of the evaporators 66 and 67 therein. A main fan unit 95 is preferably mounted on the exit side of the fan units 64 and 65 and includes a blade 96 positioned in an opening 97 of a longitudinal partition 98 extending between the end walls 15. The fan 95 may be desirable to obtain a balance between the fan units 64 and 65 in the operation of the system, and the fan 95 is in continuous operation with each of the fans 64 and 65. Accordingly, a pair of main fans 95 may be provided, one at each end of the case 10 for operation during alternate operation of each of the pairs of fans 64 or 65, or a single main fan 95 having a capacity similar to that of the pair of main fans may be centrally mounted in the case 10. The total capacity of the main fan means 95 will be determined according to the balance desired between the first and second air moving means 64, 65 for the upper and lower air flow paths, and is preferably slightly less than the total air capacity output of either the first air moving means 64 or the second air moving means 65. Accordingly, a back-pressure intermediate the main or balance fan 95 and the primary or coil fans 64, 65 will occur to effect reverse flow in the inoperative chamber. The main fan 95 maintains a substantially constant air delivery in the rear flue 40 of the case 10 and is particularly useful in multi-deck display cases having relatively high rear flues, or in refrigerated cases discharging air at much colder or lower temperatures since colder air is heavier.

An air straightener 99 may be mounted in the rear flue 40 to even out the air flow between the ends 15 of the case and provide non-turbulent air distribution through the case 10. If desired, the partition 58 in the front flue 38 may be shortened so that air reversing or feed-back is better balanced or controlled relative to the portion of air drawn into the return opening 47 of the front flue 38. Although the coil fans 64 and 65 are moving parts which heretofore have been subject to ice conditions impairing the efficiency or stopping the operation thereof, the fan units 64 and 65 are preferably positioned on the trailing or exit side of the evaporators 66 and 67 so that the low temperature air circulated past the fans is relatively dry. However, in climates of high humidity some frosting may occur during the operative period of the fans, and small heaters 100 and 101 may be provided on the fan partition 59 and adjacent to the drains 72 and 73 in juxtaposition to the fans in order to completely remove all frost during the inoperative period. The cycling or periods of operation and non-operation are preferably frequent enough to prevent large frost deposits on the fans and on the fins 69 and tubing 68 of the coils 66 and 67. Accordingly, such frost is easily removed in the defrost cycle and reverse circulation of heat through the inoperative chamber speeds the coil defrost. It will be noted that one of the heaters 85 and 86 may be positioned across the trailing edges 71 of the fins 69 so that the heat produced thereby will be carried through the entire coil by the reverse flow of air.

In FIG. 5 the placement of evaporators 66 and 67 in the chambers 56 and 57 is arranged to facilitate optimum use of space whereby the product area 29*a* may be enlarged, and thermal traps are also formed for the evaporator 66 in the upper chamber 56 by partitions 80 and 87 and are formed for the evaporator 67 in the lower chamber 57 by shaping the insulated panel 55 to provide an upwardly extending recess 102. The transversely offset or staggered arrangement of evaporators 66 and 67 illustrated in FIG. 5 does not restrict the free passage of air from the return flue 38 into and from the respective cooling chambers communicating therewith through the circuitous passages below the partitions on each side of divider 58. It is also apparent that the upper or first evaporator 66 may be located at or near the rear of the lower chamber 39 and the lower evaporator 67 positioned adjacent to the front of the case 10. The insulated panel 23 may also be shaped in a manner to provide a larger display area. Although the defrost heaters 85 and 86 are again shown intermediate the leading and trailing edges 70 and 71 of the coil fins 69, the heaters may be attached to the leading edges 70 particularly in the event unidirectional air flow through the evaporators 66, 67 is desired.

Referring to FIG. 6, it will be seen that the evaporators 66 and 67 may be positioned in the lower chamber 39 and rear flue chamber 40 in order to obtain maximum use of the space in the display case 10. In this arrangement the partition 55 extends traversely of the lower chamber 39 and is connected to vertical partitions 58 and 103 dividing the front and rear flues 38 and 40, respectively. Accordingly, the first chamber 56 above the partition 55 is in communication with the return opening 47 through the flue portion 74 and with an exit flue 104 between the partition 103 and the rear panel 25. The second chamber 57 is located between the partition 103 and the rear wall 13 and communicates with the front flue portion 75 through a connecting flue 105 below the partition 55. By reason of the substantially constant air pressure in the rear flue 40, a reverse flow of air through the inoperative chamber may be obtained as set out hereinbefore. The fan blade 63 in the opening 61 may function as a thermal trap for the vertical chamber 57 and heaters may be provided as taught herein.

Referring to FIG. 7, it will be seen that the invention may be utilized in an air curtain case 10 comprising a display portion 107 and a closed cooler or storage portion 108, both of which form product areas. The parallel flow chambers 56 and 57 are arranged in a header area 109 having a return opening 47 and a discharge opening 48 adapted to circulate refrigerated air through the display product area 107 and form an air wall across an open front 110 thereof. A substantial portion of the refrigerated air is returned by a closed insulated duct 111 to the closed storage area 108 for maintaining product temperature therein substantially constant. It will be

readily apparent that the alternate flow paths through chambers 56 and 57 contain the air cooling and circulating means 66, 64 and 67, 65 for providing continuous cooling of the product areas 107, 108 to predetermined temperatures. The chambers 56 and 57 have a common inlet or return 47 and a common outlet or discharge 48 whereby reverse air flow or feed-back of air may be provided for the purposes set out.

The invention may be more fully described by reference to FIG. 8 wherein the refrigeration system and operating controls therefor are shown schematically. The refrigeration system comprises a condensing unit 115 including a compressor 116, a liquid line 117, the evaporator means 66, 67, and a gas return conduit or suction line 118. The liquid line 117 is connected to the inlet port of a three-way valve 119 having solenoids 120 and 121 adapted to be energized for reversing the valve position and selectively connecting one of parallel liquid flow conduits 122 and 123, which connect the evaporators 66 and 67 in series flow relation with the liquid and suction lines 117 and 118. The evaporators 66 and 67 are in parallel flow relation in the system between the valve 119 and a T 124 to which the suction line 118 is connected, and are alternately rendered operative by the operation of the valve 119. The parallel liquid lines 122 and 123 are connected through typical expansion valves 125 and 126 to the evaporators 66 and 67, and a portion of the liquid and suction lines 117 and 118 are in heat exchange relation, at 127. The control means for operating the refrigeration system includes an electrical circuit having timing means 130 for operating switch means 131, 132 and 133 for operating the valve 119, the defrost heaters 85 and 86, and the fan units 64 and 65.

In the operation of the simplified electrical control means utilizing time as the control unit for alternating the operation of the first air cooling and circulating means 66, 64 with the second air cooling and circulating means 67, 65, the switch 131 is shown in position for energizing the solenoid 120 of the valve 119 to connect the liquid line 117 through the valve 119 to the liquid conduit 122 connected through expansion valve 125 to the evaporator 66, whereby the refrigerant flow in the evaporator 67 is shut off by the valve 119. The switch 133 connects the fans 64 in a circuit for operation, and the defrost heater 86 for the evaporator 67 is connected in a circuit through switch 132. After a predetermined interval of operation of the evaporator 66 and defrost of the evaporator 67, the timer 130 times out and moves the switch 131 to energize the solenoid 121 and reverse the valve 119 to divert refrigerant flow into the evaporator 67 and shut off flow into the evaporator 66. The switch 133 starts the operation of fans 65 and stops the fans 64, and the defrost heaters 85 for the now inoperative evaporator 66 is connected in the circuit through switch 132. The timer 130, of course, is automatically reset for another timing operation.

It is also apparent that more complex timing means may be desired in order to provide delays between the energization of fan and associated evaporator means following a defrost cycle or for operating the defrost heaters 85, 86 during a portion only of the inoperative period of the evaporators 66, 67. For instance, in FIG. 8 the heater 86 may be shut off after a predetermined interval for the remainder of the inoperative period of evaporator 67 by moving switch 132 to an intermediate position opening the circuits to all heaters. When the timer 130 times out the pre-set period, the valve 119 is reversed by operation of switch 131 and energization of solenoid 121 to connect the evaporator 67 to the liquid line 117 and stop all flow of refrigerant into the evaporator 66. The switch 133 may be delayed before moving to stop fans 64 and start the fans 65, and a lag in actuation of the switch 132 may be provided before moving from a neutral position to connect defrost heater 85 in the circuit.

In the actual use of complex timing units, the various components of the system may be operated for predetermined intervals independently of the other components. For instance, in a single time period beginning when the fans 64 are placed in operation to circulate air over the evaporator 66 and the fans 65 are rendered inoperative, the fans 64 and 65 being the basic air control means, the evaporator 66 is connected in series flow relation with the liquid and suction lines 117 and 118 through the three-way valve 119 in the refrigerant flow system and no refrigerant is being circulated in the evaporator 67. The temperature of the evaporator 66 is substantially at normal operating temperature and the tubing 68 and fins 69 are substantially frost free following a complete defrost thereof. For purposes of disclosure, the operative time period of the fan 64 will be two hours, although the time period may be varied between one and six hours or more depending upon the balance of the system and the conditions under which the case 10 is operating.

During this period the fan 64 runs continuously and the evaporator 66 is at the desired low temperature whereby air is circulated through the upper flow path 56 and discharged by the fan into the rear flue 40 to the air distribution system for maintaining a constant temperature in the product area. Sensible and latent heat constituting the operating load is removed from return air by the evaporator 66. The evaporator 67 and fans 65 are in their inoperative period which includes idle and defrost cycles or portions. Initially an idle period is provided during which no heat is applied to the evaporator 67 and the evaporator temperature rises slowly from its normal low operating temperature. This idle period may extend between an hour and one and one-half hours during which there will be no appreciable warming of even the minor portion of reverse flow air passing through the inoperative air flow path. A defrost period of approximately twenty to thirty minutes is then provided during which the heaters 86 are energized and the coil mass raised to a temperature above 32° F. for melting all frost accumulations from the evaporator 67, and the heaters 86 are then de-energized for an idle period of approximately ten to twenty minutes. Reverse air flow will slowly dissipate the defrost heat into the operative evaporator 66 without producing an appreciable rise in product temperature and thereby lowering the temperature of the chamber 57. It should also be noted that the defrost heat is provided near the end of the inoperative period whereby residual moisture in the chamber 57 may be carried by the warm reverse air flow portion into the operative chamber 56 just prior to its inoperative period so that the additional frost deposit resulting on the evaporator 66 will not materially reduce the efficiency of the evaporator during the major portion of its operation. At the end of the operative period of the fans 64, the solenoid 121 is energized to reverse the valve 119 and direct refrigerant flow into the evaporator 67. The fan 64 continues to circulate the air flow through the evaporator 66 for a short period such as two minutes inasmuch as the refrigerant in the tubing 67 at the time of the valve actuation will continue to maintain the evaporator temperature unchanged for a short period. Furthermore, the temperature of the evaporator 67 will drop rapidly toward operating temperature inasmuch as there is substantially no air circulation with its attendant heat load, whereby only the sensible heat of the coil mass must be removed. This short interim period is terminated by stopping the fans 64 and starting the fans 65 on the operative cycle thereof. The timing for operation of the second air cooling and circulating means 67, 65 and the inoperative period of the first air cooling and circulating means 66, 64 is similar to the steps just described. Although timing control means 130 are shown for alternating the operation of the evaporators by determining the length of the periods therefor, temperature or pressure control means may also be utilized.

Referring to FIG. 9 it will be seen that air moving

means 64*a* and 65*a* may comprise centrifugal blowers rather than propeller type fans 64 and 65 as shown in other views, and it will be apparent that still other air moving means may also be used. The centrifugal blowers 64*a* and 65*a* are mounted in position for controlling the air circulation through the chambers 56 and 57, and each blower includes a housing 135 having a squirrel cage 136 including a plurality of blades 137. The housing provides a side air intake opening 138 and a discharge orifice 139 positioned in the opening 60 of the partition 59. The blowers each operate in a conventional manner and in alternating relationship as previously set out. The problem of controlling induced air movement does not exist in the type of blower arrangement disclosed, and substantially constant air pressures are provided whereby discharge of air from relatively high distribution flues may be maintained at a substantially continuous rate and volume. However, frosting is more likely to occur between the blades 137 of the squirrel cage 136 than between the blades 62, 63 of fans 64 and 65 although operating and defrosting cycles in the present case 10 may be regulated to maintain effective operation. Heaters 140 may be associated with the housings 135 for removing all frost during the inoperative period of each blower 64*a* and 65*a*.

It should be noted that the size of the discharge openings 139 controls the volume of air during reverse flow operation at defrosts, and it is the effective area of the discharge opening 139 that must be predetermined to provide or control the desired air flow therethrough when the blowers 64*a* and 65*a* are inoperative. Similarly, the effective open area between and around the blades 62 and 63 of fans 64 and 65 within the housings 91, FIG. 3, or openings 60, FIGS. 2, 4, 5, 6 and 8 is the actual control for return air. Of course, the effective opening area also affects the air flow therethrough during operation of the fans or blowers, but the proper balance may be provided by the capacity of the air moving means whereby it is apparent that opening size and air handling capacity are both important in controlling air flow.

It will be readily apparent that other arrangements or schedules in the operation of a refrigeration system embodying the invention may be made, and that the various embodiments herein chosen for illustration do not constitute a limitation upon the invention. The different features or components, conditions and steps set out may be combined to provide a refrigeration system for balanced continuous operation and maintaining product temperatures constant, and the problem of controlling moisture, which may migrate counterflow to air movement, is substantially overcome.

The invention is to be limited only by the claims which follow.

What we claim is:

1. An open front refrigerated case having a product area and air distribution means in communication therewith, first and second chambers having air discharge openings adjacent to said air distribution means, air cooling and moving means housed in each chamber, control means for operating said air cooling and moving means in one chamber in alternating periods with said air cooling and moving means in the other chamber, divider means separating said air discharge openings and forming chamber extensions in direct communication with said air distribution means, said control means providing each of said air moving means with an inoperative period during operation of the other air moving means, and said operative and inoperative air moving means providing an air pressure balance in said chambers and air distribution means to effect a controlled reverse flow of air through the chamber in which the inoperative air cooling and moving means is housed, and warming means in at least one of said chamber extensions.

2. In a refrigerated case having a refrigeration chamber housing air cooling means, air moving means having successive operative and inoperative periods for controlling the circulation of air through said refrigeration chamber to maintain a substantially constant pressure of refrigerated air to said case during the operative period and to limit the volume of air flow through the refrigeration chamber during the inoperative period, control means for providing said air cooling means with succesive operative and inoperative periods substantially co-extensive in time with the operative and inoperative periods of said air moving means, said air cooling means being defrosted during its inoperative period, and other air cooling and moving means in said case including control means therefor and being operative during the inoperative periods of said first mentioned air cooling means and air moving means, said other air cooling and moving means during operation creating negative pressures through said refrigeration chamber producing controlled reverse flow of air therethrough.

3. A refrigerated case having a product area, first and second chambers in parallel air flow relationship and having common air distribution and return means in communication with said product area, an evaporator in each of said chambers, a fan in each of said chambers for circulating air through the evaporator therein and discharging the air into said air distrbution means, means providing alternate operation of said evaporator and fan in said first chamber with the evaporator and fan in said second chamber, and a main fan positioned in said air distribution means for effecting an air circulation balance between said fans in said first and second chambers.

4. A refrigerated case having a product area, first and second chambers in parallel air flow relationship and having common air distribution and return means in communication with said product area, an evaporator in each of said chambers, a fan in each of said chambers for circulating air through the evaporator therein and discharging the air into said air distribution means, means providing alternate operation of said evaporator and fan in said first chamber with the evaporator and fan in said second chamber, and a main fan continuously operating in said air distribution means and having a predetermined air moving capacity slightly less than the air moving capacity of said fans in said first and second chambers whereby a minor reverse flow air movement is created in the inoperative chamber.

5. A refrigerated case having a product area, first and second chambers in parallel air flow relationship and having common air distribution and return means in communication with said product area, an evaporator in each of said chambers for cooling air to predetermined temperature, a fan in each chamber for circulating air through the evaporator therein and discharging cooled air into said air distribution means, means providing alternate operation of said evaporator and fan in said first chamber with the evaporator and fan in said second chamber, heater means for defrosting each evaporator during an inoperative period thereof during operation of the other evaporator, said fans having an inoperative period and controlling air circulation through said chambers to provide a minor portion of air from said operative evaporator and fan to be fed back through said inoperative evaporator counterflow to normal air movement during the operative period, said minor portion of air being recirculated through said operative evaporator.

6. The refrigerated case according to claim 5 in which said heater means is positioned on the normal exit side of said evaporators whereby heat therefrom during defrosting is carried by said minor portion of air through said inoperative evaporator.

7. A refrigeration system for a case having a product area, comprising first and second evaporators adapted to operate at frosting temperatures, first and second fan units adapted to circulate air past said first and second evaporators respectively, said first evaporator and fan unit and said second evaporator and fan unit being ar-

ranged in parallel air flow relation and having common air distribution and return communication with said product area, first and second heater means for defrosting said first and second evaporators, and control means for operating said first and second evaporators, fan units and heater means to produce cyclic operation and defrost and continuous cooling of air distributed to said product area, said control means including a closed refrigerant flow system and a valve in the liquid line alternately connecting one of said evaporators in series flow relation between said lines and simultaneously shutting off refrigerant flow to the other of said evaporators, first switch means for reversing said valve to alternate the refrigerant flow between said evaporators at preset intervals, second switch means for alternately operating said first and second fan units for predetermined intervals, third switch means for operating said first and second heater means for predetermined intervals, and timing means for selectively operating said switch means.

8. In a refrigerated case having a refrigeration chamber housing air cooling means, air moving means for intermittently circulating air through said case and refrigeration chamber and intermittently substantially blocking the circulation of air through said refrigeration chamber, said air moving means including a fan comprising blades constructed and arranged in an air passage to limit air circulation therethrough to a predetermined amount when said fan is inoperative, control means for establishing successive operative and inoperative periods of said air cooling means and of said fan substantially co-extensive therewith, means for defrosting said air cooling means during the inoperative period thereof, and other means for cooling the refrigerated case during the inoperative periods of said air cooling means and fan.

9. In a refrigerated case having a refrigeration chamber housing air cooling means, air moving means for intermittently circulating air through said case and refrigeration chamber and intermittently substantially blocking the circulation of air through said refrigeration chamber, said air moving means having successive operative and inoperative periods, said air cooling means having successive operative and inoperative periods substantially co-extensive with the operative and inoperative periods, respectively, of said air moving means, means for defrosting said air cooling means during the inoperative period thereof, said air moving means being positioned in an air passage and being constructed and arranged therewith to limit air circulation through said passage and substantially retain heated air in the area of said air cooling means during the defrosting thereof, and other means for cooling the refrigerated case during the inoperative periods of said air cooling means.

10. In a refrigerated case having a refrigeration chamber housing air cooling means, air moving means for intermittently circulating air through said case and refrigeration chamber and intermittently blocking the circulation of air through said refrigeration chamber, said air moving means including a fan having successive operative and inoperative periods and comprising blades constructed and arranged in an air passage to limit air circulation therethrough to a predetermined amount when said fan is inoperative, said air cooling means having operative and inoperative periods substantially co-extensive with said operative and inoperative periods, respectively, of said fan, means for defrosting said air cooling means during the inoperative period thereof, and thermal barrier means in addition to said fan for retaining heated air in the immediate area of said air cooling means during the defrosting thereof.

11. In a refrigerated case having a product area to be cooled to low refrigeration temperatures, a common air distribution system for circulating refrigerated air into the product area and returning a substantial portion of said refrigerated air for re-circulation, and at least two closed refrigeration chambers each having inlet and outlet openings in communication with said common air distribution system and being adapted to provide alternate air flow paths for said return air, refrigeration means in each of said refrigeration chambers having an operative refrigeration cycle for re-cooling and de-humidifying the entire mass of returned refrigerated air and a defrost cycle, said refrigeration and defrost cycles succeeding each other, air moving means in each of said refrigeration chambers adjacent to said outlet opening thereof, each air moving means having an operative cycle for circulating refrigerated air past said refrigeration means during its operative refrigeration cycle and discharging said air into said air distribution system through said outlet opening, and each air moving means having an inoperative cycle during which air movement through said refrigeration means to said air distribution system is substantially prevented by at least one of said air moving means and outlet opening, and control means for effecting operation of one of said refrigeration and air moving means in alternate cycles relative to the operation of the other of said refrigeration and air moving means.

12. The refrigerated case according to claim 11 including divider means separating said refrigeration chamber outlet openings and forming chamber extensions in direct communication with said air distribution system.

13. The refrigerated case according to claim 12 wherein said air distribution system includes a vertical air discharge duct to said product area, and said divider means extend to said duct.

14. The refrigerated case according to claim 11 wherein said alternately operable refrigeration means in said refrigeration chambers are each a predetermined size for carrying the entire refrigeration operating load of said case.

15. The refrigerated case according to claim 11 wherein said product area has a front opening, and said air distribution system includes means forming an air curtain across said front opening.

16. The refrigerated case according to claim 11 wherein said refrigeration means in said refrigeration chambers comprises the only means for cooling said product area of said refrigerated case.

17. In a refrigerated case having a product area to be cooled to low refrigeration temperatures, a common air distribution system for circulating refrigerated air into the product area and returning a substantial portion of said refrigerated air for re-circulation, and at least two refrigeration chambers in communication with said common air distribution system and adapted to provide alternate air flow paths for said return air, refrigeration means in each of said refrigeration chambers having an operative refrigeration period for re-cooling and dehumidifying the entire mass of returned refrigerated air and an inoperative defrost period during which said refrigeration means is defrosted, said operative and inoperative periods succeeding each other, air moving means associated with each refrigeration means and operative therewith for circulating refrigerated air through said refrigeration chamber and said refrigeration means and discharging it into said air distribution system, each air moving means having an inoperative period during defrost of its associated refrigeration means and including fan blade means constructed and arranged in said refrigeration chamber to substantially prevent the flow of air through said refrigeration means associated therewith during the defrost cycle of said refrigeration means, and control means for said refrigeration means and air moving means whereby one of said refrigeration means and air moving means is operative in alternate cycles relative to the operation of the other of said refrigeration and air moving means.

18. In a refrigerated case having a product area to be cooled to low refrigeration temperatures, a common air distribution system for circulating refrigerated air into the product area and returning a substantial portion of

said refrigerated air for re-cooling, and at least two refrigeration chambers in communication with said common air distribution system and providing alternate air flow paths for said return air, evaporator means in each of said refrigeration chambers having an operative refrigeration period for re-cooling and de-humidifying the entire mass of said returned refrigerated air and an inopertive defrost period during which said evaporator means is defrosted, said periods succeeding each other, air moving means associated with each of said evaporator means and operative therewith for circulating refrigerated air past said evaporator means and discharging it into said air distribution system, control means for effecting the operative and inoperative periods of one of said evaporator means in alternate cycles relative to the operation of the other of said evaporator means, and each of said evaporator means having heating means for removing frost accumulations therefrom during its defrost period, each of said refrigeration chambers including thermal barrier means

adjacent to said evaporator means for retaining heat in the area of said evaporator means during defrosting thereof.

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