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REFRIGERATED DISPLAY CASE

Filed Sept. 6, 1960

2 Sheets-Sheet 1

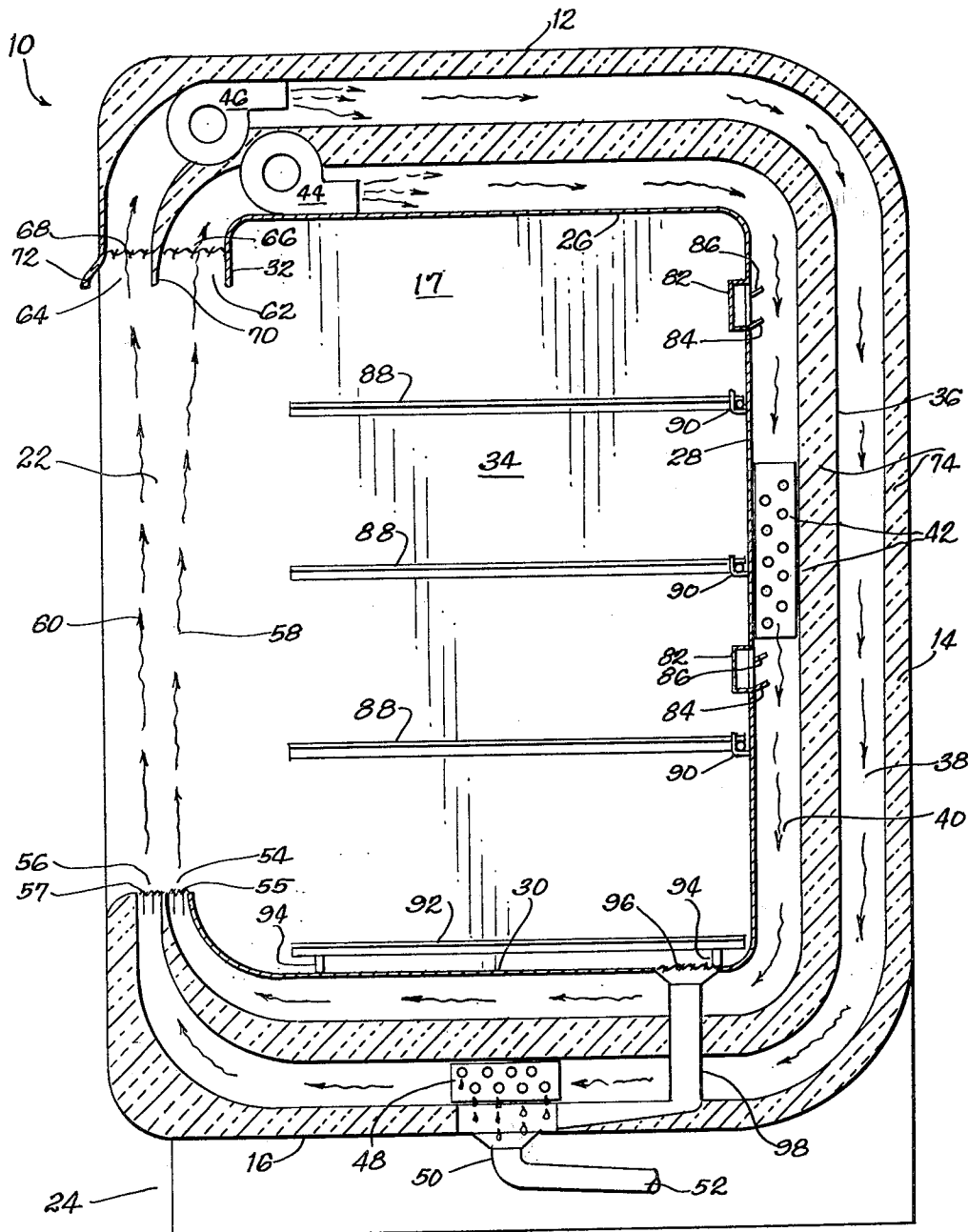


FIG. 1

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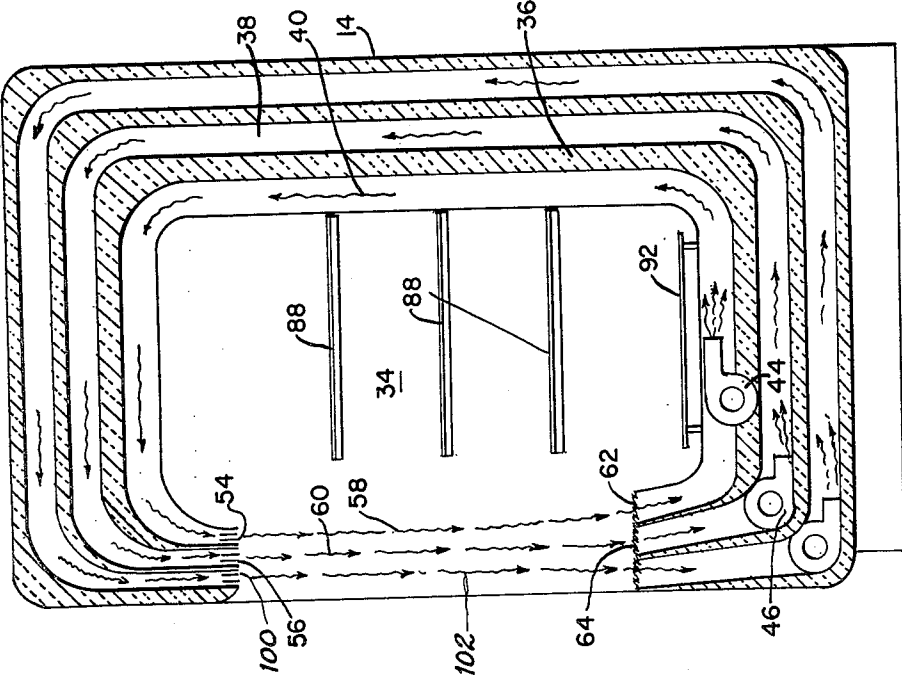


FIG. 3

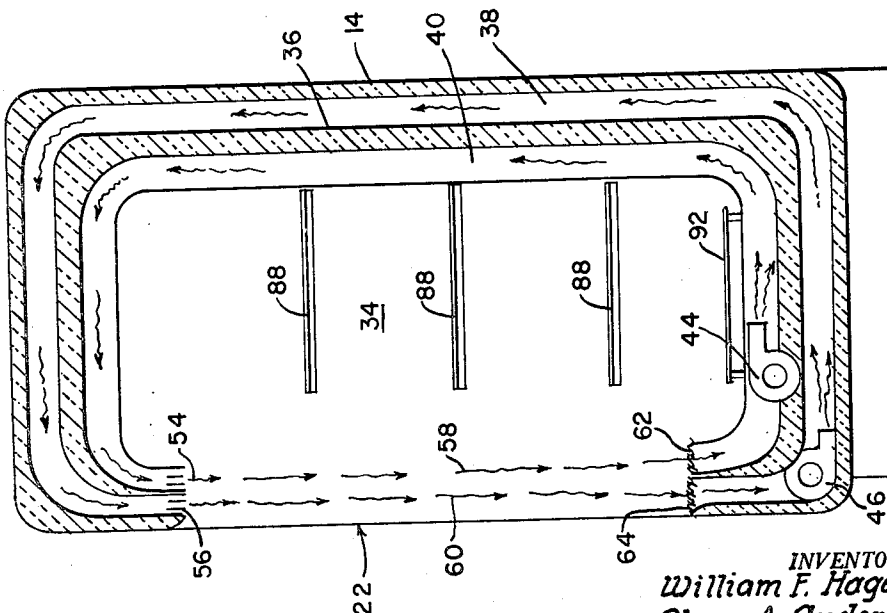


FIG. 2

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REFRIGERATED DISPLAY CASE

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3 Claims. (Cl. 62-256)

This invention relates to a means for maintaining a controlled atmosphere within a storage space, and it relates more particularly to a method and means for the refrigeration of a cold storage space having an open side for access into the interior of the cold storage space for the displacement of articles therefrom.

In the Simons Patent No. 2,862,369, entitled "Means and Method for Maintaining Material at a Predetermined Temperature in an Open Compartment," there is disclosed a refrigerated display case having an open side exposed to the ambient atmosphere. Briefly described, the loss of cold from the display case is minimized by blocking the open space with an air curtain formed of two parallel panels of air flowing from one edge to the other across the space. An inner panel is composed of cold air at about the temperature of the air within the display case, while the outer panel is composed of air having a temperature corresponding to that of the atmosphere about the display case. To be operative, it is desirable that the movement of the air panels across the open side of the display case be of substantially equal velocity and that the flow be laminar flow so that a minimum amount of entrainment will take place between the air in the two layers. A major portion of the cold air from the inner panel is recirculated within the refrigerated compartment of the display case and the majority of the warmer air in the outer panel is expelled into the atmosphere. For a more complete description of the method and apparatus, reference can be made to the above-identified patent, the disclosure of which is incorporated herein by reference.

One of the major advantages of an open side display case, particularly in the display and sale of packaged frozen foods, beverages, meats, ice creams and the like, is that it presents an arrangement of articles which is extremely attractive and which are easily accessible for display and for dispensing. Conventional frozen food storage containers are usually provided in the form of rectangularly shaped, open topped members, which means that the food must be vertically stacked therein thereby to render its removal somewhat awkward and identification more difficult.

In operating the open side cold storage containers of the type described in the aforementioned Simons patent, it was found that a small amount of warm air mixed with the cold air of the inner panel, markedly to reduce the temperature thereof and of the interior of the container, while also markedly increasing the relative humidity of the cold air as well as the cost of refrigeration. It would be desirable, if possible, further to reduce the admixture of warm air from the warm air panel into the cold air panel and into the refrigeration compartments of the open side container, thereby not only to save on the horsepower of refrigeration required but also to provide for more uniform refrigeration and lesser amounts of moisture in the recirculated cold air stream, with corresponding reduction in frost formation.

It is an object of this invention to provide a method for

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minimizing the entrainment of warm air into the cold air curtain and/or into the refrigeration compartments.

Another object is to provide a refrigerated display case having an open side, which case is attractive in appearance, simple in construction, and efficient in operation to maintain the interior at a uniformly cold temperature.

Another object is to provide a refrigerated display case of the type described having improved moisture removal means associated therewith.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, embodiments of the invention are shown in the accompanying drawing, in which—

FIGURE 1 is a schematic sectional elevational view through about the mid-section of an open-sided refrigerated display case embodying the features of this invention;

FIGURE 2 is a schematic sectional elevational view similar to that of FIGURE 1, showing a modification in the air circulation; and

FIGURE 3 is a fragmentary sectional view of a modification in the arrangement of air nozzles for providing multiple jets.

The cold storage or refrigerated display case shown in the drawings is generally designated by the numeral 10. The case is constructed with an outer housing wall including a top wall 12, a back wall 14, a bottom wall 16, vertical side walls 17, and vertical front wall 20, the latter of which is provided with an opening 22 for access into the interior. The housing rests upon a suitable base 24.

Spaced inwardly from the housing walls in substantially parallel relation is an inner wall including top, back, bottom, side and front walls 26, 28, 30, 31 and 32, respectively, which define the interior of a storage space or container 34. The space between inner walls 26, 28 and 30 and the housing walls 12, 14 and 16 is divided by a partitioning wall 36 into two separated channels 38 and 40 which extend substantially continuously about the storage space from an inlet at one edge of the opening 22 to an outlet at the opposite edge of the opening 22.

Located within the inner channel 40 are refrigeration coils 42 through which a suitable refrigerant is circulated for indirect heat exchange to cool the air passing through the coils and the channel 40. Although the refrigeration means is illustrated as being located centrally within the channel 40, the refrigeration or evaporator coils can be located in other portions of the channel, but preferably in the downstream portion thereof. Located in the upstream side of the refrigeration means is an air-circulating means, such as a fan or blower 44, for causing a stream of air to flow through the channel from the inlet to the outlet and through the coils and from the outlet to the inlet across the open space 22 to form the inner cold air panel of an air curtain.

Similarly, located within the outer channel 38 is another air-circulating means, such as the blower 46, for causing air to flow from the inlet of channel 38 to the outlet and from the outlet to the inlet across the open space 22 to form an outer panel flowing in substantially parallel relation with the inner panel of cold air. Preferably located within the channel 38, though not essential, is a dehumidifier 48 in the form of refrigerated coils for the removal of moisture by condensation from the air stream passing therethrough, thereby to reduce the amount of moisture in the outer air panel to prevent the development of a supersaturated state when the air circulating

through channel 38 is reduced in temperature due to its close association with the cold air, as will hereinafter be pointed out. Condensate separated by the dehumidifier 48 is drained through the passage 50 to a suitable drain 52.

The outlet of the inner channel 49 is in the form of a nozzle 54 which extends substantially continuously across the bottom side of the access opening 22 in the front wall of the refrigerated display case. Similarly, the outlet for the outer channel 38 is in the form of a nozzle 56 which also extends substantially continuously across the bottom side of the access opening alongside the nozzle 54 and in substantially parallel relationship therewith and with negligible space in between, as shown in FIGS. 1, 2 and 3. For this purpose, the adjacent walls of the channels 38 and 40 are made to converge whereby there is negligible space between the panels of air issuing from the nozzles such as to avoid dead air space which would interfere with laminar flow. The nozzle 54 is preferably provided with a screening member 55 and the nozzle 56 is similarly provided with a separate screening member 57 to block the entrance of foreign matter, insects and the like into the channels which might otherwise interfere with the desirable operation thereof.

The streams of air issuing from the nozzles 54 and 56 form continuous inner and outer air panels 58 and 60, respectively, stretching from the outlets across the access opening to the inlets 62 and 64, respectively, at the opposite side of the access opening. The nozzle 54 is arranged to direct the inner panel 58 of cold air to the inlet 62 in communication with the cold air return duct of channel 40, and the nozzle 56 is positioned to direct the outer panel 60 of air to the inlet 64 of the return duct in communication with the outer channel 38. Both of the inlets 62 and 64 may be provided with screening members 66 and 68 to prevent the entrainment of foreign matter, insects and the like into the air stream entering the channel sections. The wall 32 is illustrated as being formed with a forwardly deflecting lip 70, and the wall 20 is similarly provided with a deflecting lip 72 at their inlet ends more effectively to subdivide the panels between the inner cold air panel 58 and the outer warmer air panel 60 so that most of the cold air will be cut off for recirculation through the inner cold air channel 38 and so that the air panel 60, hereinafter referred to as the guard panel, will be recaptured in the inlet for the return channels 40. It will be understood that the described lipped construction is not essential, especially when more effective control is available for extending the laminar flow of the air streams forming the adjacent panels, or the inlets can be arranged without lips to correspond to the area of the panels at the inlet portion of the access opening.

With reference to the process described in the aforementioned Simons patent, the inner and outer panels projected across the access opening were similarly subdivided, but only the inner panel of cold air was recirculated while the outer panel formed of atmospheric air was displaced for return into the atmosphere. It was found that, notwithstanding the efficiency of laminar flow between the panels across the access opening, certain amounts of leakage occurs at the interface between the panels whereby some of the warm atmospheric air became entrained to form a part of the panel of cold air and quite proportionately some amounts of the cold air were lost from the panel of cold air into the warm air panel. This resulted in loss of substantial amounts of refrigeration to the atmosphere and it also increased the load on the refrigeration means to compensate for the heat loss into the recycled cold air stream plus the refrigeration of the warm air entrained therein.

It was found, in accordance with the practice of this invention, that the refrigeration temperature of the cold air stream and the refrigerated space could be stabilized at the desired low temperature and that less power of refrigeration would be required if means were provided to

save the cold from the air escaping from the inner panel by recirculating the guard panel, whereby the guard panel recovered cold lost from the inner panel of cold air and thus became gradually reduced to a temperature intermediate the temperature of the cold air in the inner panel and the temperature of the outside atmosphere. Thus, the guard panel at intermediate temperature is interposed between the inner panel of cold air and the atmospheric air, thereby to guard the cold air from the heat of the atmosphere and whereby the air entrained from the guard panel into the panel of cold air is at a considerably lower temperature and moisture content than the air from the atmosphere which would otherwise be the component admixed therewith.

A further advantage derived from the recirculating guard stream as a protective panel between the cold air panel and the warm atmospheric air resides in the sequence of steps wherein atmospheric air first enters the guard stream before portions thereof are able to enter the cold air stream. Thus, the temperature of the atmospheric air entrained is gradually reduced before entering the recirculating cold air stream, thereby to enable treatment for the gradual removal of moisture as the relative humidity is increased. As a result, lesser amounts of moisture are introduced with the air entering the cold stream thereby materially to reduce the amount of frost formation and, correspondingly, the amount of defrosting required for the system.

To minimize heat loss into the cold air recirculated through the channel 40, it is desirable, though not essential, that the partitioning wall 36 and the outer wall 14 be provided with suitable insulation, designated by the numeral 74.

In instances where the cold air stream is insufficient to reduce the temperature of the storage space 34 to a desirably low level, it is possible to construct the rear wall 28 with a plurality of ducts 82 which communicate with the inner cold air channel 40. The lower rear portion of the ducts may be formed with a lip 84 which deflects a small portion of the cold air from the channel into the interior of the storage space. To minimize withdrawal of cold air through the ducts 82, they are suitably provided with downwardly inclined louvers 86 to direct the cold air downwardly into the interior of the container. It will be understood that the described means for introducing cold air directly into the storage space will be avoided in the event that the cold air introduced interferes with the laminar flow desired between the inlets and the outlets across the access opening.

For displaying merchandise within the compartments, it is desirable that the interior of the refrigerated display case be fitted with one or more vertically spaced-apart, horizontally disposed shelves 88. The shelves can be suitably fastened to the interior walls 28 with angle brackets 90, or other suitable fastening and support means. The bottom shelf 92 is fitted on its bottom side with suitable studs 94. Provision is made for drainage of the bottom wall through the drain opening 96 which communicates through passage 98 with the drain 52. This drainage feature is desirable when the display case is inactivated for cleaning or repair as it allows condensate to be removed.

From the foregoing description, it will be apparent that the device provides a panel of cold air 58 adjacent to the interior of the storage space, and a panel of warmer air 60 which is intermediate the temperatures of the cold air panel and the temperatures of the ambient air. The guard panel is spaced to protect the refrigerated space from the ambient atmosphere and to minimize loss in temperature of the recirculating cold air responsive to the entrainment of air from the guard jet therein.

Since the guard panel is composed of air some of which has previously been dehumidified, the amount of moisture entering the refrigerated space and/or the recirculating cold air stream is materially reduced thereby

to enhance the efficiency of the refrigerated display case and the amount of shutdown time required for defrosting.

The velocity sufficient to maintain the air panels for minimum entrainment has been found to be within the range of 50-1500 feet per minute, with about 200-400 feet per minute being preferred for most refrigerated cases of conventional dimension.

Having described the basic concepts of this invention in the recirculation of a guard jet in which no refrigeration is invested but which is reduced in temperature by recovery of cold otherwise lost from the cold air stream, description will now be made of a few modifications which can be made in adapting the foregoing concepts to the new and improved refrigerated display case.

Certain advantages are derived if, instead of circulating the air streams in a clockwise direction for projecting the jets of refrigerated air and guard air upwardly from the outlets at the bottom side of the access opening to the inlets at the top side of the access opening, the described streams of air are reversed in a direction to project the air stream downwardly across the access opening from the outlets at the upper edge of the openings to inlets across the bottom side of the access opening. It is believed that by reason of the gravitational effects on the heavier cold air, advantage can be taken of such gravitational forces to assist downward flow of the colder air rather than to oppose such flow. As a result, laminar flow can be maintained more effectively over a greater distance thereby to reduce turbulence and corresponding mixing of air from one stream to the other. Such reversal in direction to provide the inlet at the bottom also enhances the flow of cold air in and about the refrigerated space since the cold air naturally falls downwardly to correspond with the direction of flow of the air panels to enable re-entrance without undue interference. Furthermore, the cold air from the refrigerated space flows downwardly to the inner inlet for the cold air stream to re-enter the cold air stream, thereby to minimize entrance of warm air from the guard stream. Reversal of the direction of flow can be achieved, as illustrated in FIGURE 2, by reversal of the blowers and preferably relocation thereof toward the inlet air portion of the ducts at the bottom side of the housing. Similarly, the air panels can be projected from one side to the other in a vertical plane or from one wall to the opposite wall in a plane other than vertical such as across a horizontal opening in the top wall of a case or across a sloping opening in an inclined wall of a case.

By way of still further modification, illustrated in FIGURE 3, instead of making use of a single guard jet, additional guard jets may be provided whereby the air panels extending across the access opening will correspond to the number of such jets. In the modification illustrated in FIGURE 3, one additional guard jet is employed to provide three parallel streams of air 58, 60 and 102 extending across the access opening. It will be understood that more than one additional jet may be provided.

The addition of jets will operate further to reduce the temperature differential between the jets. Thus, the guard jet adjacent the inner refrigeration panel of cold air would be at a temperature still closer to the temperature of the cold air stream, such that entrainment of air from the one panel to the other will have minimum effect on the temperature thereof. Thus the amount of heat required to be removed from the refrigeration stream will be reduced to a minimum with resulting decrease in refrigeration cost. Similarly, the air entering the refrigeration stream will have moisture removed therefrom, whereby frost formation on the refrigeration coils and other elements in the refrigerated space and channels will be reduced to a minimum, with corresponding decrease in shutdown time for defrosting.

In the practice of the invention with the refrigerated coils 48 in the guard stream, it is expedient to limit the

refrigerant circulated to the coils for refrigerating the coils to a temperature above freezing temperature and preferably to within a few degrees of 32° F. so that moisture condensed on the surface thereof will remain in the form of water and not frost thereby to obviate the problem of defrosting and thereby also to enhance the efficiency of operation of the unit. The condensed moisture can constantly be removed by drainage, as previously described. Temperature control of the refrigerated coils to the desired range can be achieved by pressure control of the refrigerant vapors circulated thereto. The use of such refrigerated coils for removal of moisture from the jet stream operates to stabilize load on the refrigeration system, since the refrigerated coils assume a greater amount of the load when the ambient air is at a high relative humidity and lesser load when the relative humidity is lower.

The reduction in heat loss and savings in refrigeration by reason of the use of multiple jets should be balanced by the increased costs of construction of a refrigerated case with the additional separated channels for each jet, it being understood, as illustrated in FIGURE 3, that each guard jet will have its separate inlet and outlet in connection with separate ducts for the circulation of air there-through. While these additional ducts can be embodied within the refrigerated case by the addition of dividing walls, such as wall 36, it will be understood that the additional jets may be short-circuited from the inlets to the outlets through duct work or piping located outside of the refrigerated case.

In the practice of this invention, it will be apparent that refrigeration is provided only to the refrigeration stream. The guard stream or streams derive their cold from the stream inwardly thereof across the panels and by reason of the adjacent streams which function as insulating streams to protect each inner stream from the atmosphere.

It will be apparent from the foregoing that we have provided a material improvement for use in the construction and operation of open-sided refrigeration display cases whereby the temperature within the case may be maintained at a desired level while permitting full and complete access to the goods mounted interior thereof in position to be displayed to the purchaser.

It will be understood that changes may be made in the details of construction, arrangement and operation without departing from the spirit of the invention, especially as defined in the following claims.

We claim:

1. A refrigerated display cabinet having an open side for access between the interior and the atmosphere comprising a compartment having open side, inner and outer walls about the compartment defining inner and outer channels therebetween, inlets arranged in side by side parallel relation across one side of the open space and communicating with said channels with the inner inlet communicating with the inner channel and the outer inlet communicating with the outer channel, outlets arranged in side by side parallel relation across the side of the open space opposite the inlets and communicating with said channels with the inner outlet communicating with the inner channel and the outer outlet communicating with the outer channel, refrigerating means in at least the inner channel to refrigerate the air circulated there-through, means for recirculating all of the air from the inlets, through the channels, to the outlets so that the entire increment of air entering the inlets is recirculated from the inlets to the outlets and for directing the air issuing from the outlets in substantially parallel relation towards the inlets to form an air curtain extending across the open side of the cabinet with the inner portion of the air stream comprising a cold air panel and for return of the cold air panel to the inner channel and the outer portion of the air curtain to the outer channel for the recirculation thereof therethrough, said outlets being arranged in side by side parallel relationship with minimum space in

between to avoid the presence of a dead air space which would cause interference with laminar flow.

2. A refrigerated display cabinet as claimed in claim 1 in which the walls of the channels converge toward the outlets to provide minimum space in between.

3. A refrigerated display case as claimed in claim 1 which includes dehumidifying means in the outer channel for removal of moisture from the air passing there-through.

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