

Feb. 20, 1968

L. J. GERWECK ET AL
REFRIGERATED DISPLAY CASE

3,369,375

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3 Sheets-Sheet 1

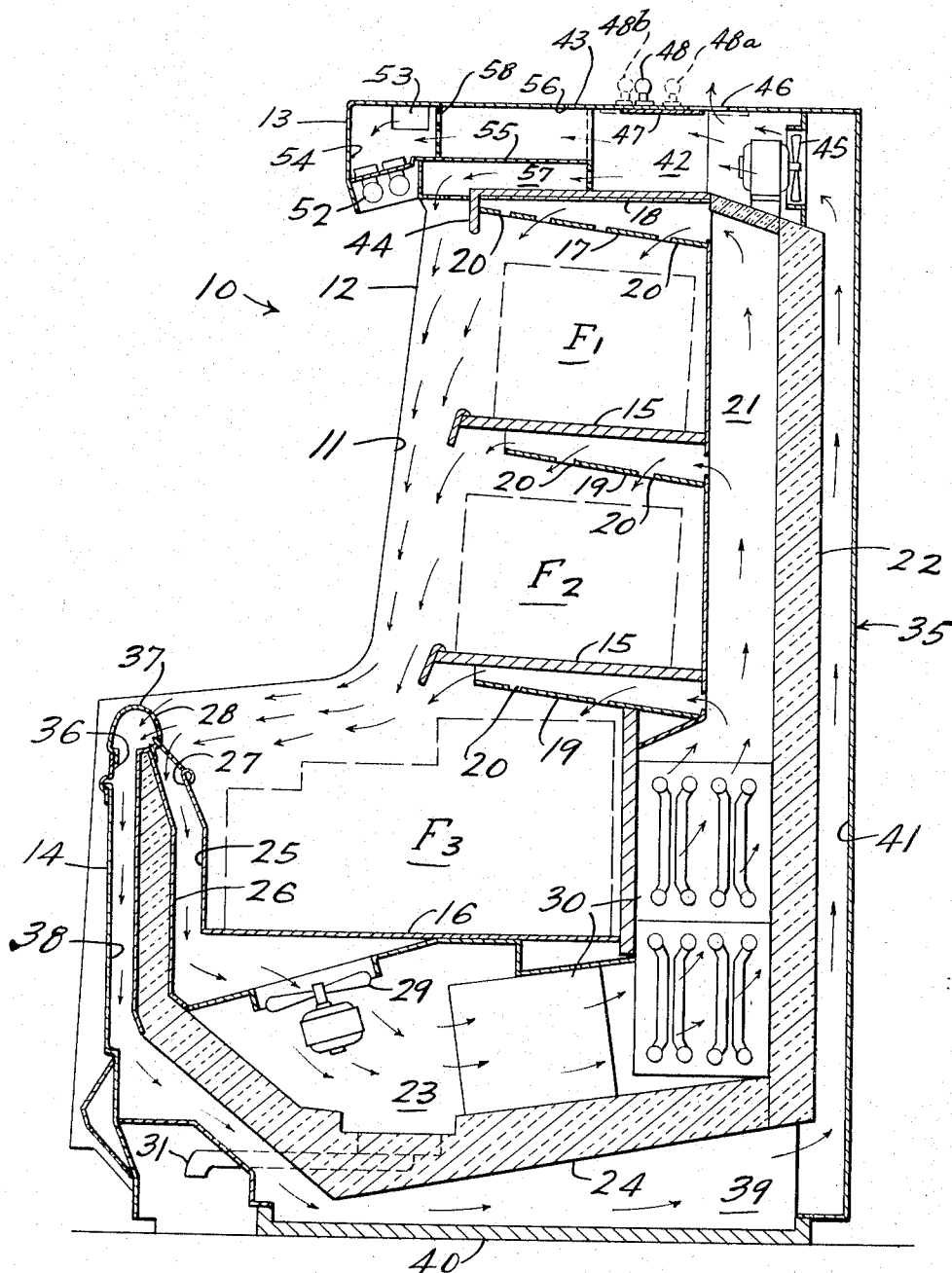


FIG - 1 -

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3 Sheets-Sheet 2

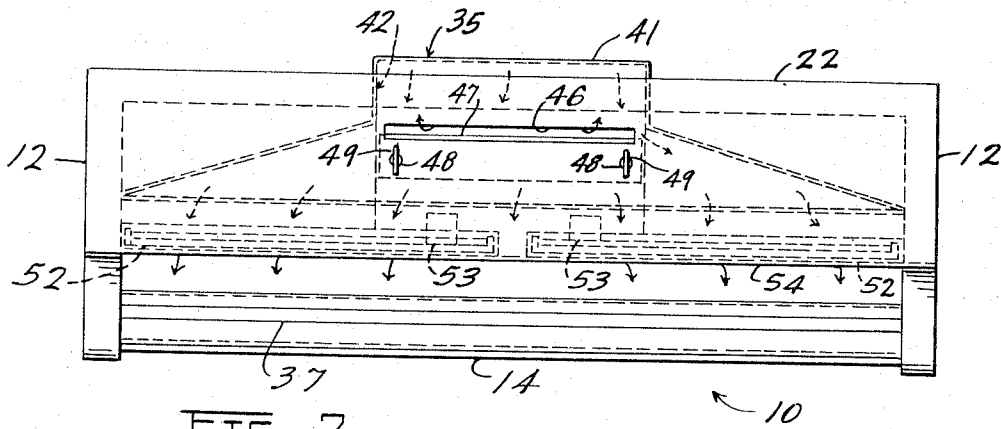


FIG -2-

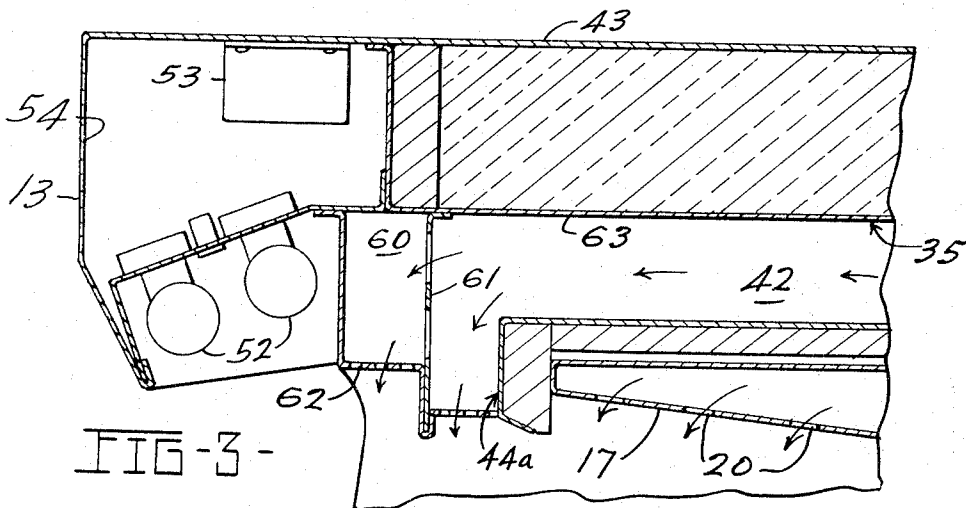


FIG-3-

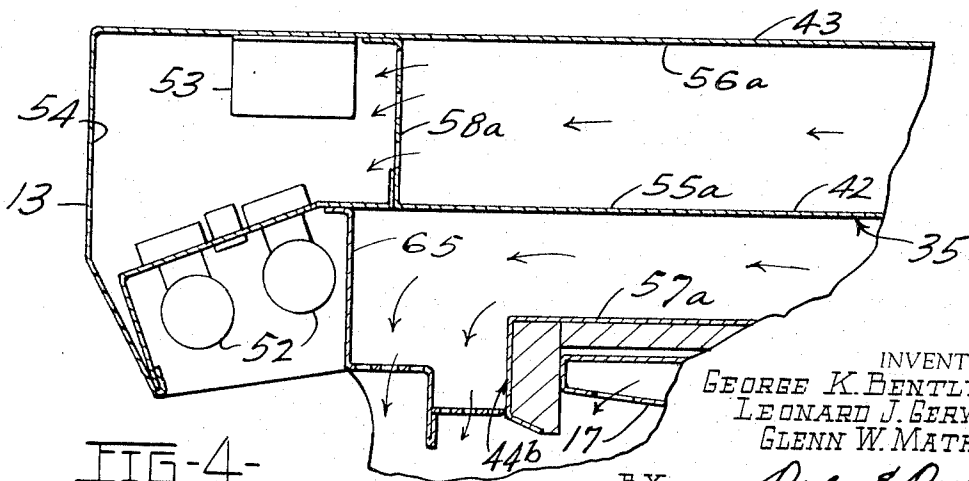


FIG-4-

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3 Sheets-Sheet 3

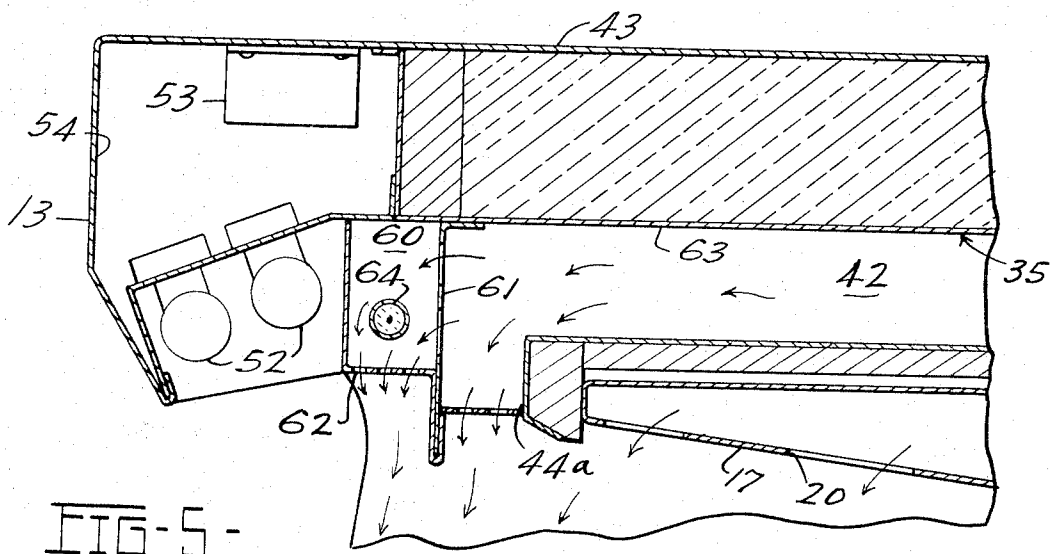


FIG. 5 -

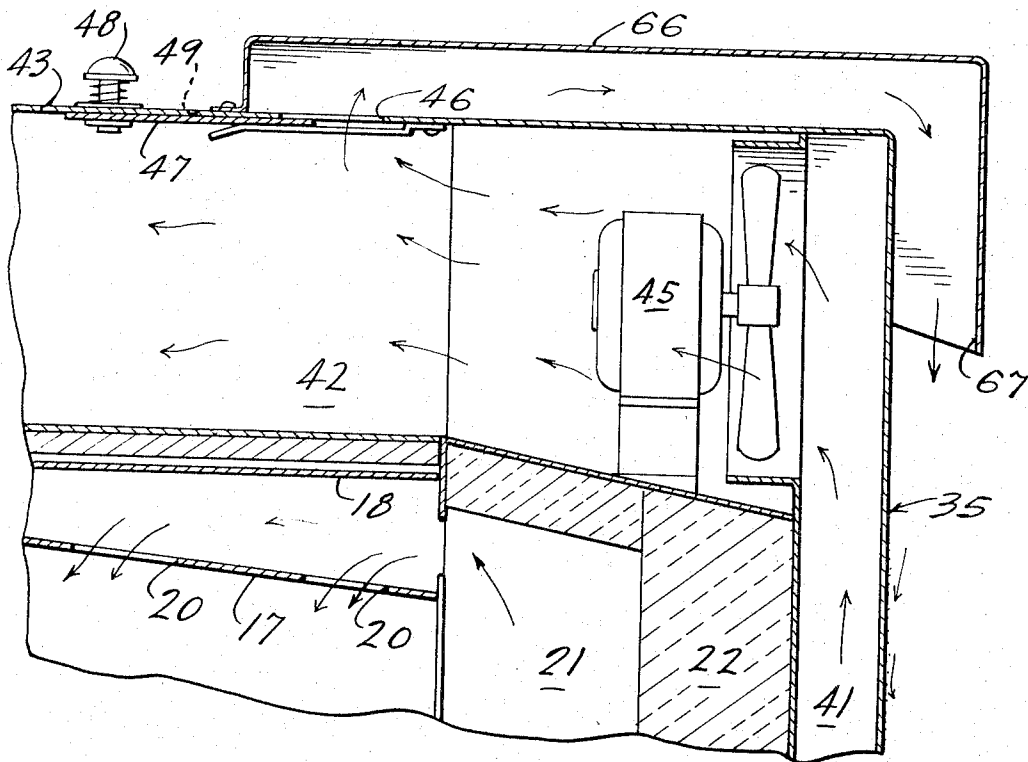


FIG. 6 -

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REFRIGERATED DISPLAY CASE

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ABSTRACT OF THE DISCLOSURE

A refrigerated display case having a moving air curtain across an open reach-in portion of the case. The air curtain includes an air bleed vent for discharging from the curtain air passage a volume of air drawn into the air curtain inlet in excess of the volume of air discharged from the air curtain outlet; the excess air can be discharged down the outside back of the display case. A portion of the curtain air is used to cool display case lighting elements such as fluorescent lamp ballasts.

This invention relates to a refrigerated display case for foods and the like, and particularly, to a refrigerated display case having means for preventing the spillover of cool air into an ambient zone immediately in front of the display unit and air curtain means for minimizing heat transfer and mixing with respect to refrigerated air within the case and the room ambient air.

Upright refrigerated cases or display units, having an access opening in the front thereof, are in common use. Such refrigerated display units are used in the merchandising of, for example, refrigerated food products, the cases have been readily accepted by customers who may choose the product by observing such product within the case. The customers may then reach through the access opening to remove the product, without first opening an insulated door or cover.

Refrigerated display cases of this type normally define a display space having a plurality of shelves vertically disposed therein. The products are placed upon the shelves and the temperature adjacent the shelves is often maintained at or below 0° F. while the ambient temperatures exterior of the display case within the store may be 70° F. or higher. Cold or refrigerated air is supplied to the display space through outlets either above or in front of the shelves. This refrigerated air cascades generally forwardly and downwardly through the display space and is recirculated through suitable refrigerating apparatus and hence back into the display space.

In this type of unit as the cold air flows downwardly across the access opening in its recirculation path it contacts the ambient air exterior of the display case and a heat transfer plus a mixing occurs between the refrigerated cold air and the ambient air. This creates a quantity of mixed cooled air which is beyond the recirculation capacity of the display case recirculation fans and, consequently, the cooled air mixture eventually exceeds the capacity of the case and spills out of the case where it flows to the floor in front of the case and creates an aisle cold zone. The cold air in this zone is uncomfortable to potential consumers. In addition to customer discomfort, refrigeration efficiency is lowered by the heat transfer and mixing between the refrigerated air and the ambient air.

Ural, U.S. Patent No. 3,125,864, attempts to solve the aisle cold zone problem by scavenging the refrigerated cold air-ambient air mixture and discharging it to the exterior of the display case at a point removed from the aisle.

The present invention relates to an improved refrigerated display case which substantially decreases or elimi-

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ates the cold zone normally found in front of prior art display cases. This improvement is achieved by the use of apparatus which forms an intermediate air curtain between the refrigerated cold air and the room ambient air. As the curtain air is recirculated a bleed is provided in the curtain air passageway and a portion of the air stream, which includes some ambient air which was mixed therewith as the curtain air traveled across the access opening, is either discharged from the case or is directed downwardly at a predetermined location to reduce case condensation. A remaining portion of the curtain air is either discharged from one or more curtain air outlets downwardly across the access opening or is again split, with a portion thereof being directed to a predetermined location to serve as cooling means to cool, for example, fluorescent lamp ballast units.

It is the principal object of the invention to provide an improved upright refrigerated display case having means for retarding or preventing objectionable spillover of cold refrigerated air adjacent the bottom of an access opening in the refrigerated display case, thereby insuring a warmer, more comfortable, area in the aisle adjacent the front wall of the case.

It is a further object of the present invention to provide means for forming one or more air curtains intermediate the cold refrigerated air within the case and the room ambient air.

It is another object of the present invention to provide an improved refrigerated display case which has an improved refrigeration efficiency.

Other objects of this invention will become apparent from the following specification and drawings in which:

FIG. 1 is a vertical cross sectional view showing one embodiment of an upright refrigerator display unit according to the present invention;

FIG. 2 is a top plan view of the refrigerated display case shown in FIG. 1;

FIG. 3 is a fragmentary, vertical sectional view, drawn on an enlarged scale and showing another embodiment of the curtain air passageway means of a refrigerated display case, according to the present invention;

FIG. 4 is a view similar to FIG. 3, showing another embodiment of the curtain air passageway means;

FIG. 5 is a view similar to FIG. 3 showing the positioning of heating means in a portion of the curtain air passageway means; and

FIG. 6 is a fragmentary, vertical sectional view, showing another embodiment of the present invention in which a bleed air passageway is provided to serve as anti-condensation means.

Referring to FIG. 1 of the drawings, one embodiment of an upright refrigerated display unit, according to the present invention, is generally indicated by the reference number 10. The refrigerated display unit or case 10 has a front access opening 11 which is defined by sidewalls 12, an upper front wall 13 and a lower front wall 14. The refrigerated display case 10 includes vertically spaced shelves 15 and a lower shelf or bottom 16. It should be expressly understood that the present invention is not limited by the number or type of shelves.

When in use a customer may reach into the refrigerated display case 10 and remove refrigerated food packages designated F1, F2, and F3 which are located on the shelves 15 and 16.

Cold air is supplied to the display space, in which the food packages F1, F2 and F3 are located, through an upper supply chamber 17 which is immediately below an upper insulated wall 18 and also through two lower shelf chambers 19 which are located immediately below the shelves 15. Each of the chambers 17 and 19 have a plurality of perforations 20 in their bottom surfaces through which cold air is emitted.

Cold refrigerated air is supplied to the chambers 17 and 19 from a rear supply duct 21 which is adjacent the inner side of a rear insulating wall 22 of the refrigerated display case 10. The supply duct 21 is in fluid communication with a lower return duct 23 which is adjacent a lower insulating wall 24 of the refrigerated display case 10. Similarly, the lower return duct 23 is in fluid communication with an inlet duct 25 which is adjacent an insulating dividing wall 26 of the lower front wall 14. The inlet duct 25 has an inlet opening 27 which is provided with a perforated inlet plate 28 in the present embodiment. The ducts 21, 23, and 25 serve as means forming a refrigerated air passageway.

Cold air is drawn through the inlet opening 27 by a case fan 29. The recirculated cold air passes through the inlet duct 25 and the lower return duct 23 and then is forced through one or more refrigerating coils 30 to cool the air to a predetermined desired temperature in order to keep the display space adjacent the shelves 15 and 16, at, for example, 0° F. Refrigerant is supplied to the coils 30 by a suitable compressor unit (not shown) usually remotely located and having a sufficient capacity to supply a number of the coils 30. The first coil unit is designed to lower the air temperature below the dew point to extract as much moisture as possible. This substantially eliminates frost or condensation on the second coil. The refrigerating coils 30 are periodically defrosted with the waste water draining through a suitable lower drain conduit 31. After being cooled, the refrigerated cold air is forced upwardly through the supply duct 21 and into the respective chambers 17 and 19. The cold air then flows out of the chambers 17 and 19 into the display space containing the refrigerated food packages F1, F2, and F3. This refrigerated cold air continues downwardly and outwardly toward the front of the case entering the inlet opening 27 for a repetition of the above cycle.

It has been discovered that refrigeration efficiency may be increased by using at least one curtain of air in front of the inner cold air. The intermediate air curtain or curtains serve as a thermal barrier between the inner cold air and the ambient room air. Referring to FIG. 1, an air curtain passageway is generally indicated by the reference number 35. The air curtain passageway 35 includes a curtain air inlet 36 adjacent the bottom of the access opening 11. Preferably, a longitudinally extending reach-in rail cover 37 is provided over the air curtain inlet 36. The air curtain inlet 36 is in fluid communication with a front air curtain duct 38 which is located adjacent to and defined by portions of the lower front wall 14 and the insulated dividing wall 26. The front duct 38 is in communication with a bottom air curtain duct 39 which is adjacent the lower insulating wall 24 and a bottom 40 of the refrigerated display unit 10. A rear air curtain duct 41 is positioned adjacent the outer side of the rear insulating wall 22 and is in communication with the bottom air curtain duct 39 and an upper air curtain duct 42 is adjacent the upper insulated wall 18 and a top 43 of the display case 10. A curtain air outlet 44 is provided at the upper air curtain duct 42 and is located adjacent the top of the access opening 11. Air is discharged from the curtain air outlet 44 and forms an air curtain between the cold air within the display space and the ambient air exterior of the display case 10. It has been found that it is desirable to discharge the curtain air from the outlet 44 at a relatively low velocity so that the air curtain (indicated by the arrows in FIG. 1) blankets the inner cold air path (also indicated by arrows in FIG. 1) as both air streams travel downwardly into their respective inlets. It has also been found that if the inner cold air is approximately 0° to minus 10° F., and the outer ambient temperature is 70° F., the intermediate air curtain layer should be maintained at, for example, 45° F. A case fan 45 is provided in the air curtain passageway 35 to recirculate the air curtain air at the desired velocities.

The insulated walls 18, 22, 24 and 26 serve to retard

heat transfer between air streams in the inner cold air ducts 21, 23, and 25 and the outer air curtain ducts 38, 39, 41, and 42.

It has been found that as the air curtain moves downwardly and is received by the air curtain inlet 36, ambient air from the room, exterior of the display case 10, is induced to flow downwardly, mixing with the air curtain air whereby it also enters the air curtain inlet 36. This introduction of ambient air into the system occurs during each cycle of the air curtain air and the quantity of such mixture becomes so great that a portion of the mixture spills over the reach-in rail cover 37 and creates a cold zone or discomfort area along the aisle in front of the front wall 14 of the display case 10.

According to the present invention, an air bleed means is provided in the air curtain passageway 35. Referring to FIGS. 1 and 2, in the present embodiment, a rectangularly shaped bleed opening 46 is provided in the top 43. Preferably, a sliding gate 47 having opposed handles 48 is reciprocally mounted in slots 49 in the top 43. The adjustable gate is provided to regulate the area of the bleed opening 46. The gate 47 is movable between a closed position and an open position with the handles 48 being indicated in FIG. 1 by dashed lines. The reference number 48a represents the position of the handles when the gate 47 is in the closed position and the reference number 48b represents the position of the handles when the gate 47 is in the open position.

A portion of the curtain air which enters the air curtain inlet 36 is discharged through the bleed opening 46 and the remaining portion of the curtain continues its travel through the upper air curtain duct 42 and at least a portion of this air is discharged through the air curtain outlet 44 and forms the air curtain indicated by the arrows in FIG. 1. Because the air curtain picks up a certain quantity of room air as well as refrigerated air on the way to the inlet 36, more air must be sucked into the inlet 36 than is discharged through the outlet 44. When this is done, spill over the reach-in rail cover 37 is minimized or practically eliminated. This is accomplished by use of the bleed opening 46 through which excess air is expelled thereby allowing the correct quantity to exit at the outlet 44 to form a balanced air curtain that will contain itself within the walls of the case.

Referring to FIGS. 1 and 2, fluorescent lamps 52 having ballast units 53 are positioned in a soffit 54 which is located interior of and adjacent the upper front wall 13 of the display case 10.

Partition or divider means are provided in the air curtain passageway 35. In the present embodiment a horizontally extending divider partition 55 is disposed in the upper air curtain duct, dividing the duct 42 into an upper section 56 and a lower section 57. A perforated vertical plate 58 is positioned in the upper section 56 adjacent the soffit 54. Therefore, in this embodiment, a first part of the remaining portion of the curtain air enters the upper section 56, passes through the perforated plate 58, and serves as cooling means for the ballast units 53. A second part of the remaining portion of the curtain air enters the lower section 57 and is discharged through the curtain air outlet 44 forming the air curtain indicated by the arrows in FIG. 1. In this embodiment, the quantity of air dissipated through the bleed opening 46 is reduced by an amount approximately equivalent to the quantity of air that passes through the upper section 56 and serves as cooling means for the ballast units 53.

A slightly modified air curtain passageway 35 is shown in FIG. 3. In this embodiment, a horizontally extending duct 60 is in communication with the upper air curtain duct 42 through a perforated plate 61. The duct 60 has a longitudinally extending discharge opening 62 defined in its lower edge. Curtain air within a front portion 63 of the duct 42 is divided with a portion of the divided air flowing downwardly and being discharged through a curtain air outlet 44a and another portion

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discharged downwardly through the discharge opening 62 of the duct 60. These two portions of air, which are discharged through the opening 62 and outlet 44a respectively, form two laminar air curtains which separate the cold refrigerated air being emitted, for example, from the upper supply chamber 17 from the room ambient air. It has been found that dividing of the curtain air creates a more effective thermal barrier. An example of respective air temperatures during a typical operation would find the temperature of the cold refrigerated air emitted from the upper supply chamber 17 to be approximately minus 10° F.; the temperature of the air curtain formed at the outlet 44 approximately 45° F.; the temperature of the air curtain formed at the discharge opening 62 approximately 60° F.; and the temperature of the ambient air approximately 75° F.

FIG. 5 shows a slightly modified version of the embodiment shown in FIG. 3, and described above. In this modification heating means are provided to heat a portion of the air traveling through the upper air curtain duct 42. In this specific embodiment, a longitudinally extending electrical heating element 64 is disposed within the horizontally extending duct 60. However, the element 64 may be disposed within the upper air curtain duct 42. Various types of heating means may be employed other than an electrical heating element. For example, a high temperature fluid line from the refrigeration unit may be employed.

In this embodiment, the air which is discharged through the discharge opening 62 has been heated and if desired, when using this embodiment the quantity of air discharged through the bleed opening 46 (see FIG. 1) may either be reduced or eliminated. The warm outer air curtain formed by the air emitted from the discharge opening 62 travels downwardly and if the capacity of the front air curtain duct 38 and the case fan 45 is exceeded this heated curtain air spills over the reach-in rail cover 37. However, because this spillover air has been heated, it does not tend to form a discomfort zone in the aisle.

FIG. 4 shows another embodiment of the air curtain passageway 35, according to the present invention. In this embodiment the upper air curtain duct 42 is divided into an upper section 56a and a lower section 57a by an intermediate partition 55a. The air within the upper duct 42 is split and a first part enters the upper section 56a, passes through a perforated plate 58a and serves as cooling means to cool the ballast units 53 within the soffit 54. A second part of the air passes through the lower section 57a with one portion being discharged through a curtain air outlet 44b and another portion discharged through an adjacent discharge opening 62a defined in a front duct wall 65. The air discharged through the curtain air outlet 44b and the discharge opening 62a form adjacent air curtains which travel downwardly and enter the air curtain inlet 36 (see FIG. 1). When using this embodiment, the bleed opening 46 is regulated in area by moving the gate 47 until curtain air spilling over the reach-in rail cover 37 is either eliminated or substantially reduced.

Another modification of the present invention is shown in FIG. 6. In this embodiment a bleed housing 66 is mounted on the top 43 of the refrigerated display unit 10 and is in fluid communication with the upper air curtain duct 42 through the bleed opening 46. The bleed housing 66 surrounds the bleed opening 46 and receives the bleed air as it passes through the opening. The bleed housing 66 has a discharge opening 67 which directs bleed air downwardly adjacent the rear air curtain duct 41 of the air curtain passageway 35. It has been found that when the dew point of the air traveling through the rear curtain duct 41 is lower than the dew point of the room air, condensation is formed on the exterior of the duct 41. Even though the bleed air which is discharged through the opening 67 has essentially the same dew point as the air within the duct 41, the movement of the bleed air

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past the exterior surface of the duct 41 eliminates or substantially reduces the moisture which tends to form on such duct work.

While the present invention has been disclosed with a specific arrangement and disposition of the parts, it should be expressly understood that numerous modifications and changes may be made without departing from the scope of the appended claims.

We claim:

1. An upright refrigerated display unit comprising, in combination:

a housing having a front access opening and a display space;

means for forming a refrigerated air passageway;

outlet means in fluid communication with said refrigerated air passageway for supplying cold air to said display space;

said refrigerated air passageway having an inlet adjacent the bottom of said access opening;

means for forming a curtain air passageway having a curtain air outlet adjacent the top of said access opening and a curtain air inlet adjacent the bottom of said access opening, said curtain air passageway having an exterior wall; and

air bleed means in fluid communication with said curtain air passageway for discharging a portion of the curtain air received by said curtain air inlet, said air bleed means including a bleed opening formed in said air curtain passageway and an air bleed housing surrounding said opening for receiving said discharged portion of said air, said housing having an outlet for directing said discharged air along said exterior wall of said curtain air passageway to remove condensation from said exterior wall.

2. An upright refrigerated display unit comprising, in combination:

a housing having a front access opening and a display space;

a plurality of fluorescent lamps and ballast units therefor mounted above said front access opening for illuminating said display space;

means for forming a refrigerated air passageway;

outlet means in fluid communication with said refrigerated air passageway for supplying cold air to said display space;

said refrigerated air passageway having an inlet adjacent the bottom of said access opening;

refrigeration means in communication with said refrigerated air passageway for lowering the temperature of the air traveling therethrough;

means for forming a curtain air passageway having a curtain air outlet adjacent the top of said access opening, a curtain air inlet adjacent the bottom of said access opening, and an upper curtain air duct adjacent the top of said unit;

partition means for dividing the air stream within said upper duct and for directing one part of said air stream at said ballast units and for directing a second part of said air stream through said curtain air outlet; and

air bleed means in fluid communication with said curtain air passageway for discharging a portion of the curtain air received by said curtain air inlet.

3. An upright refrigerated display unit comprising, in combination:

a housing having a front access opening and a display space;

means for forming a refrigerated air passageway;

outlet means in fluid communication with said refrigerating air passageway for supplying cold air to said display space;

said refrigerated air passageway having an inlet adjacent the bottom of said access opening;

refrigeration means in communication with said re-

frigerated air passageway for lowering the temperature of the air traveling therethrough;
 means forming a curtain air passageway having a curtain air outlet adjacent the top of said access opening and a curtain air inlet adjacent the bottom of said access opening, said curtain air passageway including an upper curtain air duct adjacent the top of said unit, a discharge opening adjacent said curtain air outlet, and dividing means within said upper curtain air duct for dividing the air stream within said duct wherein a first part of such air stream is directed through said discharge opening and a second part of such air stream is directed through said curtain air outlet so that at least two adjacent and essentially laminar air curtains are formed across said front access opening; and
 air bleed means in fluid communication with said curtain air passageway for discharging a portion of the curtain air received by said curtain air inlet.

4. Apparatus according to claim 3, which further includes:
 heating means mounted adjacent said discharge opening whereby said first part of said air stream is heated as it passes across said heating means.

5. An upright refrigerated display unit comprising, in combination:
 a housing having a front access opening and a display space;
 means for forming a refrigerated air passageway;
 outlet means in fluid communication with said refrigerated air passageway for supplying cold air to said display space;
 said refrigerated air passageway having an inlet adjacent the bottom of such access opening;
 refrigeration means in communication with said refrigerated air passageway for lowering the temperature of the air traveling therethrough;
 means forming a curtain air passageway having a plurality of curtain air outlets adjacent the top of said access opening, a curtain air inlet adjacent the bottom of said access opening and an upper curtain air duct adjacent the top of said unit;
 air bleed means in fluid communication with said curtain air passageway for discharging a portion of the curtain air received by said curtain air inlet;
 a plurality of fluorescent lamps and ballast units therefor mounted above said front access opening for illuminating said display space; and
 partition means within said upper curtain air duct for dividing the air stream within said upper duct to direct a portion of such air stream at said ballast units and to direct remaining portions through said plurality of air curtain outlets, wherein at least two adja-

cent and essentially laminar air curtains are formed across said front access opening.

6. An upright refrigerated display case comprising, in combination:
 a housing having a front access opening and a display space for refrigerated products;
 a refrigerated air passageway including a plurality of communicating ducts;
 an inlet adjacent the bottom of such access opening and at least one outlet for supplying cold refrigerated air to such products;
 circulating means located in one of said ducts;
 refrigeration means in communication with said refrigerated air passageway for lowering the temperature of air passing therethrough;
 a curtain air passageway including a plurality of outer communicating ducts;
 a curtain air outlet from said curtain air passageway for forming an air curtain across said access opening between the inner cold air within said display space and room ambient air, said air curtain being cooled upon mixture with said inner cold air;
 a curtain air inlet adjacent the bottom of said access opening for directing said cooled air curtain into said outer communicating ducts, said ducts being cooled by said curtain air so that condensation tends to form on the outer surfaces of said outer ducts, said curtain air being warmed by the transfer of heat thereto from the ambient air as said curtain air flows through said outer ducts so that condensation does not form on at least part of said outer surfaces of said outer ducts;
 bleed means located adjacent one end of said outer ducts for discharging at least a portion of said warmed curtain air from said outer ducts; and
 a bleed housing adjacent said bleed means for receiving said warmed curtain air from said bleed means, said bleed housing defining a discharge nozzle extending along at least a portion of the outer surface of the outer ducts for directing said warmed curtain air along said outer surfaces to remove the condensation therefrom.

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