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MacMaster et al.

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[45] **Sept. 4, 1973**

[54] **REFRIGERATED DISPLAY EQUIPMENT**

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[52] **U.S. Cl.** **62/256**, 62/275, 62/276

[51] **Int. Cl.** **A47f 3/04**

[58] **Field of Search** 62/255, 256, 275, 62/276

[56] **References Cited**

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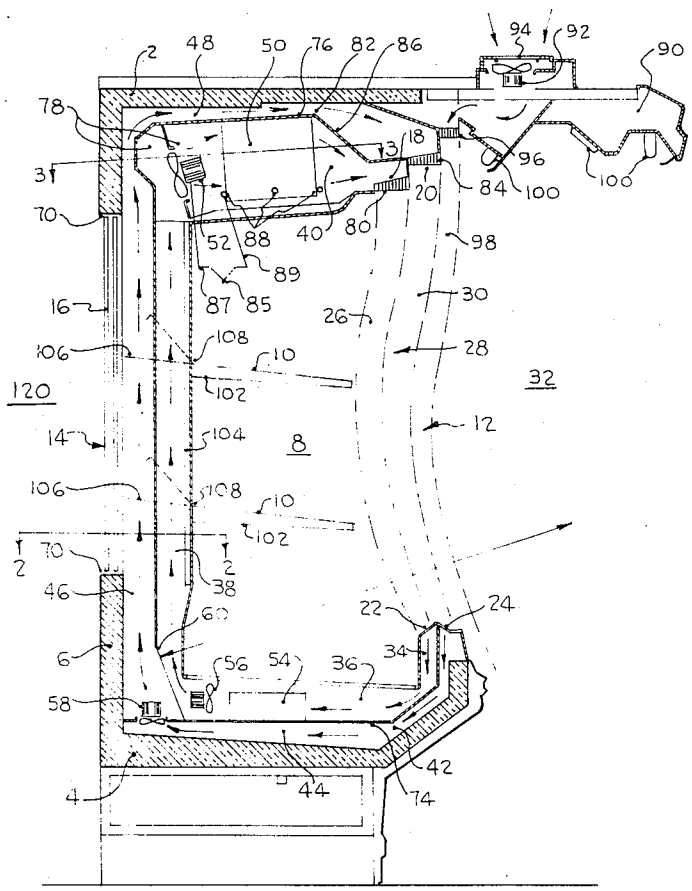
Primary Examiner—William J. Wye

Attorney—Albert Sperry et al.

[57] **ABSTRACT**

Refrigerated display equipment is provided with a refrigerated space having an access opening for customers at the front thereof together with separate air duct means through which air is passed from inner and outer return air inlets to inner and outer air discharge means for establishing an air curtain moving across said front access opening and embodying at least two layers of air at least the inner one of which layers is refrigerated air. The equipment is further provided with an access opening for service personnel at the rear of the refrigerated space and the air duct means through which air is passed from the return air inlets to the air discharge means each include a portion which is located adjacent the access opening at the rear of the refrigerated space.

12 Claims, 7 Drawing Figures



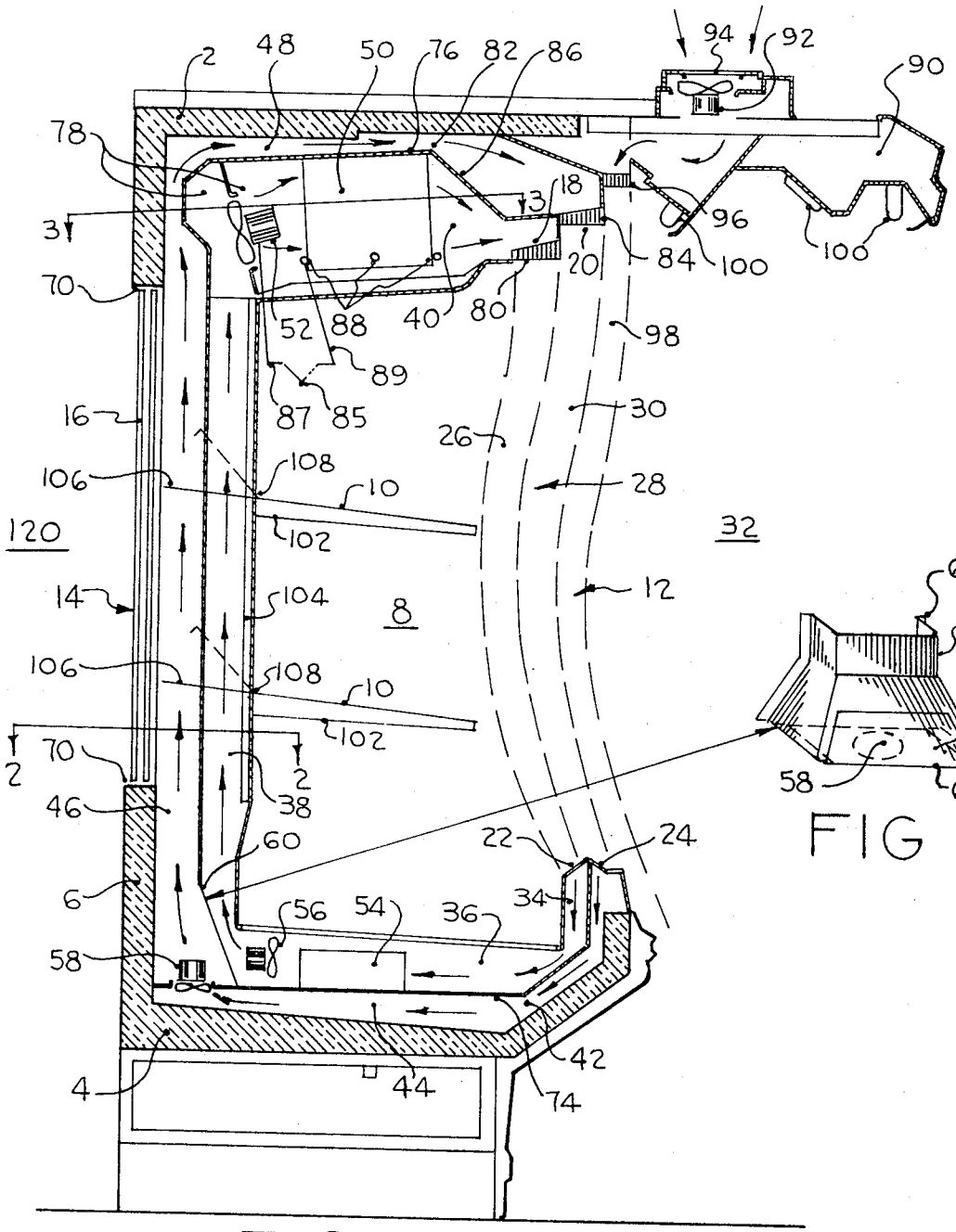

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FIG 1

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FIG 1A

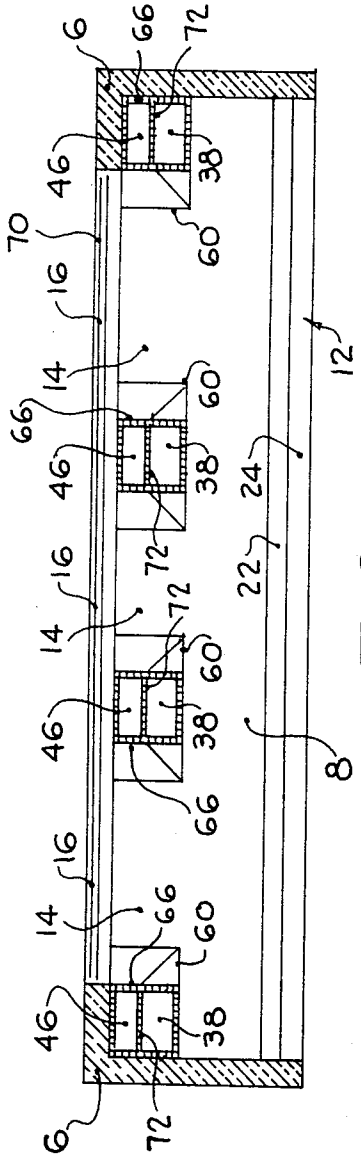


FIG 2

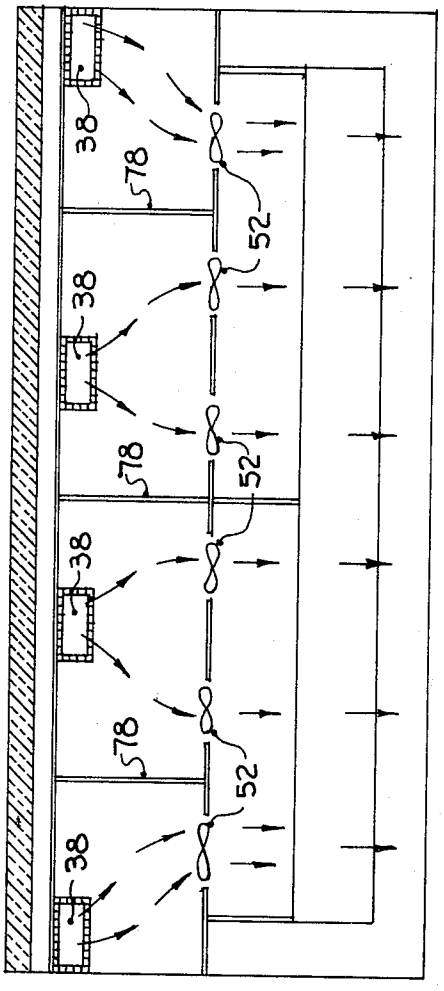


FIG 3

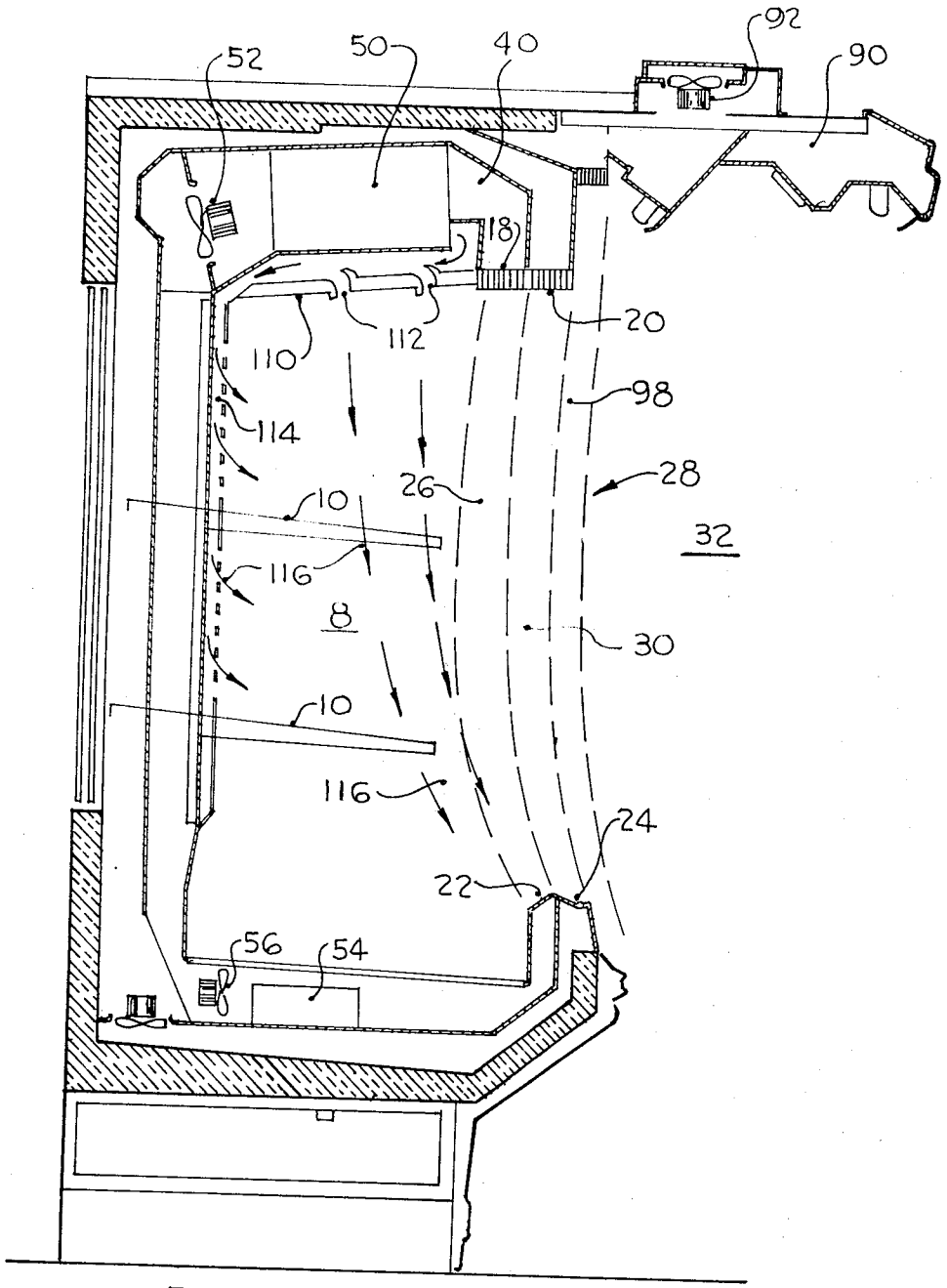

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FIG 4

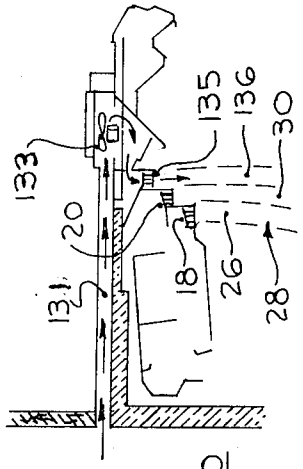

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FIG 6

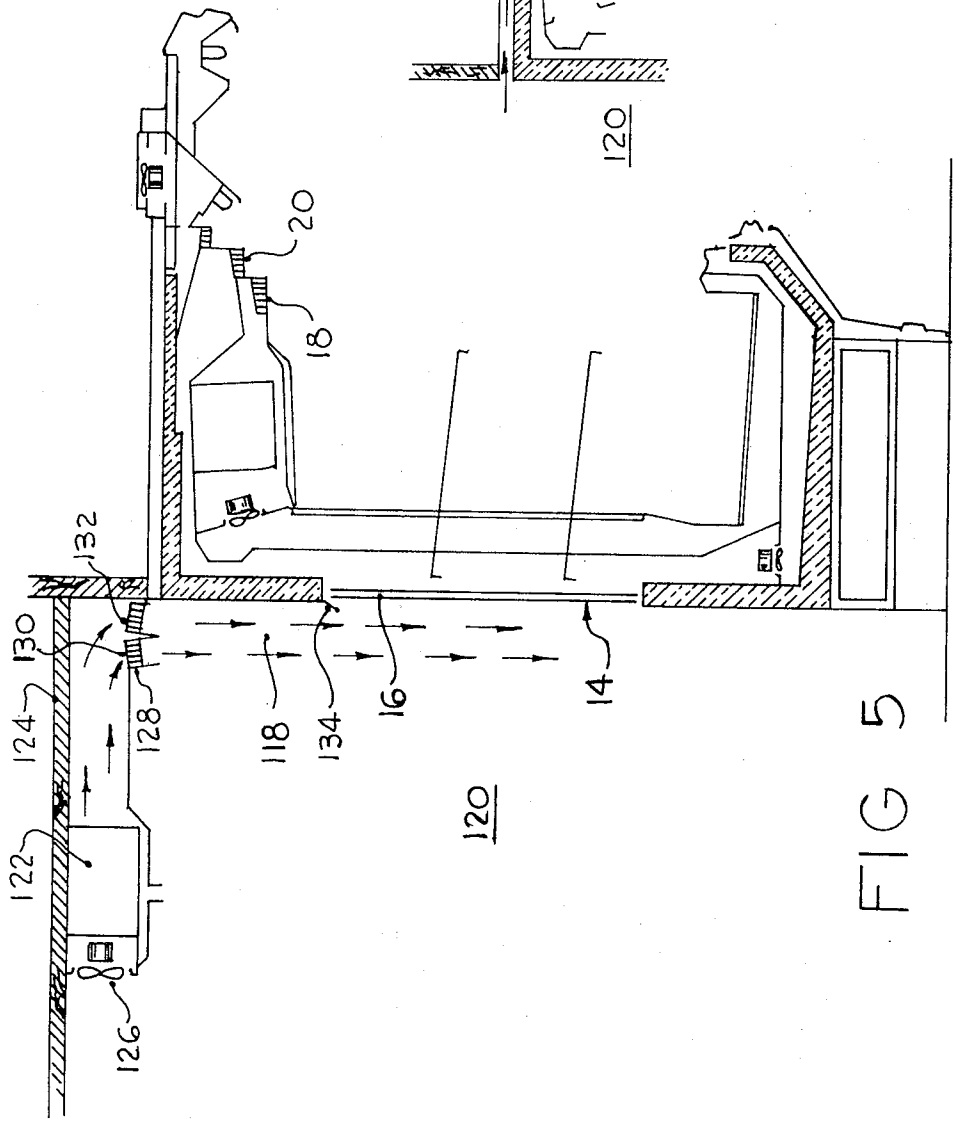

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FIG 5

REFRIGERATED DISPLAY EQUIPMENT

FIELD OF INVENTION

It is common practice today to provide refrigerated display equipment with a refrigerated space having an access opening for customers at the front thereof and to establish an air curtain moving across the access opening from inner and outer air discharge means to inner and outer return air inlets. In this way an air barrier embodying multiple layers of air is established and it is usual to refrigerate the inner layer of air in the air curtain to provide a desired low temperature in the refrigerated space whereas an adjacent layer of air in the air curtain may have a somewhat higher temperature than the refrigerated layer of air and serves to reduce the loss of refrigeration from the refrigerated air to the ambient air in front of the case. Typical equipment of this type is disclosed in U.S. Pat. Nos. 2,862,369; 3,060,253; 3,063,254; 3,128,609; 3,130,559; 3,134,243; 3,103,796; 3,304,736; 3,304,740; 3,365,908 and 3,528,258; for example.

It has further been suggested heretofore that refrigerated cases having an access opening for customers at the front of a refrigerated space may also be provided with an access opening for service personnel at the rear of the case to enable such personnel to restock the shelves within the refrigerated space, as exemplified by U.S. Pat. Nos. 2,923,137; 2,993,349; 3,044,274 and 3,063,255.

However, those constructions which have an access opening at the rear of the refrigerated space have not heretofore been provided with an air curtain for the front access opening embodying multiple layers of air maintained at different temperatures or including layers of air circulated from inner and outer air discharge means to inner and outer return air inlets within the confines of the case itself. As a result the air curtains used in equipment having a rear access opening for service personnel have not heretofore been very effective as an air barrier to prevent the loss of refrigeration to ambient air in the front of the refrigerated space. Moreover, a single layer air curtain at the front of an access opening to a refrigerated space tends to pick up and mingle with the ambient air carrying moisture to the refrigerating elements so as to require frequent defrosting thereof. Furthermore, such an air curtain is more readily deflected inwardly upon the opening of a door at the rear of the refrigerated space with the result there is a greater tendency for ambient air to enter the refrigerated space and cause moisture to condense on products being displayed and other surfaces with which it comes in contact.

The presence of doors at the rear of a refrigerated case also limits the area in which air ducts leading from the lower to the upper portion of the case can be located with the result that problems are presented in maintaining a uniform flow of air in an air curtain extending across the full width of the access opening.

In accordance with the present invention the foregoing difficulties and limitations inherent in constructions of the prior art are overcome and equipment is provided which affords access to a refrigerated space from both the front and rear thereof while providing a multiple layer curtain opposing the entry of ambient air into the refrigerated space through the front access opening and reducing the loss of refrigeration from the refrigerated space to the ambient air.

These results are preferably attained by providing refrigerated equipment having front and rear access opening to a refrigerated space, with two or more separate air duct means extending from inner and outer return air inlets adjacent one edge of a front access opening for customers to inner and outer air discharge means arranged to direct air toward the return air inlets in the form of a multiple layer air curtain. At least the inner layer of air forming the air curtains is refrigerated whereas an outer layer of air forming the air curtain has a temperature somewhat higher than the refrigerated air layer but below the ambient air temperature.

THE DRAWINGS

FIG. 1 is a vertical sectional view of a typical form of equipment embodying the present invention;

FIG. 1A is a perspective illustrating the lower end of the vertical portion of the second air duct means of the equipment shown in FIG. 1;

FIG. 2 is a horizontal sectional view taken on the line 2—2 of FIG. 1;

FIG. 3 is a horizontal sectional view taken on the line 3—3 of FIG. 1;

FIG. 4 is a vertical sectional view similar to FIG. 1 illustrating an alternative embodiment of the invention;

FIG. 5 is a view similar to FIG. 1 illustrating a further alternative embodiment of the invention, and

FIG. 6 is a view illustrating a portion of another alternative construction embodying the present invention.

In that form of the invention chosen for purposes of illustration in FIGS. 1, 2 and 3 of the drawings the equipment embodies insulated top, bottom and rear walls 2, 4 and 6 respectively extending about a refrigerated space 8 in which shelves 10 or the like may be located for the display of meats or other products to be refrigerated. The front of the refrigerated space is provided with an access opening 12 for customers whereas the rear of the refrigerated space is provided with an access opening 14 for service personnel. The rear access opening is normally closed by sliding, roll-up, or swinging doors 16 so that the articles on display can be replenished or rearranged as desired and the needs of the customers can be served by persons located in a service area at the rear of the case.

In order to shield the display space 8 from ambient air in the front of the case an air curtain is established across the front access opening 12. In order to render the air curtain more effective it embodies at least two adjacent layers of air travelling in parallel relation but having different temperatures. For this purpose an inner air discharge means 18 and an outer air discharge means 20 are located adjacent one side or edge, and preferably the upper edge, of the access opening 12. Inner and outer return air inlets 22 and 24 respectively are positioned adjacent the opposite or lower edge of the access opening in position to receive air directed across the access opening from the inner and outer air discharge means 18 and 20. In this way the air discharged from the inner discharge means 18 to the inner return air inlet 22 will form the inner layer 26 of an air curtain 28 whereas air from the outer air discharge means 20 and flowing to the outer return air inlet 24 will form an outer layer 30 of the air curtain. The two layers of air are adjacent and positioned between the refrigerated space 8 and the ambient air 32 in front of the case.

The inner return air inlet 22 is connected to the inner air discharge means 18 by a first air duct means which includes the return air passage 34 extending downward from inner return air inlet 22 to a lower plenum chamber 36 directly beneath the refrigerated space 8, together with vertically extending air duct portions 38 communicating at their upper ends with an upper plenum chamber 40 directly above the refrigerated space 8. The air in the first air duct means then flows from the upper plenum chamber 40 to the inner air discharge means 18 to form the inner layer 26 of air curtain 28. In a similar way a second and separate air duct means extends from the outer return air inlet 24 through a return air passage 42 to a bottom plenum chamber 44 below the lower plenum chamber 36 and to vertically extending air duct portions 46 communicating at their upper ends with a top plenum chamber 48 above the upper plenum 40. The air then passes from top plenum chamber 48 to the outer air discharge means 20 to form the outer layer 30 of air curtain 28.

Refrigerating means 50 are located in the first air duct means for reducing the temperature of the air circulated therethrough and about the refrigerated space so as to maintain said space at a desired low temperature. Thus, an evaporator 50 and blowers 52 are located in the upper plenum chamber 40 and extends substantially the full length of the plenum chamber. The evaporator preferably includes longitudinally extending coils with a plurality of parallel fins extending from the rear toward the front of the plenum chamber and is located directly above the refrigerated space 8 and in heat exchanging relation therewith. If desired a further evaporator 54 and blower 56 may be located in the lower plenum chamber 36 directly below the refrigerated space. The air thus refrigerated and circulated serves as the primary source of refrigeration for the refrigerated space 8 and the articles on display therein.

The air forming the outer layer 30 of the air curtain 28 is circulated through the second air duct means by means of blowers 58 which preferably are located within outwardly flaring hoods 60 at the lower ends of the vertically extending portions 46 of the second air duct means as shown in FIG. 1A. The hoods 60 serve to draw air from substantially the entire width of the bottom plenum chamber 44. The hoods 60 project inwardly at the rear of the lower plenum chamber 36 and the blowers 58 may be inserted into the hoods from the lower plenum chamber through openings 62. For this purpose a unit of the type disclosed in copending application Ser. No. 248,826 filed May 1, 1972 may be used and provided with a closure 64 for the openings 62 so as to isolate the blowers 58 from the lower plenum chamber 36.

The vertically extending portions 38 and 46 of the first and second air duct means are preferably arranged on the inner side of the insulated rear wall 6 of the case and form columns or mullions 66 located between and on opposite sides of the rear access openings 14 in the rear wall of the case as shown in FIGS. 2 and 3. Sliding or movable doors or windows 16 for the access openings 14 close the rear of the refrigerated space 8 while enabling service personnel at the rear of the equipment to replenish articles on the shelves 10 in the refrigerated space. The doors or windows 16 in the access openings 14 are preferably slidable along tracks 70 at the rear of the columns or mullions 66 at opposite sides of the access opening. The vertically extending air duct portions 38 and 46 then will be located in front of such doors so the vertically extending duct portions will be located entirely within the confines of the case and in direct heat exchanging relation with the refrigerated space 8 to aid in lowering the temperature of the air therein and reducing refrigeration loss to the exterior of the case from the duct means.

The partition 72 between the vertical portions 38 and 46 of the air duct means extends transversely of the mullions 66 and may be formed of metal. In the same way the partition 74 between the lower and bottom plenum chambers 36 and 44 and member 76 between the upper and top plenum chambers 40 and 48 may be formed of metal or they may include thermal insulating material or be otherwise formed to afford the deserved heat transfer effect. In this way the secondary air layer 30 or the air curtain 28, which consists of air circulated through the second air duct means will be cooled to a temperature below that of the ambient air but above that of the primary refrigerated air circulated through the first air duct means and over the evaporator 50.

In the preferred construction embodying the present invention the partition 74 between the lower plenum chamber 36 and the bottom plenum chamber 44 is removably held in place so that it can be readily taken out to provide access to the bottom plenum chamber 44 from the refrigerated space 8 for cleaning of the case and to provide access to the evaporator 54 and blower 56, if used.

The air drawn upward through the vertically extending portion 48 of the first air duct means by fans 52 is distributed laterally so as to flow substantially evenly over the coils and fins of the evaporator 50 within the upper plenum chamber 40. For this purpose it is desirable to arrange a plurality of fans 52 in spaced relation between the upper ends of the duct portions 38 and the plenum chamber 40. As shown in FIG. 3, for example, six such fans may be provided in a 12 foot case and dividers or baffles 78 may be positioned to aid in distributing the air more or less equally to each individual fan for passage over the evaporator. Furthermore, the inner air discharge means 18 to which air from the upper plenum chamber 40 and evaporator 50 passes is preferably provided with a honeycomb nozzle 80 that additionally serves to equalize the flow of air throughout the length of the inner layer 26 of the air curtain 28.

The member 76 between the upper plenum chamber 40 and top plenum chamber is preferably inclined upward toward the insulated top 2 of the case so as to provide a restricted passage 82 between the upper ends of the vertically extending portions 46 of the second air duct means and the outer air discharge means 20. This restriction together with a honeycomb type nozzle 84 in the discharge means 20 serves to effectively distribute the secondary air forming the outer layer 30 of the air curtain substantially evenly across the access opening 12 at the front of the refrigerated space 8.

The upwardly inclined member 76 forming the top of the upper plenum chamber 40 is located above the evaporator 50 and has a forward part 86 inclined downward toward the inner discharge means 18. Defrosting means for the evaporator 50 are provided and may be of the hot gas or electrical type, here shown as electrical resistor elements 88 positioned adjacent the evaporator 50 for periodically defrosting the same. During such a defrosting operation the fans 52 are stopped and the air within the plenum chamber 40 is not circulated.

This may be accomplished by suitable control means, shown as a switch 85 operable to break the circuit 87 including fans 52 upon closing the circuit 89 for energizing the heating elements 88 during a defrosting cycle of operation. The member 78 with its part 86 then serves to trap or confine the air adjacent the coil and heating elements within the plenum chamber 40 so that it will be positively circulated downward about the refrigerated space 8. At the same time the blowers 58 which circulate the secondary air to form the outer layer 30 of the air curtain will continue to operate so as to maintain the layer 30 of the air curtain effective at all times. At the conclusion of the defrosting cycle the evaporator 50 is again rendered operative and after a short delay blowers 52 will again be actuated whereby the air trapped within the plenum chamber 40 from which excess heat has been removed by initial operation of evaporator 50, will be discharged and recirculated so as to re-establish the inner refrigerated layer 26 of the air curtain 28.

The construction as described above refers particularly to equipment in which the air curtain 28 for the front access opening 12 for customers embodies an inner layer 26 of refrigerated air and an adjacent layer 30 of air which has been cooled to a temperature above that of the refrigerated air but below that of the ambient air. However, it has further been found to be advantageous to direct a layer of ambient air downward on the outer side of the layer 30 of the air curtain 28. For this purpose the upper portion of the equipment may be provided with a forwardly projecting extension 90 having a blower 92 therein by which ambient air may be drawn through an inlet 94 and discharged through a further air discharge means 96 located in front of the outer air discharge means 20. In this way the air curtain 28 is provided with a third layer of air 98 which is not recirculated but does serve to limit the loss of refrigeration to the ambient air from layers 26 and 30 and also reduces the passage of moisture from the ambient air into contact with the refrigerated air for condensation on the products being displayed and the surfaces adjacent thereto. The amount of moisture deposited on the coils and fins of the evaporator is also reduced with the result that defrosting of the equipment is not required as frequently as would otherwise be necessary.

The extension 90 also permits the location of lighting means 100 at points in front of the access opening 12 so that they may be directed downward and inwardly in a manner to afford brighter and better illumination of the articles on shelves 10 without glare into the eyes of the customers.

The shelves 10 upon which articles may be arranged are preferably supported on brackets 102 mounted on upright standards 104 secured to the inner surfaces of the columns and mullions 66 within which the vertically extending portions of the air duct means are located. The shelves 10 then will be spaced inwardly from the doors 16 on tracks 70 and may be provided with rear extensions 106 which are pivotally connected at 108 to the rear part of the shelves 10 so that they may be raised if necessary to afford better access to lower shelves when placing or arranging articles thereon or to enable personnel to reach farther into the refrigerated space to hand special items to customers standing in front of the case.

The modified form of the present invention shown in FIG. 4 is designed for use in those display cases wherein it is desired to permit refrigerated air to be circulated through the display space and shelves and about the articles on the shelves 10. In such cases the member 110 which forms the bottom of the upper plenum chamber 40 and defines the top of the refrigerated space 8 may be provided with openings 112 and a passage 114 for directing a portion of the primary air refrigerated by the evaporator 50 into the display space as indicated by the arrows 116. The air thus circulated within the display space will be drawn off through the inner return air inlet 22 for recirculation through the first air duct means by the fans 52 and/or the fans 56 when the latter are employed.

The further alternative construction illustrated in FIG. 5 is similar to the construction shown in FIGS. 1, 2 and 3. However, the case is further provided with means for establishing an air curtain 118 adjacent the rear access opening 14 to reduce or prevent the entry of air from a rear service or storage area 120 into the refrigerated space 8 when the doors 16 at the rear of the display space are opened. For this purpose an evaporator 122 is supported near the ceiling 124 or elsewhere and provided with a blower 126 by which air is drawn from the service area and is passed over the evaporator 122 to air discharge means 128. The air discharge means may include two converging honeycomb type nozzles 130 and 132 located above the rear access opening 14 and directed downwardly to establish the rear protective air curtain 118. If desired the blower 126 may be controlled by a switch or other means 134 positioned to be actuated upon opening of one or more of the doors 16 which normally close the rear access opening 14 for service personnel. However, since the service area 120 may require at least limited refrigeration the evaporator 122 and blower 126 may be operated substantially continuously if desired.

As shown in the alternative construction of FIG. 6 the equipment may be provided with a duct 131 and a blower 133 operable to draw cool and relatively dry air from the storage area 120 and direct such air downward through a discharge nozzle or outlet 13 to form a protective layer of air 136 on the outer side of the layers of primary and secondary air 26 and 30 which make up the air curtain 28 directed across the front access opening 13 of the case. In such constructions it will not generally be necessary to employ the blower 92 of the construction shown in FIG. 1 by which ambient air is utilized in forming an outer protective layer of air for the air curtain.

While various embodiments of the present invention have been shown in the drawings and described above, it will be apparent that numerous changes and modifications may be made in the form, construction and arrangement of the various elements of the combination. In view thereof it should be understood that the particular forms of the invention herein disclosed are intended to be illustrative only and are not intended to limit the scope of the invention.

We claim:

1. In a refrigerated display case having a refrigerated space therein provided with an access opening for customers in the front of said display space, means for establishing an air curtain embodying at least two layers of air moving across said opening, said means including inner and outer air discharge means positioned adjacent one edge of said access opening, inner and outer return air inlets positioned adjacent the opposite edge

of said access opening, a first air duct means extending from said inner return air inlet to said inner air discharge means, a second air duct means extending from said outer return air inlet to said outer air discharge means, means for circulating air through said first and second air duct means from said return air inlets to said air discharge means, and means for refrigerating the air circulated through at least said first air duct means, the improvement comprising a rear opening providing access to said refrigerated space for service personnel at the rear of said case, a door for closing said rear opening, said first and second air duct means each having a portion thereof extending vertically upward within the display space in the rear thereof and in heat exchanging relation with said space and adjacent said rear opening.

2. A refrigerated display case as defined in claim 1 wherein said vertically extending portions of said first and second air duct means are arranged side by side and in heat exchanging relation with each other.

3. A refrigerated display case as defined in claim 1 wherein there are two rear openings to said refrigerated space with a vertically extending column therebetween and at least a part of said vertically extending portions of said first and second air duct means are located within said column.

4. A refrigerated display case as defined in claim 1 wherein said case is provided with thermally insulated top, bottom and rear walls and said first and second air duct means are located within the confines of said insulated walls and door of the case.

5. A refrigerated display case as defined in claim 4 wherein shelves are supported within the refrigerated space and have portions pivotally connected thereto and projecting rearwardly between the vertically extending portions of said air duct means.

6. A refrigerated display case as defined in claim 1 wherein means are provided for establishing an air curtain directed across the rear opening in said case.

7. A refrigerated display case as defined in claim 6 wherein said means include a refrigerating element, a blower for directing air over said refrigerating element and two converging nozzles located above the rear opening in the case through which air cooled by said refrigerating element is directed across said rear opening.

8. A refrigerated display case as defined in claim 1 wherein means are provided for drawing air from a space at the rear of the display case and directing such air downward in front of said air curtain.

9. A refrigerated display case as defined in claim 1 wherein said inner and outer air discharge means extend throughout substantially the entire length of the access opening, a plenum chamber communicating with at least said first air duct means and extending substantially the full length of said air discharge means, said refrigerating means including an evaporator extending longitudinally of the plenum chamber, means for distributing air moving from the upper ends of said air duct means to said air discharge means substantially uniformly throughout the length of said air discharge means including fins mounted on said evaporator extending substantially at right angles thereto, together with a plurality of longitudinally spaced dividers extending at right angles to said air discharge opening between the upper ends of said air duct means, and blowers positioned between said dividers.

10. A refrigerated display case having a display space which is open at the front, means movable to close the rear of said display space, a plurality of longitudinally spaced vertically extending columns located within said case and in front of said means closing the rear of said display space, a lower plenum chamber within said case beneath said display space, an upper plenum chamber within said case above said display space, an evaporator in said upper plenum chamber, means for establishing an air curtain moving across said open front of the display space including an air inlet adjacent the lower edge of said opening communicating with said lower plenum chamber, vertical air ducts communicating with said lower plenum chamber and extending upward through said columns to said upper plenum chamber, two air discharge outlets communicating with said upper plenum chamber and located adjacent the upper edge of said opening, fans for moving air from said inlet opening through the lower plenum chamber, vertical air ducts and upper plenum chamber to said air discharge outlets, heating means associated with said evaporator to defrost the same, and control means operable to discontinue operation of said fans when said heating means is actuated to defrost the evaporator, said upper plenum chamber being formed to retain air therein when said heating means is actuated and the operation of said fans discontinued.

11. A refrigerated display case as defined in claim 10 wherein an evaporator is located in said upper plenum chamber, heating elements associated with said evaporator, and control means operable to discontinue operation of said fans when said heating elements are energized.

12. A refrigerated display case as defined in claim 10 wherein said upper plenum chamber is formed to retain air therein when operation of said fans is discontinued and said heating elements are energized.

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