

March 24, 1970

J. H. BRENNAN ET AL
REFRIGERATED EQUIPMENT

3,501,925

Filed Dec. 26, 1967

4 Sheets-Sheet 1

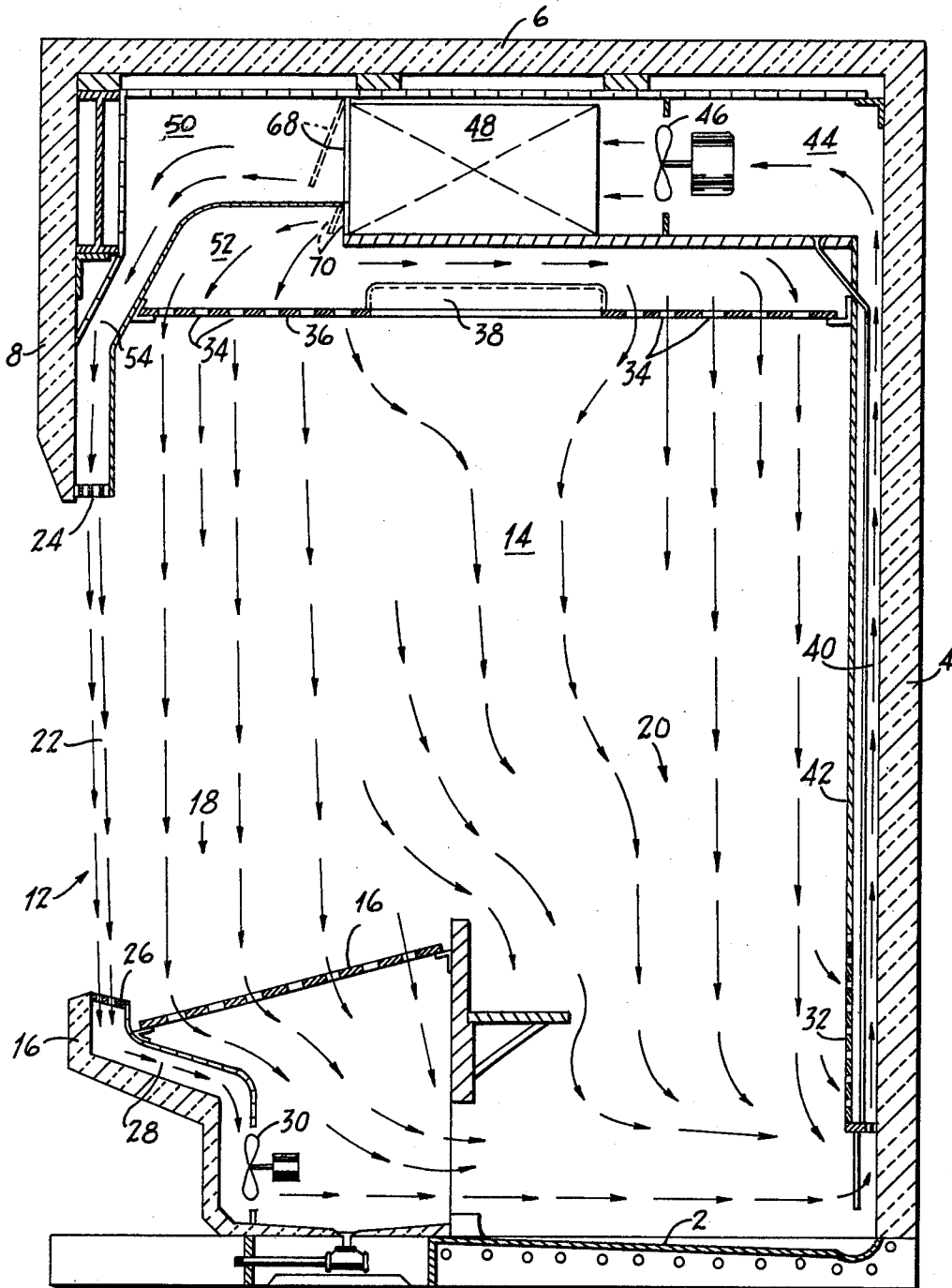


Fig. 1.

JAMES H. BRENNAN INVENTORS.
& WINFIELD R. BURTIS

BY *Sperry and Zoda*
Attorneys

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4 Sheets-Sheet 2

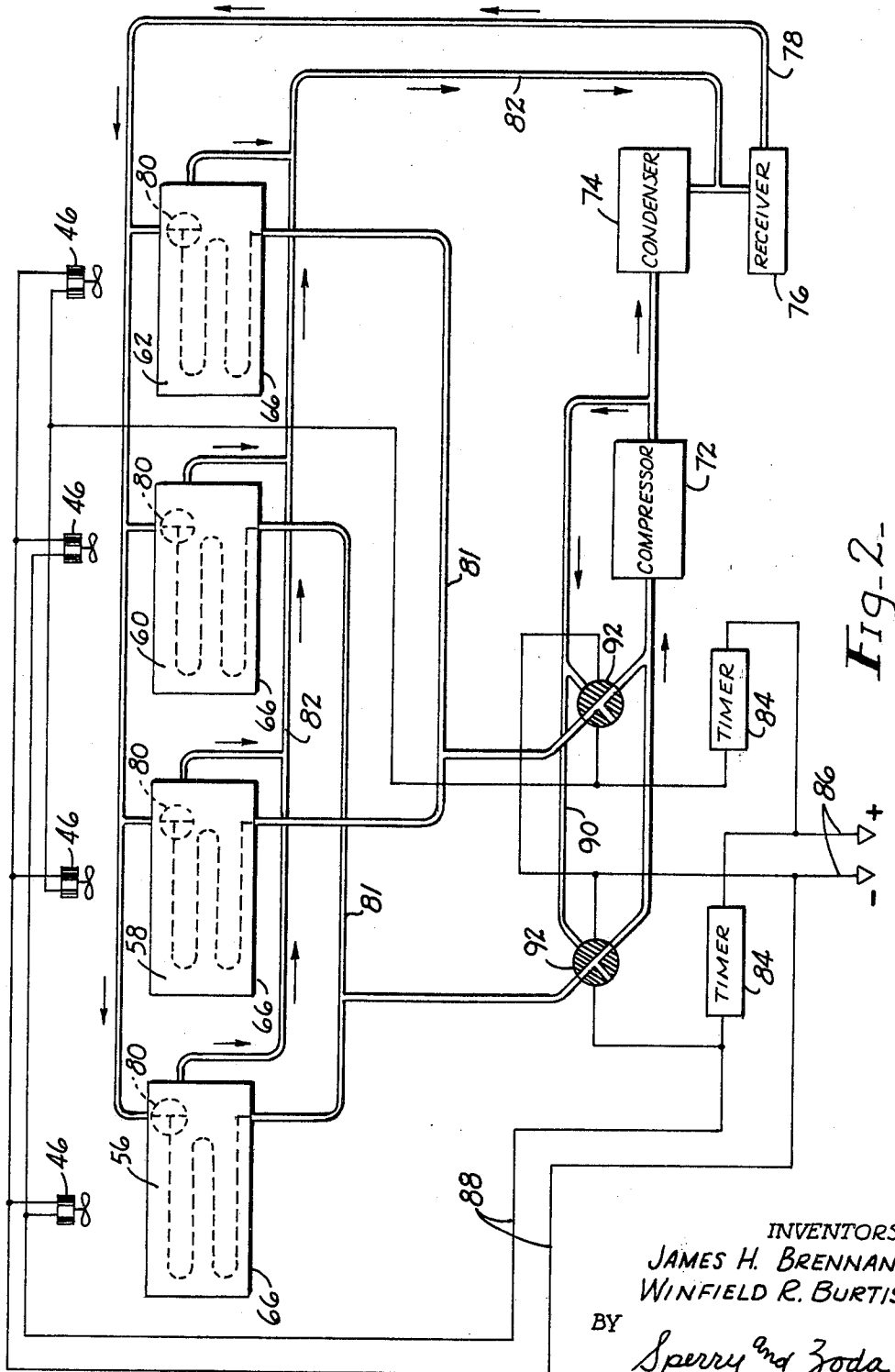


Fig. 2-

INVENTORS.
JAMES H. BRENNAN &
WINFIELD R. BURTIS
BY
Sperry and Zoda
Attorneys

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4 Sheets-Sheet 3

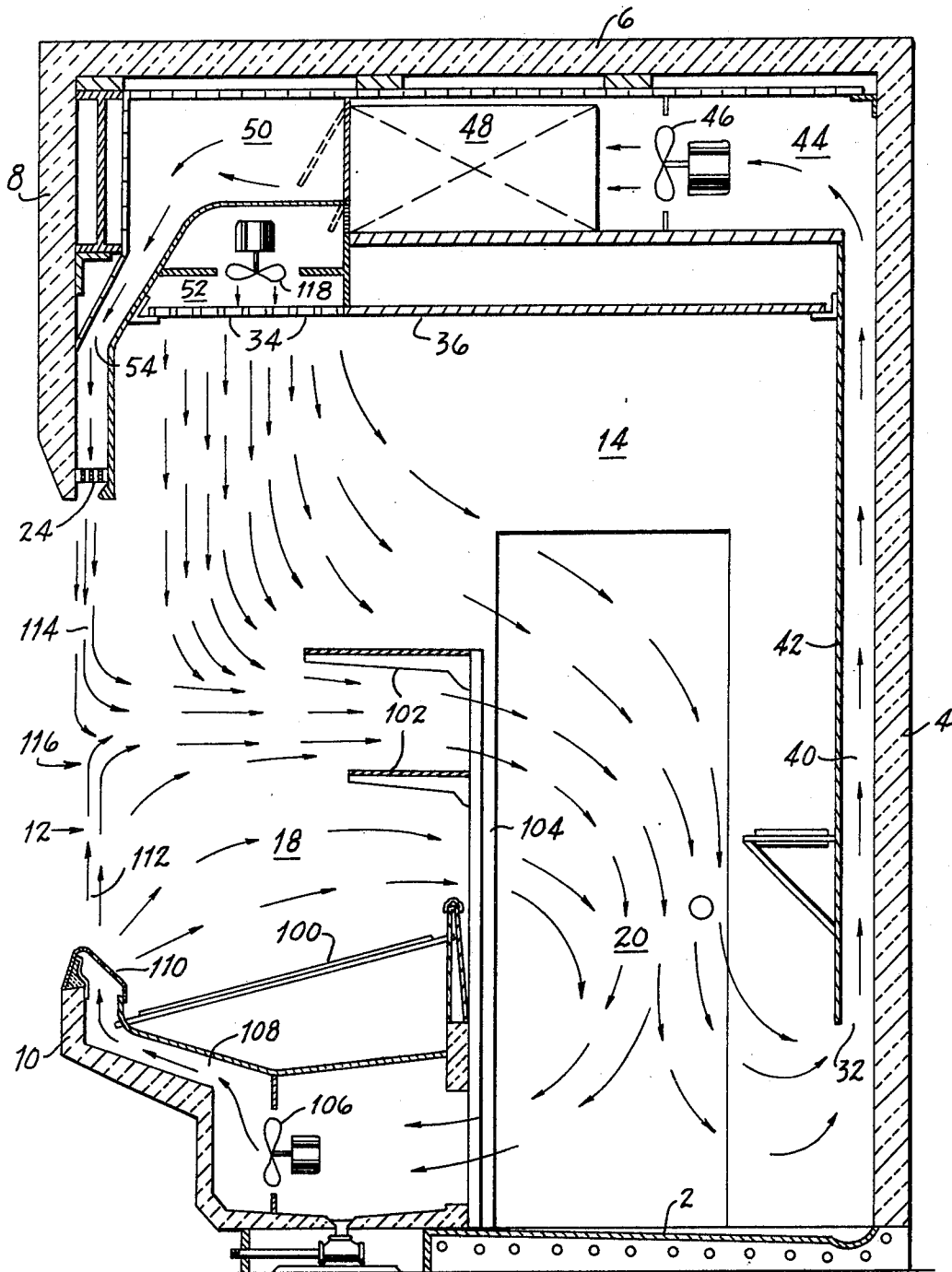


Fig. 3-

JAMES H. BRENNAN INVENTORS.
& WINFIELD R. BURTIS

BY *Sperry and Zoda*
Attorneys

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3,501,925

REFRIGERATED EQUIPMENT

James H. Brennan and Winfield R. Burtis, Trenton, N.J.,
assignors to Emhart Corporation, Bloomfield, Conn., a
corporation of Connecticut

Continuation-in-part of applications Ser. No. 608,340,
Jan. 10, 1967, and Ser. No. 621,909, Mar. 9, 1967. This
application Dec. 26, 1967, Ser. No. 693,200

Int. Cl. A47f 3/04

U.S. Cl. 62—256

21 Claims

ABSTRACT OF THE DISCLOSURE

Refrigerated equipment having a refrigerated space, a front access opening, a display area adjacent the access opening and a service area near the rear of the refrigerated space which is in open communication with the display area. Air flows through a discharge outlet adjacent the access opening establishing an air barrier and through additional outlets into the refrigerated space. Air from both these outlets is withdrawn from the service area and recirculated to such outlets. The recirculated air is cooled by a plurality of successively defrosted refrigerated elements but is passed into heat exchanging relation with only those elements not being defrosted.

RELATED APPLICATIONS

This application is a continuation-in-part of copending applications Ser. No. 608,340 filed Jan. 10, 1967 and Ser. No. 621,909 filed Mar. 9, 1967, both now abandoned.

BACKGROUND OF INVENTION

This invention relates to refrigerated equipment of the type having an access opening in the front thereof through which customers may reach to remove articles on display in the equipment. Display cases of this type are widely used in super-markets and elsewhere and it is quite usual to establish an air barrier adjacent the access opening to prevent or reduce the entry of warm, moist, ambient air into the refrigerated space through the access opening and to avoid or limit loss of refrigeration by spillage of cold air out of the case through the access opening. Typical of such equipment are those cases shown in U.S. Patent Nos. 3,289,432 and 3,304,736.

It has also been suggested heretofore that open self service refrigerated display cases might be combined with a storage space or "walk-in" cooler which communicates with the rear of the display case through doors which are normally closed and form the rear wall of the display case as exemplified by U.S. Patent No. 2,993,349.

SUMMARY OF INVENTION

In accordance with the present invention refrigerated equipment is provided with an access opening in the front of the case whereas the refrigerated space within the equipment has a display area located adjacent the access opening together with a service area located at the rear of the display area and in continuous and open communication therewith. An air discharge outlet is located adjacent the access opening to establish an air barrier and additional air outlets are arranged to supply air to the refrigerated space. Air from both the air discharge outlet and such additional air outlets is withdrawn from the refrigerated space for cooling and recirculation. The air thus recirculated is passed into heat exchanging relation with a plurality of refrigerating elements and thereafter passes to separate plenum chambers which communicate with the air discharge outlet and the additional air outlets respectively. A substantially uniform temperature is maintained within the refrigerated space by employing a plu-

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ality of refrigerating elements adapted to be sequentially defrosted and by circulating the air to the plenum chambers and outlets past only those elements which are not being defrosted.

THE DRAWINGS

FIGURE 1 is a vertical sectional view through one typical form of equipment embodying the present invention;

FIGURE 2 is a diagrammatic illustration of the refrigerating system employed in equipment embodying the present invention;

FIGURE 3 is a sectional view of an alternative embodiment of the present invention; and

FIGURE 4 is a sectional view through equipment illustrating a further alternative form of the invention.

In that form of the invention chosen for purposes of illustration in FIGURES 1 and 2 the equipment embodies an insulated enclosure having a bottom 2, a rear wall 4 and a top wall 6. The front of the equipment has an upper wall portion 8 and a lower wall portion 10 which are spaced apart to provide an access opening 12 in the front of the case.

The refrigerated space 14 within the equipment has a perforated shelf or article support 16 located adjacent and below the access opening 12 to provide a display area 18 whereas the rear wall of the refrigerated space 14 is spaced from the display area by an aisle or similar space which constitutes a service area 20 located at the rear of the display area. The service area is in continuous and open communication with the display area to enable service personnel to wait upon customers and maintain the supply and arrangement of the articles in the display area in a well stocked and attractive arrangement at all times.

An air barrier 22 is established adjacent the access opening by directing air downward through a discharge outlet 24 located adjacent the upper edge of the access opening and extending substantially the full width of said opening. The air forming the air barrier 22 is drawn into an inlet opening 26 located adjacent the lower edge of the access opening and through an air passage 28 by means of a blower 30. The blower serves to direct such air rearwardly through the service area 20 toward a return air inlet 32 located at the rear of the refrigerated space 14 and preferably located below the perforated shelf 16 in the display area.

Additional refrigerated air is caused to flow downward through the refrigerated space 14 and the display and service areas thereof by passage through additional air outlets 34 in a ceiling panel 36 which extends across the top of the refrigerated space at a level above the access opening 12. A lighting fixture 38 may also be mounted on the ceiling panel 36 if desired. A portion of the air issuing from the additional air outlets 34 flows downward adjacent the air barrier 22 and serves to support the air barrier so as to prevent it from being deflected inwardly in a manner to permit the entry of warm moist ambient air into the refrigerated space. This portion of the additional air also serves to cool the display area and maintain the articles on display on the perforated shelf 16 at a desired low temperature. The air then flows rearwardly from the display area and through the lower portion of the service area 20 to the return air inlet 32 at the rear of the service area. The remainder of the air from the additional air outlets 34 flows downward through the refrigerated space 14 and the service area 20 thereof to cool the same. This air then also flows rearwardly to the return air inlet 32.

The return air inlet 32 preferably extends the full width of the refrigerated space and communicates with a return air duct 40 formed by a heat transmitting panel 42 spaced from the insulated rear wall 4 of the equipment. The upper end of the return air duct communicates with a

return air plenum chamber 44 through which air is directed by the blowers 46 into heat exchanging relation with refrigerating means 48. The air cooled by the refrigerating means 48 then flows forward into an air discharge plenum chamber 50 and into an additional air plenum chamber 52. The air from the air discharge plenum chamber 50 flows through a discharge duct 54 of reduced cross section to the air discharge outlet 24 whereby its velocity is increased and it is directed downward across the access opening to establish the air barrier 22. At the same time the air from the additional air plenum chamber 52 is caused to flow downward through the additional air outlets 34 adjacent the inner side of the air barrier 22 and into and through the refrigerated space 12.

In order to maintain the temperature within the refrigerated space substantially constant and assure the preservation of the articles on display at a substantially uniform temperature, the refrigerating means 48 preferably embodies a plurality of refrigerating elements indicated at 56, 58, 60 and 62 in FIGURE 2. Each refrigerating element is provided with one or more blowers 46 for directing air from the return air plenum chamber 44 over the refrigerating element to the discharge plenum chamber 50 and the additional air plenum chamber 52. However, each element also is provided with an enclosure 66 having dampers or other closure members 68 and 70 at the outlet side thereof where the enclosure communicates with the discharge and additional air plenum chambers 50 and 52. The closures 68 and 70 are movable by gravity or otherwise to closed positions so as to prevent the passage of warm air into the plenum chambers 50 and 52 when any refrigeration element is being defrosted. All of the air is supplied to the plenum chambers 50 and 52 is therefore refrigerated air cooled by those elements which are being actively refrigerated whereby the air delivered to the air discharge outlet 24 and to the additional outlets 34 will always be maintained at a constant and predetermined low temperature.

In the refrigerating system shown in FIGURE 2 the refrigerating means 48 embodies the four refrigerating elements 56, 58, 60 and 62 which are supplied with refrigerant from a compressor 72, condenser 74 and receiver 76 through a refrigerant supply line 78. Each refrigerating element is, of course, provided with an expansion valve 80 and is connected to a refrigerant return line 81 leading back to compressor 72.

The various refrigerating elements are arranged to be successively defrosted under control of time clocks or other suitable means 84 which are connected into the power supply lines 86 and electrical circuits 8 in such a way as to render the blowers 46 associated with the element being defrosted inactive during the defrosting cycle of operation. The dampers or closure members 68 and 70 at the outlet side of the enclosure 66 for the element being defrosted are thereby closed during the defrosting period and the heat utilized in defrosting such element does not cause the temperature of the air delivered to the discharge and additional air plenum chambers 50 and 52 to be raised.

In the construction shown in FIGURE 2 the defrosting of the refrigerating elements is effected by means of hot refrigerant gas received from the compressor 72 through the by-pass line 90 upon actuation of the three-way valves 92 under control of the time clocks 84. Refrigerant condensed in the evaporator being defrosted is returned to the receiver 76 through the line 82. Further as shown the refrigerating elements 56, 58, 60 and 62 may be arranged in pairs so that two elements, such as the elements 56 and 60, may be defrosted while the two remaining elements 58 and 62, continue to remain on the refrigerating cycle of operation. As a result the plenum chambers 50 and 52 are continually supplied with cool refrigerated air from at least two of the refrigerating elements whereby the temperature of the air which is discharged through the discharge outlet 24 to establish the air barrier 22 and

through the additional air outlets 34 to cool the display and service areas of the refrigerated space 14 is maintained substantially uniform under all conditions of operation of the equipment.

In that form the equipment illustrated in FIGURE 3 of the drawings the air barrier 116 adjacent the access opening 12 in the front of the case embodies two opposed streams of air 112 and 114 which are directed into impinging contact and thereafter combine and flow inwardly through the refrigerated space 14 to the return air inlet 32 near the rear of the service area 20. In this construction the display area 18 is provided with an article support 100 which may be imperforate and further, as shown, the equipment may be provided with additional shelves 102 mounted on a bracket 104 which extends upwardly at the rear of the article support 100.

Air from the service area 20 is caused to flow forwardly beneath the article support 100 by a blower 106 and is forced through the lower air duct 108 so as to issue through a second air discharge outlet 110. The air thus discharged flows upwardly to form the lower portion 114 of the air barrier 116 whereas air directed downwardly from discharge opening 24 forms the upper portion 112 of the air barrier. These streams of air combine to establish the air barrier 116 and create a pressure area adjacent the mid-area of the access opening opposing the entry of air into the refrigerated space and decreasing the tendency for the air barrier to be deflected inwardly toward said space.

The construction shown in FIGURE 3 also has the additional air outlets 34 confined to the forward portion of the ceiling panel 36 and communicating with the additional air plenum chamber 52. Additional blower means 118 may also be used to promote the flow of air downward through the additional air outlets 34 and parallel to the upper portion 112 of the air barrier 116 and also serves to assure the desired uniform cooling of the articles on display in the display area 18 and on the support 100 and shelves 102. In this way a larger volume of articles may be presented for cooling and access to the customers whereas the proper cooling or refrigeration thereof is assured.

The air from both the upwardly directed stream 114 and the downwardly directed stream 112 which combine to establish the air barrier 116, flows inwardly through the refrigerated space 14 and into the service area 20. A portion of such air is withdrawn from the service area by the blower 106 for recirculation in forming the lower portion 114 of the air barrier whereas the major portion of such air is drawn off through return air inlet 32 and return air duct 40 for recirculation and cooling by the refrigerating means 48. In this way the refrigerated space 20 is maintained at an even more uniform and predetermined temperature while the entrainment and entry of ambient air into the refrigerated space is reduced and the spillage of cold air and the loss of refrigeration is minimized.

The refrigerating system employed in cooling the air when using the equipment of FIGURE 3 is preferably similar to that illustrated in FIGURE 2 in that the air utilized in establishing the air barrier 116 and in cooling the refrigerated space 14 does not undergo any rise in temperature during the defrosting periods of the refrigerating elements embodied in the refrigerating system.

In the further alternative embodiment of the invention illustrated in FIGURE 4 the construction and operation of the equipment is generally similar to that shown in FIGURE 3 and described above. However, the equipment is further provided with an outer guard air circuit by which a guard layer of air is projected downward on the outer side of the upper portion 112 of the air barrier 116 established adjacent the access opening 12. For this purpose the equipment is provided with a guard air duct 120 located between the rear wall 4 and the refrigerated air duct 40 and has an inlet air opening

at 122 below the return inlet air opening 32 of the refrigerated air duct. The guard air duct 120 extends upwardly and forwardly beneath the insulated top 6 of the equipment and terminates in a downwardly extending discharge passage 124 positioned between the upper front wall portion 8 of the equipment and the refrigerated air discharge duct 54. The discharge passage 124 of the guard air duct has a discharge opening 126 positioned adjacent the discharge outlet 24 of the refrigerated air discharge duct at the upper edge of the access opening 12. The guard air duct 120 is preferably maintained in heat exchanging relation with the return air duct 40 and the plenum chambers 44 and 50 throughout the length thereof and air is forced through the guard air duct by means of one or more blowers 128.

In this way, a guard panel of air 130 is established on the outer side of the upper portion 112 of the air panel 116. This air has an initial temperature upon entering the inlet opening 122 at the rear of the service area 20 corresponding to that of the air in the refrigerated space 14 and is maintained at a temperature higher than the temperature of the air forming the upper portion 112 of the air barrier 116 but somewhat lower than the temperature of the ambient air in front of the access opening 12. At the same time the guard panel of air 130 becomes a part of the air barrier and provides an outer support for the refrigerated stream air preventing outward diffusion thereof into the ambient air. While the refrigerated air issuing from the additional air outlets 34 in ceiling panel 36 supports the upper portion 112 of the air barrier on the inner side thereof so as to minimize diffusion and turbulence in the air barrier adjacent the upper portion 112 thereof. The guard air 130 also cooperates with the upwardly projected lower portion 114 of the air barrier so as to prevent the spillage of refrigerated air over the lower front wall 10 of the case. As a result the loss of refrigerated air and the load on the refrigerating means is reduced.

The downwardly flowing guard panel of air 130 upon contacting the lower and upwardly or inwardly projected air stream 112 is deflected inwardly and over the articles on the shelves 102 and merges with the refrigerated air from the upper air stream 112. The air streams then flow inwardly and downwardly and through the refrigerated space 14 to the return air inlet 32 and the inlet opening 122 of the guard air duct 120.

Furthermore, the blower or blowers 128 which serve to circulate the guard air are preferably operated continuously and independently of any defrosting cycle. The guard air thus serves to reduce fluctuations in the temperature maintained within the refrigerated space and about the articles on the shelves 102 during those periods when one or more of the refrigerating elements 56, 58, 60 and 62 is being defrosted and the supply therefrom is terminated. This result is attained by reason of the fact that only a portion of the relatively large volume of air forming the air barrier and circulating through the refrigerated space 14 is cut off during the successive defrosting cycle of any one or more of the refrigerating elements. Moreover, the defrosting period and the reduction in supply of refrigerated air to the equipment is in any event of relatively short duration and the over-all temperature rise of the air during such period is minimal.

While equipment embodying the present invention may be operated at substantially any desired temperature, it has been found to be particularly adapted for use in the display, servicing and preservation of meat products and vegetable or dairy products which must be maintained at temperatures above freezing, and which are adversely affected by fluctuations in temperature. Accordingly in a typical operation the equipment of FIGURE 4 is operated so as to maintain the temperature within the refrigerated space 14 at about 33° to 34° F. The air entering the inlets 32 and 122 of the refrigerated air duct 40 and the

guard air duct 120 will then be about 34° F. The air issuing from the outlet opening 126 of the guard air discharge passage 124 to form guard air panel 130 will then be about 35° F. while the air issuing from the discharge outlet 110 of the lower air passage 108 to form the lower portion of the air barrier 116 will be at about the same temperature, that is 35° F. On the other hand, the temperature of the air forming the upper portion 114 of the air barrier 116 and the air entering the top of the refrigerated air space through the additional openings 34 will be at a much lower temperature—say 0° F. However, during the defrosting period of one or more of the refrigerating elements 56, 58, 60 and 62, the supply of refrigerated air is somewhat diminished and the temperature of the air will tend to rise somewhat. The temperature of the air in upper portion 114 of the air barrier may rise to 10° or 15° F. While such air temperature variation may not result in fluctuations of more than about 5° F. in the temperature of the relatively great volume of air within the refrigerated space 14, the temperature changes which take place when using the guard air panel of the present invention are reduced to only 1° or 2° F. in even relatively small equipment with the result that the condition of the products on display can be preserved with substantially no change over much longer periods of time than has been possible heretofore.

Although several typical and preferred embodiments of the invention have been illustrated and described herein, it will be apparent that the form, construction and arrangement of the various elements of the combinations and the manner in which they are operated are capable of numerous changes and modifications. In view thereof it should be understood that the particular equipment and operation shown and described are intended to be illustrative only and are not intended to limit the scope of the invention.

What is claimed is:

1. Refrigerated equipment comprising an insulated enclosure having a refrigerated space therein provided with an access opening in the front thereof, a display area in said refrigerated space having article display means located therein adjacent said access opening, said refrigerated space having a rear wall spaced from said display area by an aisle constituting a service area in said refrigerated space located at the rear of said article display means and in continuous open communication with said display area, means for establishing an air barrier adjacent said access opening including duct means having a return air inlet communicating with said service area and an air discharge opening directed downwardly adjacent the upper edge of said access opening, refrigerating means located in heat exchanging relation with air circulated through said duct means, and means for circulating air through said duct means from said return air inlet to said discharge opening.

2. Refrigerated equipment as defined in claim 1 wherein the return air inlet for said duct means is located at the rear of said service area and at a level below said article display means.

3. Refrigerated equipment as defined in claim 1 wherein said refrigerated space has a wall thereof provided with additional air openings and means for directing additional air refrigerated by said refrigerating means through said additional air openings into said refrigerated space.

4. Refrigerated equipment as defined in claim 1 wherein there is a wall common to both said display area and said service area, said wall being provided with additional air openings, and means for directing air cooled by said refrigerating means through said additional air openings into both said display area and said service area.

5. Refrigerated equipment as defined in claim 1 wherein there is a food display shelving means within said display area extending from the front of the enclosure toward, but terminating short of, the rear of the enclosure

to define a service area rearwardly of the shelving, said display and service areas freely communicating with each other at least above the shelving, said duct means including a wall common to and defining a ceiling for both of said areas, said ceiling being perforated above each area to define air outlets therein.

6. Refrigerated equipment as defined in claim 3 wherein air supplied to both said air barrier and said additional air opening is drawn through the refrigerated space to the return air inlet of said duct means.

7. Refrigerated equipment as defined in claim 1 wherein a further air discharge opening is located adjacent the lower edge of said access opening and means are provided for drawing air from said refrigerated space and forcing it upward through the further air discharge opening into impinging contact with the air issuing from the air discharge opening adjacent the upper edge of the access opening.

8. Refrigerated equipment having a refrigerated space therein provided with an access opening in the front thereof through which persons may reach into said refrigerated space, article display shelving located in said refrigerated space adjacent said access opening, means for establishing an air barrier across said access opening for impeding the entrance of ambient air into said refrigerated space through said opening, said means including air discharge openings at opposite sides of said access opening, means for forcing curtains of air from said discharge openings in different directions and into impinging contact with each other adjacent said access opening, means for refrigerating the curtain of air issuing from the discharge opening at at least one side of the access opening, return air inlet means located at the rear of said refrigerated space, means for drawing air from the refrigerated space through said return air inlet means and serving to force said air through one of said air discharge openings to establish one of said air curtains, other return air inlet means located below said article display shelving and means for drawing additional air from said refrigerated space through the other return air inlet means and serving to force air forwardly below said shelving to the other of said air discharge openings to establish the other of said air curtains.

9. Refrigerated equipment as defined in claim 8 wherein said access opening is located in the front of said case, said air discharge openings serve to direct air inwardly adjacent the upper and lower edges of the access opening so as to impinge upon one another adjacent the mid-portion of said access opening such air after commingling thereof being caused to flow inwardly through said refrigerated space to said air inlet means.

10. A refrigerated case as defined in claim 8 wherein said access opening is located in the front of said refrigerated space, said discharge openings are located adjacent the upper and lower edges of the access opening, a return air duct communicates with the rear of said refrigerated space and with the discharge opening adjacent the upper edge of the access opening, a blower serves to move air through the return air duct and over refrigerating means arranged to reduce the temperature of the air circulated through said return air duct, and a separate duct communicating with said refrigerated space has means therein for forcing air through this discharge opening adjacent the lower edge of the access opening.

11. A refrigerated case having a refrigerated space therein with an access opening in the front thereof, said refrigerated space having a display area with an article support therein located adjacent said access opening, a service area in said refrigerated space at the rear of said display area and in continuous open communication with said display area, a first air discharge opening located adjacent the upper edge of said access opening, a return air duct having an inlet opening at the rear of said service area and at a level below said article support, said return air duct extending upward adjacent the rear of said re-

frigerated space and throughout substantially the entire area of the rear of said space, a plenum chamber above the refrigerated space communicating with said return air duct and having refrigerating means therein, means for forcing refrigerated air from said plenum chamber through said first air discharge opening at relatively high velocity to establish the upper portion of an air barrier adjacent said access opening, means for forcing additional refrigerated air from said plenum chamber into said refrigerated space in the form of a plurality of streams of air flowing downward parallel to said upper portion of the air barrier and adjacent thereto, an air discharge duct having a lower air discharge opening located adjacent the lower edge of said access opening, said air discharge duct communicating with the lower portion of said service area, and means for forcing air through said discharge duct and lower air discharge opening to establish a lower portion of an air barrier adjacent said access opening, the air forming said upper and lower portions of the air barrier being directed into impinging contact with each other adjacent said access opening so as to intermingle with each other to create an air barrier having a relatively high pressure zone near the mid-portion of the access opening.

12. Refrigerated equipment as defined in claim 11 wherein there are additional duct means and a blower arranged to direct a guard layer of air downward adjacent the outer side of the upper portion of the air barrier.

13. Refrigerated means as defined in claim 12 wherein the guard layer and its blower are operated continuously.

14. Refrigerated means as defined in claim 12 wherein said additional duct means has an air inlet opening communicating with the service area of said refrigerated space.

15. Refrigerated equipment comprising an insulated enclosure having a refrigerated space therein provided with an access opening in the front thereof, a display area in the front of the refrigerated space having a perforated article support therein located adjacent the access opening, a service area located in the rear of the refrigerated space and article support, said service area being in continuous open communication with the display area, means for establishing an air barrier adjacent said access opening including an air discharge opening located near the upper edge of said access opening and a second air discharge opening located near the lower edge of the access opening, duct means having blowers therein arranged to draw air from the service area of said refrigerated space and to conduct such air to said air discharge openings, said air being projected from said discharge openings into impinging contact substantially mid-way between the upper and lower edges of said access opening, means for directing air downward through additional air openings into said refrigerated space and on the inner side of the upper portion of the air barrier so as to oppose inward deflection thereof, further duct means having a blower therein and arranged to direct a guard layer of air downward adjacent the outer side of the upper air discharge opening to oppose outward diffusion of the upper portion of the air barrier, and means for refrigerating the air passed to the upper air discharge opening and to said additional air openings.

16. Refrigerated equipment as defined in claim 11 wherein an additional air duct is provided with an air inlet communicating with said refrigerated space and an air outlet positioned to direct a guard panel of air downward on the outer side of the air discharge opening adjacent the upper edge of the access opening and a continuously operating blower in said additional air duct.

17. Refrigerated equipment comprising an insulated enclosure having a refrigerated space therein provided with an access opening in the front thereof, a display area in said refrigerated space having article display means located therein adjacent the access opening, said refrigerated space having a rear wall spaced from said display area by an aisle constituting a service area in said re-

frigerated space located at the rear of said article display means and in continuous open communication with said display area, and means for refrigerating said refrigerated space.

18. Refrigerated equipment as defined in claim 17 wherein means are provided for circulating refrigerated air through said refrigerated space.

19. Refrigerated equipment as defined in claim 17 wherein means are provided for circulating refrigerated air downward into and through both said display area and said service area of said refrigerated space.

20. A refrigerated display case having a refrigerated space with an access opening in the front thereof, means for establishing an air curtain adjacent the access opening including air discharge openings located at opposite sides of said access opening, means for forcing air through said discharge openings in opposite directions and into impinging contact adjacent the access opening, means for refrigerating the air discharged through at least one of said air discharge openings, and means located on the outer side of one of said air discharge openings for projecting an additional layer of air parallel to said air curtain on the side thereof remote from said refrigerated space.

21. A refrigerated display case as defined in claim 1 wherein said discharge openings are located adjacent the upper and lower edges of the access opening and said additional layer of air is projected downwardly from a further discharge opening located adjacent and parallel to the discharge opening adjacent the upper edge of the access opening.

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