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(54) REFRIGERATED DISPLAY CASES WITH DEFROSTING MEANS

(71) We, KYSOR INDUSTRIAL CORPORATION, a Corporation of the State of Delaware, United States of America, of One Madison Avenue, Cadillac, Michigan, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to refrigerated display cases.

The high cost of energy in recent years has prompted efforts to develop commercial refrigerated display cases not requiring added energy, e.g. electrical or heated gas, for periodic defrosting of the coil. These efforts, largely applied to display cases of the open front, multiple curtain type, have resulted in cabinets which are defrosted by flow of ambient air through the cabinet duct system that extends around the product zone, generally separated therefrom.

With the type of display cabinet having physical access doors, such as glass doors, on the front, the refrigerated air is circulated from the coil directly through the product storage and display space and back to the coil during normal operation. However, during defrost, it is not desirable to circulate warm defrosting air through this storage product because of warming and/or melting of the product surfaces. Therefore, it would be desirable to air defrost such display cases without significant flow of warm defrost air through the product space. One conceivable technique would be to keep the warmer air out of the product space by dampers or doors in the ducts. However, such devices have a tendency to freeze shut or open to cause maintenance problems in portions of the case not readily accessible.

According to the present invention, a refrigerated display case comprises; a cabinet defining a coil chamber and a product storage and display space closed at the front by at least one access door; partition means separating the product space and the coil chamber; a refrigeration coil in the coil chamber; recirculatory flues from the coil chamber to the display space and back for cold air circulation during normal operation; air propelling means adjacent the coil in the coil chamber; and selectively openable and closeable defrost air inlet and discharge ports from the outside of the cabinet to the chamber, astraddle of the refrigeration coil for flow of ambient air through the refrigeration coil, the flow resistance through the inlet and discharge ports being insignificant compared to that through the recirculatory flues.

With this construction, when the ports are opened, the resistance to flow of air through the recirculation flues between the chamber and the display space is significantly greater than through the ports so that only insignificant flow occurs through the flues, the flow rather being through the ports under the influence of the air propelling means, thereby aerodynamically isolating the product storage and display space from the coil being defrosted. Thus, although no dampers are required in the flues, effective and rapid defrost of the coil can be achieved without damage to the products.

The invention may be carried into practice in various ways but one refrigerated display case embodying the invention will now be described by way of example with reference to the accompanying drawings, in which: —

Figure 1 is a perspective view of the display case;

Figure 2 is a side elevational sectional view of the display case shown in Figure 1;

Figure 3 is a fragmentary enlarged perspective view of a top portion of the display case shown in Figures 1 and 2, showing doors in a closed position over the defrost entry ports; and

Figure 4 is a fragmentary enlarged perspective view of the portion of the display case shown in Figure 3 showing the doors in an elevated position to open the ports.

The display case 10 shown in the drawings includes an enclosure cabinet having a back 14, front 16, ends 18, bottom 20, and

top 22. The front includes a plurality of hinged access doors 24, usually glass, employing suitable handles 26 to allow customer access to the enclosed product display space 28. The space 28 typically includes a plurality of vertically spaced shelves 30 for support of the product 31. Fluorescent lights 32 are provided to illuminate the product storage and display space. The display case may be supported on feet or pedestals 34.

In the top of the cabinet is a chamber 40 which contains a cooling coil of a conventional refrigeratoin system (not shown) that normally includes a compressor and an expansion valve connected to a coil 42 by refrigeration lines 44. Air flowing through the coil is cooled for maintaining the product at the desired temperature. Mounted in the chamber 40, adjacent to and upstream of the coil 42, is air propelling means typically in the form of a plurality of fans 46 driven by motors 49. The chamber 40 is separated from the product storage and display space 28 therebelow by a generally horizontal panel 48 which is preferably thermally insulated.

The coil is intermediate the front and back of the cabinet in the chamber 40. On opposite faces of the coil 42, front and back, are flues through which the chamber 40 is in communication with the display space 28. More specifically, in front of the coil 42 and adjacent the fans 46 is a return flue 48′ to allow return air to be drawn up by fans 46 from the display space 28 and propelled through the coil 42 from front to rear. Cold air from the rear of the coil 42 goes through a restricted vertical duct 50 at the back of the cabinet, extending downwardly behind the display space, into a bottom horizontal flue 51, which is formed by product pans 52 and the bottom 20. The air then flows vertically up across the doors 24, between these doors and the front edges of shelves 30, the product 31 usually on the shelves 30 cooperating with the doors to form an irregularly shaped vertical flue which ends at the return flue 48′ upstream of the fans 46 and forming an intake to the fans 46. This flow continues during normal operation of the display space to maintain the product in the preselected temperature range.

Periodically, frost accumulation on the surfaces within the coil unit, caused by entry of moisture into the display space with repeated opening of the doors 24, necessitates defrosting of the coil surfaces. For this purpose, the apparatus employs a short circuiting flow system. More specifically, astraddle the coil 42 are a plurality of ambient defrost air inlet ports 54 in the front portion of the top of the cabinet and a plurality of defrost air discharge ports 56 in the rear portion of the top of the cabinet. The chamber 40 between the entry ports 54 and the discharge ports 56 is closed around the coil 42 to prevent air by-passing the coil. The entry ports 54 are closed, during normal refrigeration operation of the case, by doors 60 pivotally mounted along the rear edges thereof on brackets 62. These doors can be elevated from the lower closed position to a raised opened condition, to open the ports 54 to the ambient air above the top of the display cabinet. This opening operation is caused by a controlled actuator, e.g. an electrical motor 66 or the equivalent, through a pair of interconnected links 68 and 70 and a tie bar 72 interconnecting the doors. Operation of the motor pivots the link 68 in an arc to elevate the doors. The discharge ports 56 are closed by doors 73 pivotally mounted at the forward edges thereof to be shiftable between a closed condition and an opened condition by actuators 74 through links 76 connected to tie bars 78. With doors 73 raised, the discharge ports 56 are open to the ambient atmosphere above the rear of the display. The operation of these discharge doors is just like that explained and shown for the entry doors.

The number of entry and discharge ports and corresponding doors can vary. Normally, there is one coil section for each case segment containing access doors 24, with numerous entry ports and discharge ports per coil section.

During normal refrigeration operation, the doors 60 and 73 are maintained in a closed position. The fans 46 are operated by the motors 49 to cause constant recirculation of air through the coil 42 where the air is cooled, and through the restricted flue 50 or duct down the back of the display space, and into the bottom horizontal flue 51 which is formed below product pans 52 and above the bottom 20. The air then discharges vertically across the doors 24 and the product 31, through the opening 48′, the intake to fans 46. (See solid line arrows in Figure 2). Moisture entering the display space is precipitated as undesirable frost on the cold surfaces of the coil. At selected intervals, the coil must be defrosted to allow effective air flow and heat exchange. This defrosting is achieved by maintaining the fans 46 in operation, while opening the doors 60 on the defrost air entry ports 54 and the doors 73 over the defrost air discharge ports 56, thereby to create a short circuit air flow system. Specifically, warm ambient air is caused to enter the ports 54 and is propelled by the fans 46 through the coil 42 to defrost it and is discharged out through the ports 56. (See dash line arrows). Only a minor and insignificant portion of the air finds its way

through the restricted duct passage 50 with its greater resistance to flow, thereby aerodynamically isolating the display space from the chamber, the coil, and the defrost air. Therefore the cold display space air is basically stagnant during defrost, to maintain its cold condition without melting of the product or significant frost formation on the surface of the product. After the coil 42 is defrosted, e.g. after a predetermined short time interval or when the coil surfaces reach a predetermined temperature, the doors 60 and 73 are closed, terminating defrost and re-establishing refrigerated air flow about the display space.

WHAT WE CLAIM IS:—

1. A refrigerated display case comprising: a cabinet defining a coil chamber and a product storage and display space closed at the front by at least one access door; partition means separating the product space and the coil chamber; a refrigeration coil in the coil chamber; recirculatory flues from the coil chamber to the display space and back for cold air circulation during normal operation; air propelling means adjacent the coil in the coil chamber; and selectively openable and closeable defrost air inlet and discharge ports from the outside of the cabinet to the chamber, astraddle of the refrigeration coil for flow of ambient air through the refrigeration coil, the flow resistance through the inlet and discharge ports being insignificant compared to that through the recirculatory flues.

2. A display case as claimed in Claim 1 in which the recirculatory flues include a restricted cold air flue leading to the display space and having air distribution outlets.

3. A display case as claimed in Claim 1 or Claim 2 in which the coil chamber is above the display space, and the inlet and discharge ports for ambient air are through the top of the cabinet.

4. A refrigerated display case substantially as described herein with reference to the accompanying drawings.

KILBURN & STRODE,
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Agents for the Applicants.

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1562859 COMPLETE SPECIFICATION

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Sheet 1

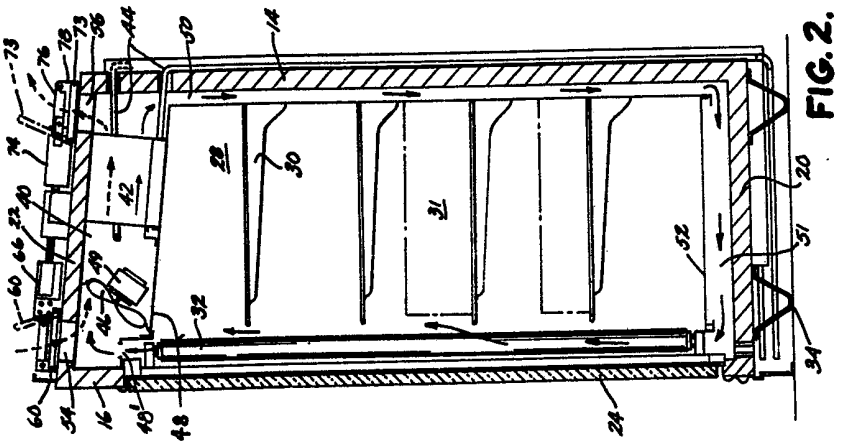

FIG. 2.

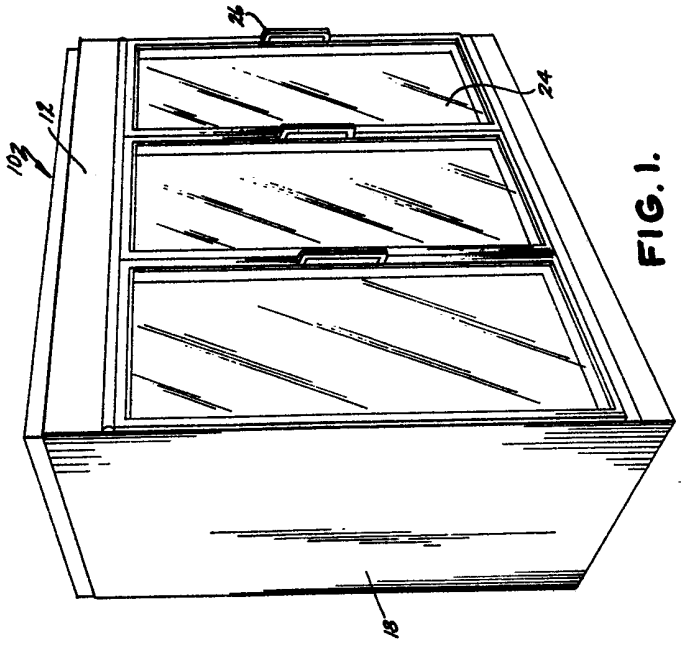

FIG. 1.

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Sheet 2

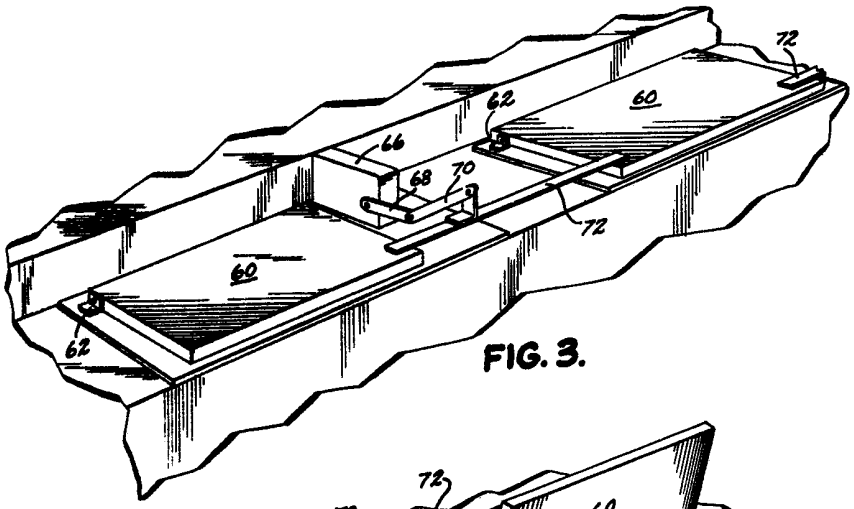

FIG. 3.

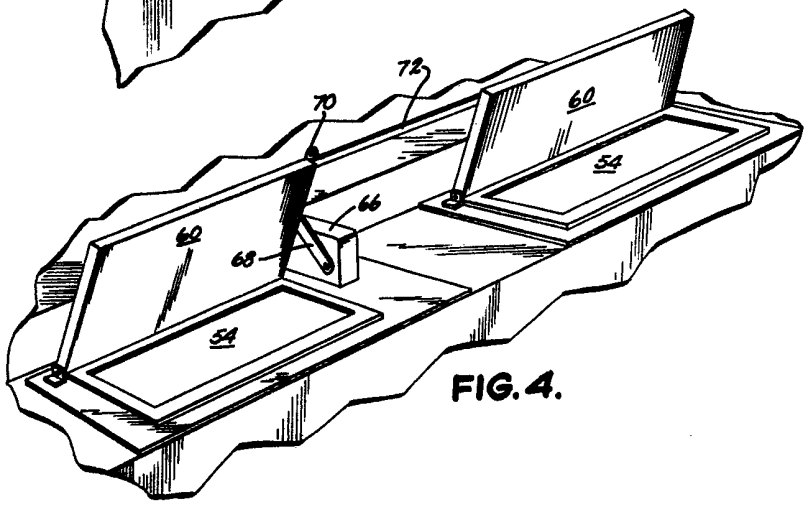

FIG. 4.