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(54) **AEROTHERMODYNAMIC SEPARATOR FOR REFRIGERATED DISPLAY CABINET**

(57) An aerothermodynamic separator (100) for a refrigerated display cabinet (400) is disclosed. The separator comprises a flat member having a predetermined dimension defining a shape of the separator. The separator is adapted to be removably positioned between a front end of one or more shelves (406) associated with the cabinet and a rear end of a connecting region between two adjacent doors (404) of the cabinet. The separator is adapted to restrict infiltration of outside air in a conservation space (426) behind the doors of the cabinet upon opening at least one of the doors.

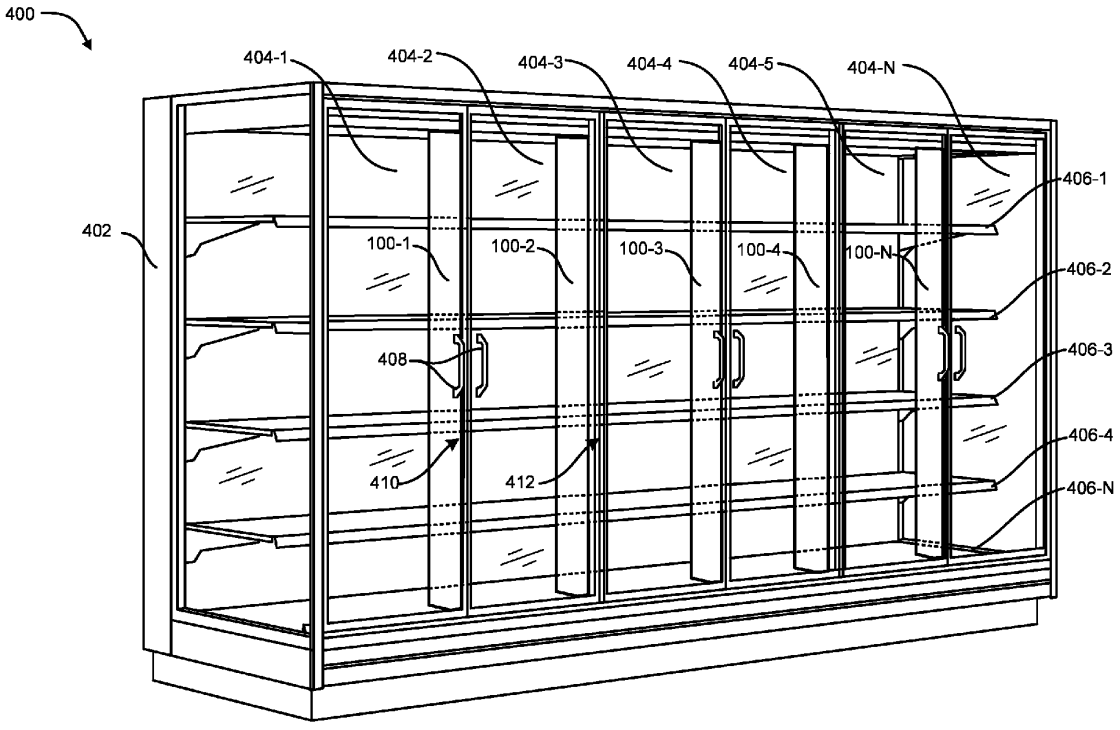


FIG. 4A

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This patent application claims the benefit of priority of US Provisional Patent Application No. 63/375,090, filed on Sep 09, 2022.

TECHNICAL FIELD

[0002] This invention relates to the field of refrigerated display cabinets.

BACKGROUND

[0003] Refrigerated display cabinets having glass doors have decreased energy efficiency when the doors are opened. There is, therefore, a need to restrict cold air loss in refrigerated display cabinets during the door opening process to further decrease the energy consumption of the cabinets.

SUMMARY

[0004] A first aspect of the invention provides an aerothermodynamic separator for a refrigerated display cabinet. The separator comprises a flat member having a predetermined dimension defining a shape of the separator, wherein, the separator is adapted to be removably configured between a front end of one or more shelves associated with the cabinet and a rear end of a connecting region between two adjacent doors of the cabinet, and the separator is adapted to restrict infiltration of outside air in a conservation space behind the closed doors of the cabinet upon opening at least one of the adjacent doors.

[0005] Optionally, the connecting region is a free end of one of the adjacent doors and the free end is used to open the door.

[0006] Optionally, the connecting region is a hinged end or pivot end of one of the adjacent doors.

[0007] Optionally, the separator is made of a transparent material.

[0008] Optionally, the separator is made of one or more of plastic, acrylic, and glass.

[0009] Optionally, the cabinet is a vertical refrigerated display cabinet with glass doors, wherein the separator is a flat rectangular member comprising a front edge in contact with and extending along the connecting region between the two adjacent doors of the cabinet, a rear edge attached to the front end of the one or more shelves, a top edge attached to a top inner wall of the cabinet, and a bottom edge attached to a bottom inner wall of the cabinet.

[0010] Optionally, the cabinet is a semi-vertical refrigerated display cabinet with flat glass doors, wherein the separator comprises a front edge in contact with and extending along the connecting region between the two adjacent doors of the cabinet, a rear edge attached to the front end of each of the shelves, a top edge attached to a top inner wall of the cabinet, and a bottom edge attached to a bottom inner wall of the cabinet.

[0011] Optionally, the cabinet is a semi-vertical refrigerator display cabinet with curved glass doors, wherein the separator comprises a curved front edge that remains in contact with and extends along the connecting region between the two adjacent curved doors of the cabinet, a rear edge attached to the front end of each of the one or more shelves, a top edge attached to a top inner wall of the cabinet, and a bottom edge attached to a bottom inner wall of the cabinet.

[0012] Optionally, a flat surface of the separator is oriented substantially perpendicular to the closed doors of the cabinet and is extending vertically from top to bottom of the cabinet.

[0013] A second aspect of the invention provides a refrigerated display cabinet comprising a case comprising one or more shelves extending between side walls of the case to form a conservation space to support and store one or more products therewithin; two or more doors movably coupled to a front of the case and adapted to move between an open position and a closed position; and at least one separator configured between a front end of the one or more shelves and a rear end of a connecting region between two doors among the two or more doors, wherein the separator restricts infiltration of outside air in the conservation space behind the closed doors of the cabinet upon opening at least one of the adjacent doors

[0014] Optionally, the at least one separator is configured behind the connecting region at a free end of one of the two doors, wherein the free end is used to open the door.

[0015] Optionally, the at least one separator is configured behind the connecting point at a hinged end or pivot end of one of the two doors.

[0016] Optionally, the cabinet comprises a refrigeration system configured to maintain a predefined temperature in the conservation space of the cabinet.

[0017] Optionally, the refrigeration system is configured to create a recirculating air curtain in front of the one or more shelves or behind the doors of the cabinet, the air curtain is configured to create an aerothermodynamic barrier between the conservation space of the cabinet and environment.

[0018] Optionally, the refrigeration system comprises a duct extending from a bottom front side of the cabinet to a top front side of the cabinet via a rear side of the cabinet; a cooling unit configured within the duct and operable to cool the air flowing through the duct to the predefined temperature; and a fan positioned adjacent to the cooling unit within the duct, the fan configured to facilitate inflow of air within the duct through the bottom front side of the cabinet, pass the received air through the cooling unit that cools the received air, and pump out the cool air from the top front side of the cabinet, wherein

the cool air pumped out by the top front side of the cabinet is received by the bottom front side of the cabinet such that the air curtain is formed in front of the one or more shelves or behind the doors of the cabinet.

[0019] Optionally, the top front side of the duct is configured with a discharge air grille (DAG) and the bottom front side of the duct is configured with a return air grille (RAG), wherein the DAG and the RAG control air directivity and facilitates the creation of the air curtain in front of the one or more shelves or behind the doors of the cabinet.

[0020] Optionally, the cabinet comprises a perforated wall panel (PWP) configured with the duct on the rear side of the cabinet, the PWP is configured to discharge a portion of the cool air, passing through the duct, in the conservation space to maintain the predefined temperature therewithin.

[0021] Optionally, the cabinet is a vertical refrigerator display cabinet having a front end of the one or more shelves vertically in line with each other.

[0022] Optionally, the cabinet is a semi-vertical refrigerator display cabinet having a front end of the one or more shelves extending in a step-wise manner from a top end to a bottom end of the cabinet.

[0023] Optionally, a flat surface of the at least one separator is oriented substantially perpendicular to the closed doors of the cabinet and is extending vertically from a top end to a bottom end of the cabinet.

[0024] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, features, and techniques of the invention will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The accompanying drawings are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0026] In the drawings, similar components and/or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label with a second label that distinguishes among the similar components. If only the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label.

FIG. 1 is a schematic diagram illustrating an aerothermodynamic separator.

FIG. 2 is a schematic diagram illustrating another aerothermodynamic separator.

FIG. 3 is a schematic diagram illustrating yet another aerothermodynamic separator.

FIGs. 4A is a schematic diagram illustrating a vertical refrigerated display cabinet fitted with the aerothermodynamic separators of FIG. 1.

FIG. 4B illustrates a side view of the cabinet of FIG. 4A depicting the refrigeration system and the separator of the cabinet.

FIGs. 5A is a schematic diagram illustrating an exemplary embodiment of a semi-vertical refrigerated display cabinet with flat glass doors fitted with the aerothermodynamic separators of FIG. 2.

FIG. 5B illustrates a side view of the cabinet of FIG. 5A depicting the refrigeration system and the separator.

FIGs. 6A is a schematic diagram illustrating a semi-vertical refrigerated display cabinet with curved glass doors fitted with the aerothermodynamic separators of FIG. 3.

FIG. 6B illustrates a side view of the cabinet of FIG. 6A depicting the refrigeration system and the separator.

DETAILED DESCRIPTION

[0027] The following is a detailed description of embodiments of the invention depicted in the accompanying drawings. The embodiments are in such detail as to clearly communicate the invention. However, the amount of detail offered is not intended to limit the anticipated variations of embodiments; on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the appended claims.

[0028] Various terms are used herein. To the extent a term used in a claim is not defined below, it should be given the broadest definition persons in the pertinent art have given that term as reflected in printed publications and issued patents at the time of filing.

[0029] In the specification, reference may be made to the spatial relationships between various components and to the spatial orientation of various aspects of components as the devices are depicted in the attached drawings. However, as will be recognized by those skilled in the art after a complete reading of the present application, the components of this invention described herein may be positioned in any desired orientation. Thus, the use of terms such as "above," "below," "upper," "lower," "first", "second" or other like terms to describe a spatial relationship between various components or to describe the spatial orientation of aspects of such components should be understood to describe a relative relationship between the components or a spatial orientation of aspects of such components, respectively, as the aerothermodynamic separator and cabinet, and corresponding components, described herein may be oriented in any desired direction.

[0030] Refrigerated display cabinets having glass

doors are supplemented with recirculating air curtain extending in front of the shelves or behind closed glass doors of the cabinet to create a thermal barrier between the environment and inner storage space of the cabinet, which helps keep the inner storage space cold. Generally, when the doors of the cabinet are closed, the air curtain extends/ flows along the surface of the back of the doors, and when the doors are open, the air curtain extends along the front ends of the shelves of the cabinet. As a result, when one of the doors of the cabinet is opened, the air curtain along a connecting region between the open door and a neighboring closed door becomes unstable. The unstable air curtain between the closed and open doors of the cabinet causes cold air to spill out from the cabinet and also causes outside air to infiltrate into the cabinet. This significantly contributes to additional energy consumption by the refrigerated cabinet to keep the inner storage space of the cabinet cold.

[0031] Referring to FIGs. 1 to 3, exemplary embodiments of the aerothermodynamic separator (100, 200, 300) (also referred to as vertical separator or separator, herein) are disclosed. The connecting region between two adjacent doors of the cabinet is generally the location where an unstable air curtain region is created in the prior art cabinet during the door opening process. The separator(s) (100, 200, 300) is positioned at this unstable air curtain region (the connecting region between adjacent doors) in the cabinet (400,500, 600). The separator (100, 200, 300) restricts infiltration of outside air in the conservation space behind closed doors of the cabinet (400, 500, 600) and also restricts spillage of cold air from the cabinet (400, 500, 600) during the opening of at least one of the doors of the cabinet (400, 500, 600). As a result, the energy consumption or requirement of the cabinet (400, 500, 600) is reduced, thereby making the cabinet (400, 500, 600) energy efficient compared to existing cabinets. Besides, as the separator(s) (100, 200, 300) extends between the front of the shelves to the back of the doors and from the top ceiling to the bottom inner wall in the cabinet (400, 500, 600), the conservation space along each of the shelves remains unobstructed and unpartitioned, which allows users to efficiently utilize the conservation space without any obstruction from the separator(s) (100, 200, 300). Moreover, the separator(s) (100, 200, 300) may also be made of a transparent material in order to keep it invisible so that the visibility of the products displayed on the shelves is not blocked. In addition, the separator(s) (100, 200, 300) have a dimension and shape concurrent to a space between the front of the shelves and back (rear end) of the doors, so that the separator (100, 200, 300) can be easily configured between any type of cabinet including but not limited to a vertical refrigerated display cabinet, a semi-vertical refrigerated display cabinet with flat glass doors, and a semi-vertical refrigerated display cabinet with curved glass doors.

[0032] The separators (100, 200, 300) can be selected to be configured with different types of refrigerated display cabinets (cabinets) (400, 500, 600) based on the type of cabinet being employed. The cabinet (400, 500, 600) includes a case comprising one or multiple shelves (collectively referred to as shelves, herein) extending between side walls of the case to form a conservation space to support and store one or more products or goods therewithin. In addition, two or more doors (collectively referred to as doors, and individually referred to as door, herein) are movably coupled to the front of the case. The separator (100, 200, 300) is configured between a front end of shelves and a back or rear end of a connecting region of the doors., such that the flat surface of the separator (100, 200, 300) remains substantially perpendicular to the closed doors of the cabinet (400, 500, 600) and the separator (100, 200, 300) extends vertically from a top ceiling to a bottom inner wall of the cabinet (400, 500, 600). The connecting region of the doors is between two adjacent doors of the cabinet (400, 500, 600). However, the separator 100, 200, 300 can also be slightly smaller than the shape and dimension defined in various embodiments of this invention, and all such embodiments are also well within the scope of this invention.

[0033] The connecting region between two adjacent doors of the cabinet (400, 500, 600) is generally a hinged end or pivot end of the doors, and/or a free end of the doors, wherein the unstable air curtain region gets created in the cabinet during the door opening process. In some embodiments, the free ends of two adjacent doors in the cabinet may be adjacent to each other and the hinged ends of the two adjacent doors away from each other. In other embodiments, a free end of one of the adjacent doors may be adjacent to a hinged end of the other adjacent door such that all the doors in the cabinet are hinged on the same side (either left or right).

[0034] The separator (100, 200, 300) is a flat member having a rear edge, a front edge, a bottom edge, and a top edge. The separator (100, 200, 300) has a predetermined dimension and size defining the shape of the separator (100, 200, 300) based on the cabinet (400, 500, 600) being employed and concurrent to a space between the front of the shelves and back of the doors of the cabinet (400, 500, 600). For instance, referring to FIG. 1, in an example embodiment, the separator 100 is a flat rectangular member having the front edge 104 parallel to the rear edge 102, the top edge 106 parallel to the bottom edge 108, and the top edge 106 and the bottom edge 108 perpendicular to the front edge 104 and rear edge 102. This separator 100 is configurable with vertical type refrigerated display cabinets 400, as shown in FIGs. 4A and 4B. Once the separator 100 is configured within the vertical refrigerated display cabinet 400, the front edge 104 of the separator 100 remains in contact with and extends along the connecting region between the two adjacent doors of the cabinet 400 when the doors are closed, the rear edge 102 of the separator 100 remains attached to the front end of the shelves, the top edge 106 of the separator 100 remains attached with a top ceiling of the cabinet, and the bottom edge 108 of the separator

100 remains attached a bottom inner wallof the cabinet, such that the flat surface 110 of the separator 100 remains perpendicular to the doors and the separator 100 remains attached to the case of the cabinet 400, independent of opening and closing of the doors of the cabinet 400.

[0035] Referring to FIG. 2, in another example embodiment, the separator 200 is a flat member having the front edge 204 inclined at a non-parallel angle with respect to the rear edge 202 with the top edge 206 parallel to the bottom edge 208, and the top edge 206 and bottom edge 208 being perpendicular to the rear edge 202. This separator 200 is configurable with semi-vertical type refrigerated display cabinets having flat doors (500) as shown in FIGs. 5A and 5B. Once the separator 200 is configured within the cabinet 500, the front inclined edge 204 of the separator 200 remains in contact with and extends along the connecting region between the two adjacent doors of the cabinet 500 when the doors are closed, the rear edge 202 of the separator 200 remains attached to the front end of the shelves, the top edge 206 of the separator 200 remains attached to a top ceiling of the cabinet, and the bottom edge 208 of the separator 200 remains attached to a bottom inner wall of the cabinet 500, such that the flat surface 210 of the separator 200 remains perpendicular to the doors and the separator 200 remains attached to the case of the cabinet 500, independent of opening and closing of the doors of the cabinet 500.

[0036] Referring to FIG. 3, in yet another example embodiment, the separator 300 is a flat member having a curved front edge 304 with the top edge 306 parallel to the bottom edge 308, and the top edge 306 and bottom edge 308 being perpendicular to the rear edge 302. This separator 300 is configurable with semi-vertical type refrigerated display cabinets having curved doors (600) as shown in FIGs. 6A and 6B. Once the separator 300 is configured within the cabinet 600, the front curved edge 304 of the separator 300 remains in contact with and extends along the connecting region between the two adjacent curved doors of the cabinet 600, the rear edge 302 of the separator 300 remains attached to the front end of the shelves, the top edge 306 of the separator 300 remains attached to a top ceiling of the cabinet 600, and the bottom edge 308 of the separator 300 remains attached to a bottom inner wall of the cabinet 600, such that the flat surface 310 of the separator 300 remains perpendicular to the doors and the separator 300 remains attached to the case of the cabinet 600, independent of opening and closing of the doors of the cabinet 600.

[0037] Therefore, the separator (100, 200, 300) of this application can be easily configured between any type of refrigerated display cabinet including but not limited to a vertical refrigerated display cabinet 400, a semi-vertical refrigerated display cabinet with flat glass doors 500, and a semi-vertical refrigerated display cabinet with curved glass doors 600.

[0038] The separator (100, 200, 300) may be made of a material selected from, but not limited to plastic, glass, and acrylic. In particular, the separator (100, 200, 300) can be transparent so that the visibility of the products displayed on the shelves of the cabinet is not blocked. Further, the side walls of the case or cabinet may also made of the same material used for the doors, in particular, a transparent material or glass.

[0039] Referring to FIGs. 4A and 4B, an example embodiment of a vertical refrigerated display cabinet 400 (also referred to as vertical cabinet 400, hereinafter) of this application is disclosed. The vertical cabinet 400 includes a case 402 comprising one or more shelves 406-1 to 406-N (collectively referred to as shelves 406, herein) extending between the side walls of the case 402 and having a front end of the shelves 406 vertically in line with each other, thereby forming a conservation space 426 to support and store products therewithin. Further, multiple doors 404-1 to 404-N (collectively referred to as doors 404, herein) are movably coupled to the front of the case 402, and are adapted to move between an open position and a closed position. Each door 404 includes a coupled end 412 (also referred to as a hinged end or pivoted end) that is hinged or pivoted to the front of the case 502. Further, each door 404 includes a free end 410 (also referred to as a handle end) opposite the coupled end 412, where the handle 408 may be provided to allow a user to open or close the door 404. The vertical cabinet 400 is further configured with a refrigeration system to keep the conservation space 426 cold and create a recirculating air curtain between the front of the shelves and the vertical doors 404 of the cabinet 400. The vertical cabinet 400 includes at least one separator 100-1 to 100-N of FIG. 1 (collectively referred to as separator 100, herein) being removably configured between the front end of the shelves 406 and the rear end of the connecting region (at 410, 412) between two adjacent doors of the cabinet 400, such that the flat surface of each separator(s) 100 remains substantially perpendicular to the closed doors 404 of the cabinet 400 and the separator(s) 100 extends vertically from a top ceiling to a bottom inner wall of the cabinet 400, independent of opening and closing of the doors. For instance, as illustrated in FIG. 4A, one separator 100-1 may be configured behind the connecting region (at 410) between the handle end or free end 410 (where handle 408 is present) of the adjacent doors 404-1, 404-2. Similarly, another separator 100-2 may be configured behind the connecting region (at 412) between the hinged end or pivoted end 412 of the adjacent doors 404-2, 404-3. Similarly, other separators 100-3 to 100-N may also be placed in the cabinet 400.

[0040] In an embodiment, the cabinet 400 disclosed in FIGs. 4A and 4B includes the refrigeration system to maintain a predefined temperature in the conservation space 426 of the cabinet 400 and also create a recirculating air curtain in front of the shelves 406 or behind the doors 404 of the cabinet 400 in order to create an aerothermodynamic barrier between the conservation space 426 and environment. The refrigeration system includes a duct 414 extending from the bottom front side of the

cabinet 400 to the top front side of the cabinet 400 via a rear side of the cabinet 440. Further, an opening of the top front side of the duct 414 is configured with a discharge air grille (DAG) 420 and an opening of the bottom front side of the duct 414 is configured with a return air grille (RAG) 422. The DAG 420 and the RAG 422 control air directivity and facilitate the creation of the air curtain in front of the shelves 406 or behind the doors 404 of the cabinet 400. The DAG 420 and RAG 422 further restrict the entry of undesired objects within the duct 414. As illustrated, a first section 414-1 of the duct 414 extends horizontally from RAG 422 to the bottom rear side of the cabinet 400, a second section 414-2 of the duct 414 extends vertically from the bottom rear side to the top rear side of the cabinet 400, and a third section 414-3 of the duct extends horizontally from the top rear side to the DAG 420.

[0041] The refrigeration system further includes a cooling unit (comprising multiple components but collectively designated as 416, herein) configured within the duct 414 and operable to cool the air flowing through the duct 414 to the predefined temperature. Further, a fan 418 is positioned adjacent to the cooling unit 416 within the duct 414. The fan 418 is configured to facilitate the inflow of air within the duct 414 through the RAG 422, pass the received air through the cooling unit 416 that cools the received air, and pump out the cool air from the DAG 420 of the cabinet 400. Accordingly, the cool air pumped out by the DAG 420 (on the top front side of the cabinet) is received by the RAG 422 (on the bottom front side of the cabinet) to create a curtain of cool air in front of the shelves 406 or behind the doors 404 of the cabinet, which acts as an aerothermodynamic barrier between the conservation space 426 and environment. In addition, the second section 414-2 of the duct on the rear side of the cabinet 400 includes perforated wall panels (PWP) 424 behind the shelves 406, which discharge a portion of the cool air, passing through the duct 414-3, into the conservation space 426 to maintain the predefined temperature within the cabinet 400. It would be obvious to understand that the number of PWPs used in the cabinet can be selected based on the number of shelves, and the size and cooling capacity required in the cabinet.

[0042] Referring to FIGs. 5A and 5B, another example embodiment of a semi-vertical refrigerated display cabinet with flat doors 500 (also referred to as cabinet 500) of this application is disclosed. The cabinet 500 includes a case 502 comprising one or more shelves 506-1 to 506-N (collectively referred to as shelves 506, herein) extending between the side walls of the case 502 and having a front end of the shelves 506 extending in a step-wise manner from top to bottom of the cabinet 500, thereby forming a conservation space 526 to support and store products therewithin. Further, multiple doors, in particular, flat glass doors 504-1 to 504-N (collectively referred to as doors 504, herein) are movably coupled to the front of the case 502, which are adapted to move between an open position and a closed position. Each door 504 includes a coupled end 512 (hinged end or pivot end) that is hinged or pivotally coupled to the front of the case 502. Further, the free end 510 (handle end) of the door 504 may be provided with the handle 508 to allow a user to open or close the door. The cabinet 500 is also configured with a refrigeration system to keep the conservation space cold and create a recirculating air curtain in front of the inclined flat doors 504 of the cabinet 500. The cabinet 500 includes at least one separator 200-1 to 200-N of FIG. 2 (collectively referred to as separator 200, herein) being removably configured between the front end of the shelves 506 and the rear end of the connecting region (at 510, 512) between two adjacent inclined doors 504 of the cabinet 500, such that the flat surface of each separator(s) 200 remains substantially perpendicular to the closed doors 504 of the cabinet 500 and the separator(s) 200 extends vertically from a top ceiling to a bottom inner wall of the cabinet 500, independent of opening and closing of the doors 504. For instance, as illustrated in FIG. 5A, one separator 200-1 may be configured behind the connecting region (at 510) between the handle end or free end 510 of the adjacent doors 504-1, 504-2. Similarly, another separator 200-2 may be configured behind the connecting region (at 512) between the hinged end or pivoted end 512 of the adj acent doors. Similarly, other separators 200-3 to 200-N may also be placed in the cabinet 500.

[0043] The doors 404, 504 of the cabinet 400, 500 of FIGs. 4A and 5A may be movably coupled to the front of the cabinet 400, 500 using hinged coupling and/or pivot coupling means, but not limited to the like. In an implementation, (not shown) the top end and bottom end of a first vertical side (at the coupled end) of the door 404, 504 may be pivotally configured in slots provided at the top ceiling and the bottom inner wall, respectively of the cabinet 400, 500. Further, a second vertical side (opposite to the first side) (at the free end or handle end) of the door may be provided with the handle 408, 508 to allow the user to pivotally move the door 404, 504 around an axis extending along the first vertical side of the door 404, 504. In another implementation, (not shown) longitudinal members may be provided in front of the door 404, 504, which may extend between the top ceiling and bottom inner wall of the cabinet 400, 500. Further, the first vertical side of the door 404, 504 may be hingedly coupled to the longitudinal member using hinges and the second vertical side of the door 404, 504 may be provided with the handle 408, 508 to allow the user to pivotally move the door 404, 504 around an axis extending along the first vertical side of the door 404, 504.

[0044] In an embodiment, the cabinet 500 of FIGs. 5A and 5B includes the refrigeration system to maintain a predefined temperature in the conservation space 526 of the cabinet 500 and also create a recirculating air curtain in front of the shelves 504 or behind the doors 504 of the cabinet 500 in order to create an aerothermodynamic barrier between the conservation space 526 and environment. The refrigeration system includes a duct

514 extending from the bottom front side of the cabinet 500 to the top front side of the cabinet 500 via a rear side of the cabinet 450. Further, an opening of the top front side of the duct 514 is configured with a discharge air grille (DAG) 520 and an opening of the bottom front side of the duct 514 is configured with a return air grille (RAG) 522. The DAG 520 and the RAG 522 control air directivity and facilitate the creation of the air curtain in front of the shelves 506 or behind the doors 504 of the cabinet 500. The DAG 520 and RAG 522 further restrict the entry of undesired objects within the duct 514. As illustrated, a first section 514-1 of the duct 514 extends horizontally from RAG 522 to the bottom rear side of the cabinet 500, a second section 514-2 of the duct 514 extends vertically from the bottom rear side to the top rear side of the cabinet 500, and a third section 514-3 of the duct extends horizontally from the top rear side to the DAG 520.

[0045] The refrigeration system further includes a cooling unit (comprising multiple components but collectively designated as 516, herein) configured within the duct 514 and operable to cool the air flowing through the duct 514 to the predefined temperature. Further, a fan 518 is positioned adjacent to the cooling unit 516 within the duct 514. The fan 518 is configured to facilitate the inflow of air within the duct 514 through the RAG 522, pass the received air through the cooling unit 516 that cools the received air, and pump out the cool air from the DAG 520 of the cabinet 500. Accordingly, the cool air pumped out by the DAG 520 (on the top front side of the cabinet) is received by the RAG 522 (on the bottom front side of the cabinet) to create a curtain of cool air in front of the shelves 506 or behind the doors 504 of the cabinet, which acts as an aerothermodynamic barrier between the conservation space 526 and environment. In addition, the second section 514-2 of the duct on the rear side of the cabinet 500 includes perforated wall panels (PWP) 525 behind the shelves 504, which discharge a portion of the cool air, passing through the duct 514-3, into the conservation space 526 to maintain the predefined temperature within the cabinet 500.

[0046] Referring to FIGs. 6A and 6B, an example of a semi-vertical refrigerated display cabinet with curved doors 600 (also referred to as cabinet 600, herein) is disclosed. The cabinet 600 includes a case 602 comprising one or more shelves 606-1 to 606-N (collectively referred to as shelves 606, herein) extending between the side walls of the case 602 and having a front end of the shelves 606 extending in a step-wise manner from top to bottom of the cabinet 600, thereby forming a conservation space 626 to support and store products therewithin. Further, multiple curved doors, in particular, curved glass doors 604-1 to 604-N (collectively referred to as doors 604, herein) are slidably coupled to the front of the case 602, which are adapted to move between an open position and a closed position. Each door 604 is provided with at least one handle 608 that allows the user to slide the door 604 to open or close the cabinet 600 as required. The cabinet 600 is also configured with a refrigeration system to keep the conservation space cold and create a recirculating air curtain in front of the inclined curved doors 604 of the cabinet 600. The cabinet 600 includes at least one separator 300-1, 300-2 of FIG. 3 (collectively referred to as separator 300, herein) being removably configured between the front end of the shelves 606 and the rear end of the connecting region (at 610, 612) between two adjacent curved doors 604 of the cabinet 600, such that the flat surface of each separator(s) 300 remains substantially perpendicular to the closed doors 604 of the cabinet 600 and the separator(s) 300 extends vertically from a top ceiling to a bottom inner wall of the cabinet 600, independent of opening and closing of the doors. For instance, as illustrated in FIG. 6A, one separator 300-1 may be configured behind the connecting region (at 610) between a handle end and a non-handle end of the adjacent doors 604-1, 604-2. Similarly, another separator 300-2 may be configured behind the connecting (at 612) region between the handle end and non-handle ends of the adjacent doors 604-2, 604-N.

[0047] The doors 604 of the cabinet 600 of FIG. 6A may be slidably coupled to the front of the cabinet 600. In an implementation, (not shown) channels (or brackets or guide rails) may be provided in front of the case 602, which may extend horizontally along the top front end, and bottom front end of the case 602. The channels may be provided with ball bearings and the top and bottom sides of the curved glass doors 604 may be slidably configured in the channels on the top front end, and bottom front end of the case 602. Further, the handle 608 may be provided on one of the vertical sides of the curved glass door 604 to allow users to open or close the cabinet 600 as required.

[0048] In an embodiment, the cabinet 600 disclosed in FIGs. 6A and 6B includes the refrigeration system to maintain a predefined temperature in the conservation space 626 of the cabinet 600 and also create a recirculating air curtain in front of the shelves 604 or behind the doors 604 of the cabinet 600 in order to create an aerothermodynamic barrier between the conservation space 626 and environment. The refrigeration system includes a duct 614 extending from the bottom front side of the cabinet 600 to the top front side of the cabinet 600 via a rear side of the cabinet 600. Further, an opening of the top front side of the duct 614 is configured with a discharge air grille (DAG) 620 and an opening of the bottom front side of the duct 614 is configured with a return air grille (RAG) 622. The DAG 620 and the RAG 622 control air directivity and facilitate the creation of the air curtain in front of the shelves 606 or behind the doors 604 of the cabinet 600. The DAG 620 and RAG 622 further restrict the entry of undesired objects within the duct 614. As illustrated, a first section 614-1 of the duct 614 extends horizontally from RAG 622 to the bottom rear side of the cabinet 600, a second section 614-2 of the duct 614 extends vertically from the bottom rear side to the top rear side of the cabinet 600, and a third section 614-3 of the duct extends horizontally from the top rear side to the

DAG 620.

[0049] The refrigeration system further includes a cooling unit (comprising multiple components but collectively designated as 616, herein) configured within the duct 614 and operable to cool the air flowing through the duct 614 to the predefined temperature. Further, a fan 618 is positioned adjacent to the cooling unit 616 within the duct 614. The fan 618 is configured to facilitate the inflow of air within the duct 614 through the RAG 622, pass the received air through the cooling unit 616 that cools the received air, and pump out the cool air from the DAG 620 of the cabinet 600. Accordingly, the cool air pumped out by the DAG 622 (on the top front side of the cabinet) is received by the RAG 622 (on the bottom front side of the cabinet) to create a curtain of cool air in front of the shelves 606 or behind the doors 604 of the cabinet, which acts as an aerothermodynamic barrier between the conservation space 626 and environment. In addition, the second section 614-2 of the duct on the rear side of the cabinet 600 includes perforated wall panels (PWP) 624 behind the shelves 604, which discharge a portion of the cool air, passing through the duct 614-3, into the conservation space 626 to maintain the predefined temperature within the cabinet 600. It would be obvious to understand that the number of PWPs used in the cabinet can be selected based on the number of shelves, and the size and cooling capacity required in the cabinet.

[0050] An evaporator (not shown) which is part of the cooling unit (416, 516, 616) used in cabinets (400, 500, 600) is provided at the bottom of the cabinet (400, 500, 600) below the conservation space (426, 526, 626). Additional components of the cooling unit (416, 516, 616), such as a compressor, a condenser, and an expansion device (not shown) may be provided within the cabinet (400, 500, 600) as well, e.g. in a bottom section of the cabinet (400, 500, 600). Alternatively, one or more of these components, in particular, the compressor and/or the condenser, may be located outside the cabinet (400, 500, 600), for example in a machine room or on the outside/on the roof of a building (not shown) housing the cabinet (400, 500, 600).

[0051] In addition, the refrigeration system includes at least one mullion (not shown) that may extend substantially along a vertical axis between the top and bottom ends of the front of the case (402, 502, 602). A refrigerant conduit fluidly connects the condenser with the expansion device of the cooling unit (416, 516, 616) and passes through the mullion. In particular, upper and lower sections of the refrigerant conduit extend through the top and bottom ends of the front of the case (402, 502, 602), respectively. The refrigerant flowing through the refrigerant conduit upstream of the expansion device is relatively warm, in particular, warmer than the refrigerant flowing through the evaporator which is arranged downstream of the expansion device. Thus, the refrigerant flowing through the refrigerant conduit increases the temperature of the front frame. This reduces the risk that undesired condensate forms on the outer front surfaces of the cabinet which are exposed to ambient air.

[0052] Further, the refrigeration system includes the return air duct (414-1, 514-1, 614-1) (first section of the duct) that extends substantially along a horizontal axis and is formed below the lowest shelf of the cabinet (400, 500, 600). The return air duct (414-1, 514-1, 614-1) is fluidly connected to an inlet side of the evaporator, which is the right side of the evaporator in the exemplary configuration shown in FIGs 4B, 5B, and 6B. The return air duct (414-1, 514-1, 614-1) houses the fan (418, 518, 618) that is configured to suck air from the conservation space through a return air opening located at the bottom of the conservation space (426, 526, 626) into the return air duct (414-1, 514-1, 614-1) and deliver the received air to the evaporator where it is cooled. The return air opening is covered by RAG (422, 522, 622) which prevents the products from falling into the return air duct (414-1, 514-1, 614-1).

[0053] Cooled air leaving the evaporator is delivered into the vertical cold air duct (414-2, 514-2, 614-2) (second section of the duct) extending vertically along the rear wall of the cabinet (400, 500, 600). The vertical cold air duct (414-2, 514-2, 614-2) is provided with perforated wall panels (424, 524, 624) having openings that allow cold air to flow from the vertical cold air duct (414-2, 514-2, 614-2) into the conservation space (426, 526, 626).

[0054] The horizontal cold air duct (414-3, 514-3, 614-3) (third section of the duct) is fluidly connected with an upper end of the vertical cold air duct (414-2, 514-2, 614-2) in order to deliver cold air from the vertical cold air duct (414-2, 514-2, 614-2) to the front side of the conservation space (426, 526, 626). A front end of the horizontal cold air duct (414-3, 514-3, 614-3) is provided with an air discharge opening fitted with the DAG (420, 520, 620), which is configured to discharge cold air from the horizontal cold air duct (414-3, 514-3, 614-3) into an upper front area of the conservation space (426, 526, 626). The cold air that is discharged through the DAG (420, 520, 620) into the upper front area of the conservation space (426, 526, 626) provides a flow of cold air, creating a cold air curtain flowing substantially along the back of the doors (404, 504, 604) and front of the shelves (406, 506, 606) from the top to the bottom of the conservation space (426, 526, 626).

[0055] As already explained in the background of this application, when doors of existing cabinets are closed, an air curtain is created behind the closed doors along the surface of the doors. Further, when the doors of the existing cabinets are opened, an air curtain is created along the front ends of the shelves. As a result, when one of the doors of the existing cabinets is opened, the air curtain along a connecting region between the open door and a neighboring closed door becomes unstable. The unstable air curtain between the closed and open doors of the cabinet causes cold air to spill out from the conservation space of the cabinet behind the adjacent closed doors and also causes outside air to infiltrate into

the conservation space of the cabinet behind the adjacent closed doors, which contributes to additional energy consumption by the refrigerated cabinet to keep the inner storage space of the cabinet cold, thereby making the existing cabinets inefficient.

[0056] To overcome the above drawbacks, shortcomings, and limitations associated with existing cabinets, the separator(s) (cabinet illustrated in FIGs. 4A to 6B) is configured at the unstable air curtain region i.e. the connecting region between adjacent doors in the cabinet. As a result, the separator(s) restricts infiltration of outside air in the conservation space behind adjacent closed doors of the corresponding cabinet and also restricts spillage of cold air from the cabinet during the opening of at least one of the doors of the cabinet. Thus, the energy consumption or requirement of the cabinets is also reduced, thereby making the cabinets energy efficient compared to existing cabinets.

[0057] Besides, as the separator(s) extends between the front of the shelves to the back of the doors and from the top ceiling to the bottom inner wall in the cabinet of this application, the conservation space along each of the shelves remains unobstructed and unpartitioned, which allows users to efficiently utilize the conservation space without any obstruction from the separator(s).

[0058] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention as defined by the appended claims. Modifications may be made to adopt a particular situation or material to the teachings of the invention without departing from the scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed, but that the invention includes all embodiments falling within the scope of the invention as defined by the appended claims.

[0059] In interpreting the specification, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "comprises" and "comprising" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. Where the specification claims refer to at least one of something selected from the group consisting of A, B, C ....and N, the text should be interpreted as requiring only one element from the group, not A plus N, or B plus N, etc.

[0060] The following clauses set out features of the invention which may not presently be claimed in this application, but which may form the basis for future amendment or a divisional application.

1. An aerothermodynamic separator for a refrigerated display cabinet, the separator comprising:

a flat member having a predetermined dimension defining a shape of the separator, wherein:

the separator is adapted to be removably positioned between a front end of one or more shelves associated with the cabinet and a rear end of a connecting region between two adjacent doors of the cabinet, and

the separator is adapted to restrict infiltration of outside air in a conservation space behind the closed doors of the cabinet upon opening at least one of the adjacent doors.

2. The separator of clause 1, wherein the connecting region is a free end of one of the adjacent doors and the free end is used to open the door.

3. The separator of clause 1, wherein the connecting region is a hinged end or pivot end of one of the adjacent doors.

4. The separator of clause 1, wherein the separator is made of a transparent material.

5. The separator of clause 1, wherein the separator is made of one or more of plastic, acrylic, and glass.

6. The separator of clause 1, wherein the cabinet is a vertical refrigerated display cabinet with glass doors, wherein the separator is a flat rectangular member comprising a front edge in contact with and extending along the connecting region between the two adjacent doors of the cabinet, a rear edge attached to the front end of the one or more shelves, a top edge attached to a top inner wall of the cabinet, and a bottom edge attached to a bottom inner wall of the cabinet.

7. The separator of clause 1, wherein the cabinet is a semi-vertical refrigerated display cabinet with flat glass doors, wherein the separator comprises a front edge in contact with and extending along the connecting region between the two adjacent doors of the cabinet, a rear edge attached to the front end of each of the shelves, a top edge attached to a top inner wall of the cabinet, and a bottom edge attached to a bottom inner wall of the cabinet.

8. The separator of clause 1, wherein the cabinet is a semi-vertical refrigerator display cabinet with curved glass doors, wherein the separator comprises a curved front edge that remains in contact with and extends along the connecting region between the two adjacent curved doors of the cabinet, a rear edge attached to the front end of each of the one or more shelves, a top edge attached to a top inner wall of the cabinet, and a bottom edge attached to a bottom inner wall of the cabinet.

9. The separator of clause 1, wherein a flat surface of the separator is oriented substantially perpendicular to the closed doors of the cabinet and is extending vertically from top to bottom of the cabinet.

10. A refrigerated display cabinet comprising:

a case comprising one or more shelves extending between side walls of the case to form a conservation space to support and store one or more products therewithin;
two or more doors movably coupled to a front of the case and adapted to move between an open position and a closed position; and
at least one separator positioned between a front end of the one or more shelves and a rear end of a connecting region between two doors among the two or more doors,
wherein the separator restricts infiltration of outside air in the conservation space behind the closed doors of the cabinet upon opening at least one of the adjacent doors.

11. The refrigerated display cabinet of clause 10, wherein the at least one separator is positioned behind the connecting region at a free end of one of the two doors, wherein the free end is used to open the door.
12. The refrigerated display cabinet of clause 10, wherein the at least one separator is positioned behind the connecting point at a hinged end or pivot end of one of the two doors.
13. The refrigerated display cabinet of clause 10, wherein the cabinet comprises a refrigeration system that is configured to maintain a predefined temperature in the conservation space of the cabinet.
14. The refrigerated display cabinet of clause 13, wherein the refrigeration system is configured to create a recirculating air curtain in front of the one or more shelves or behind the doors of the cabinet, the air curtain is configured to create an aerothermodynamic barrier between the conservation space of the cabinet and environment.
15. The refrigerated display cabinet of clause 14, wherein the refrigeration system comprises:

a duct extending from a bottom front side of the cabinet to a top front side of the cabinet via a rear side of the cabinet;
a cooling unit configured within the duct and operable to cool the air flowing through the duct to the predefined temperature; and
a fan positioned adjacent to the cooling unit within the duct, the fan configured to facilitate inflow of air within the duct through the bottom front side of the cabinet, pass the received air through the cooling unit that cools the received air, and pump out the cool air from the top front side of the cabinet,
wherein the cool air pumped out by the top front side of the cabinet is received by the bottom front side of the cabinet such that the air curtain is formed in front of the one or more shelves or behind the doors of the cabinet.

16. The refrigerated display cabinet of clause 10, wherein the top front side of the duct is configured with a discharge air grille (DAG) and the bottom front side of the duct is configured with a return air grille (RAG), wherein the DAG and the RAG control air directivity and facilitates the creation of the air curtain in front of the one or more shelves or behind the doors of the cabinet.
17. The refrigerated display cabinet of clause 10, wherein the cabinet comprises a perforated wall panel (PWP) configured with the duct on the rear side of the cabinet, the PWP is configured to discharge a portion of the cool air, passing through the duct, in the conservation space to maintain the predefined temperature therewithin.
18. The refrigerated display cabinet of clause 10, wherein the cabinet is a vertical refrigerator display cabinet having a front end of the one or more shelves vertically in line with each other.
19. The refrigerated display cabinet of clause 10, wherein the cabinet is a semi-vertical refrigerator display cabinet having a front end of the one or more shelves extending in a step-wise manner from a top end to a bottom end of the cabinet.
20. The refrigerated display cabinet of clause 10, wherein a flat surface of the at least one separator is oriented substantially perpendicular to the closed doors of the cabinet and is extending vertically from a top end to a bottom end of the cabinet.

Claims

1. An aerothermodynamic separator (100; 200; 300) for a refrigerated display cabinet (400; 500; 600), the separator comprising:
a flat member having a predetermined dimension defining a shape of the separator, wherein:

the separator is adapted to be removably positioned between a front end of one or more shelves (406; 506; 606) associated with the cabinet and a rear end of a connecting region between two adjacent doors (404; 504; 604) of the cabinet, and
the separator is adapted to restrict infiltration of outside air in a conservation space (426; 526; 626) behind the closed doors of the cabinet upon opening at least one of the adjacent doors.

2. The separator of claim 1, wherein the separator (100; 200; 300) is made of a transparent material, optionally wherein the separator is made of one or more of plastic, acrylic, and glass.

3. A refrigerated display cabinet (400; 500; 600) comprising one or more shelves (406; 506; 606) and two adjacent doors (404; 504; 604), and a separator

(100; 200; 300) according to claim 1 or 2.

4. The refrigerated display cabinet of claim 3,

wherein the connecting region is a free end of one of the adjacent doors (404; 504; 604) and the free end is used to open the door,
and/or wherein the connecting region is a hinged end or pivot end of one of the adjacent doors.

5. The refrigerated display cabinet of any preceding claim,

wherein the cabinet is a vertical refrigerated display cabinet (400) with glass doors (404), wherein the separator (100) is a flat rectangular member comprising a front edge (104) in contact with and extending along the connecting region between the two adjacent doors of the cabinet, a rear edge (102) attached to the front end of the one or more shelves (406), a top edge (106) attached to a top inner wall of the cabinet, and a bottom edge (108) attached to a bottom inner wall of the cabinet,
or wherein the cabinet is a semi-vertical refrigerated display cabinet (500) with flat glass doors (504), wherein the separator (200) comprises a front edge (204) in contact with and extending along the connecting region between the two adjacent doors of the cabinet, a rear edge (202) attached to the front end of each of the shelves (506), a top edge (206) attached to a top inner wall of the cabinet, and a bottom edge (208) attached to a bottom inner wall of the cabinet.

6. The refrigerated display cabinet of any of claims 1 to 4, wherein the cabinet is a semi-vertical refrigerator display cabinet (600) with curved glass doors (604), wherein the separator (300) comprises a curved front edge (304) that remains in contact with and extends along the connecting region between the two adjacent curved doors of the cabinet, a rear edge (302) attached to the front end of each of the one or more shelves, a top edge (306) attached to a top inner wall of the cabinet, and a bottom edge (308) attached to a bottom inner wall of the cabinet.

7. The refrigerated display cabinet of any preceding claim, wherein a flat surface of the separator (100; 200; 300) is oriented substantially perpendicular to the closed doors (404; 505; 604) of the cabinet (400; 500; 600) and is extending vertically from top to bottom of the cabinet.

8. A refrigerated display cabinet (400; 500; 600) comprising:

a case (402; 502; 602) comprising one or more shelves (406; 506; 606) extending between side walls of the case to form a conservation space (426; 626; 626) to support and store one or more products therewithin;
two or more doors (404; 504; 604) movably coupled to a front of the case and adapted to move between an open position and a closed position; and
at least one separator (100; 200; 300) as claimed in claim 1 or 2 positioned between a front end of the one or more shelves and a rear end of a connecting region between two doors among the two or more doors,
wherein the separator restricts infiltration of outside air in the conservation space behind the closed doors of the cabinet upon opening at least one of the adjacent doors.

9. The refrigerated display cabinet of claim 8,

wherein the at least one separator (100; 200; 300) is positioned behind the connecting region at a free end of one of the two doors (404; 504; 604), wherein the free end is used to open the door,
and/or wherein the at least one separator is positioned behind the connecting region at a hinged end or pivot end of one of the two doors.

10. The refrigerated display cabinet of claim 8 or 9, wherein the cabinet (400; 500; 600) comprises a refrigeration system that is configured to maintain a predefined temperature in the conservation space (426; 526; 626) of the cabinet.

11. The refrigerated display cabinet of claim 10, wherein the refrigeration system is configured to create a recirculating air curtain in front of the one or more shelves (406; 506; 606) or behind the doors (404; 504; 604) of the cabinet (400; 500; 600), the air curtain is configured to create an aerothermodynamic barrier between the conservation space (426; 526; 626) of the cabinet and environment.

12. The refrigerated display cabinet of claim 10 or 11, wherein the refrigeration system comprises:

a duct (414; 514; 614) extending from a bottom front side of the cabinet to a top front side of the cabinet via a rear side of the cabinet (400; 500; 600);
a cooling unit (416; 516; 616) configured within the duct and operable to cool the air flowing through the duct to the predefined temperature; and
a fan (418; 518; 618) positioned adj acent to the cooling unit within the duct, the fan configured to facilitate inflow of air within the duct through

the bottom front side of the cabinet, pass the received air through the cooling unit that cools the received air, and pump out the cool air from the top front side of the cabinet,
wherein the cool air pumped out by the top front side of the cabinet is received by the bottom front side of the cabinet such that the air curtain is formed in front of the one or more shelves (406; 506; 606) or behind the doors of the cabinet (404; 505; 604).

13. The refrigerated display cabinet of claim 12,

wherein the top front side of the duct (414; 514; 614) is configured with a discharge air grille (420; 520; 620) and the bottom front side of the duct is configured with a return air grille (422; 522; 622), wherein the discharge air grille and the return air grille control air directivity and facilitates the creation of the air curtain in front of the one or more shelves (406; 506; 606) or behind the doors (404; 504; 604) of the cabinet,
and/or wherein the cabinet comprises a perforated wall panel (424; 525; 624) configured with the duct on the rear side of the cabinet, the perforated wall panel is configured to discharge a portion of the cool air, passing through the duct, in the conservation space to maintain the predefined temperature therewithin.

14. The refrigerated display cabinet of any of claims 8 to 13,

wherein the cabinet is a vertical refrigerator display cabinet (400) having a front end of the one or more shelves (406) vertically in line with each other,
or wherein the cabinet is a semi-vertical refrigerator display cabinet (500) having a front end of the one or more shelves (506) extending in a step-wise manner from a top end to a bottom end of the cabinet.

15. The refrigerated display cabinet of any of claims 8 to 14, wherein a flat surface of the at least one separator (100; 200; 300) is oriented substantially perpendicular to the closed doors (404; 504; 604) of the cabinet (400; 500; 600) and is extending vertically from a top end to a bottom end of the cabinet.

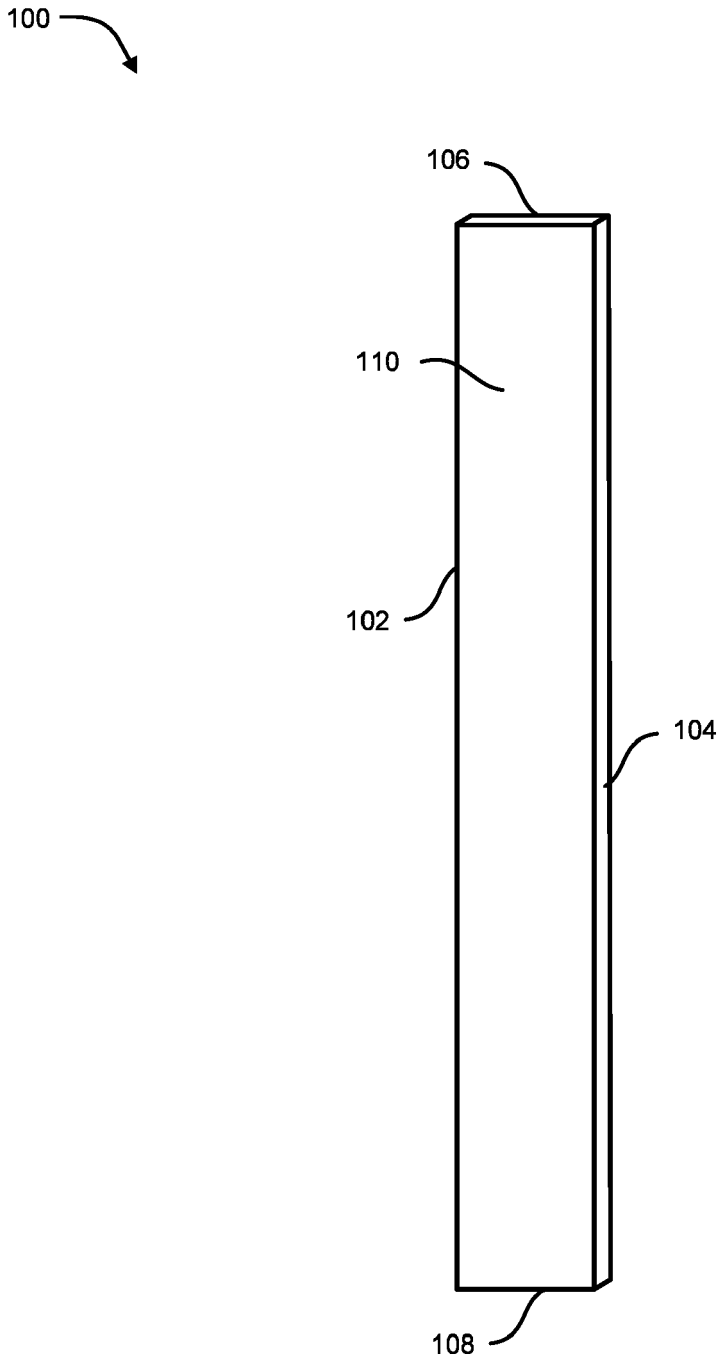


FIG. 1

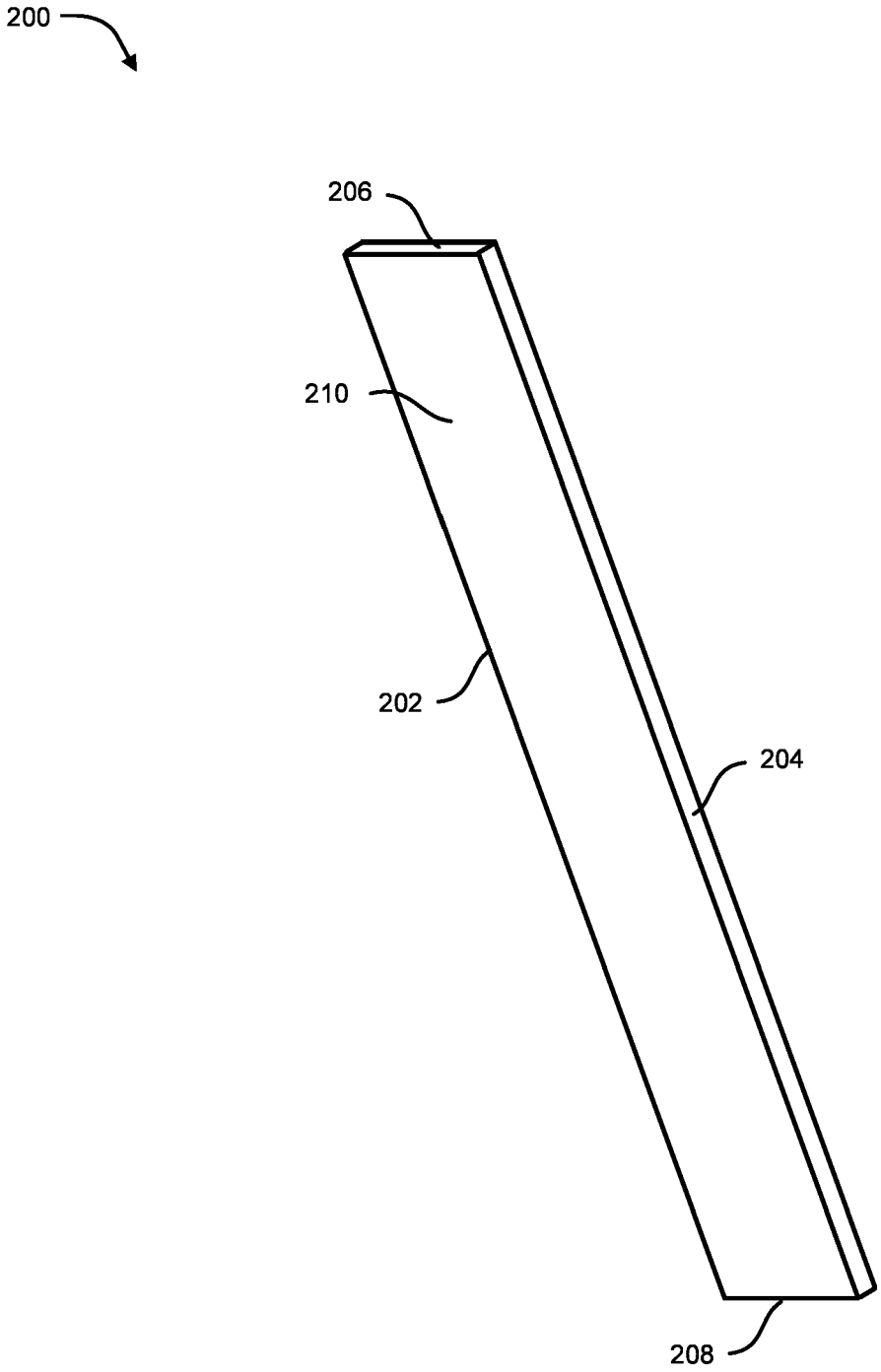


FIG. 2

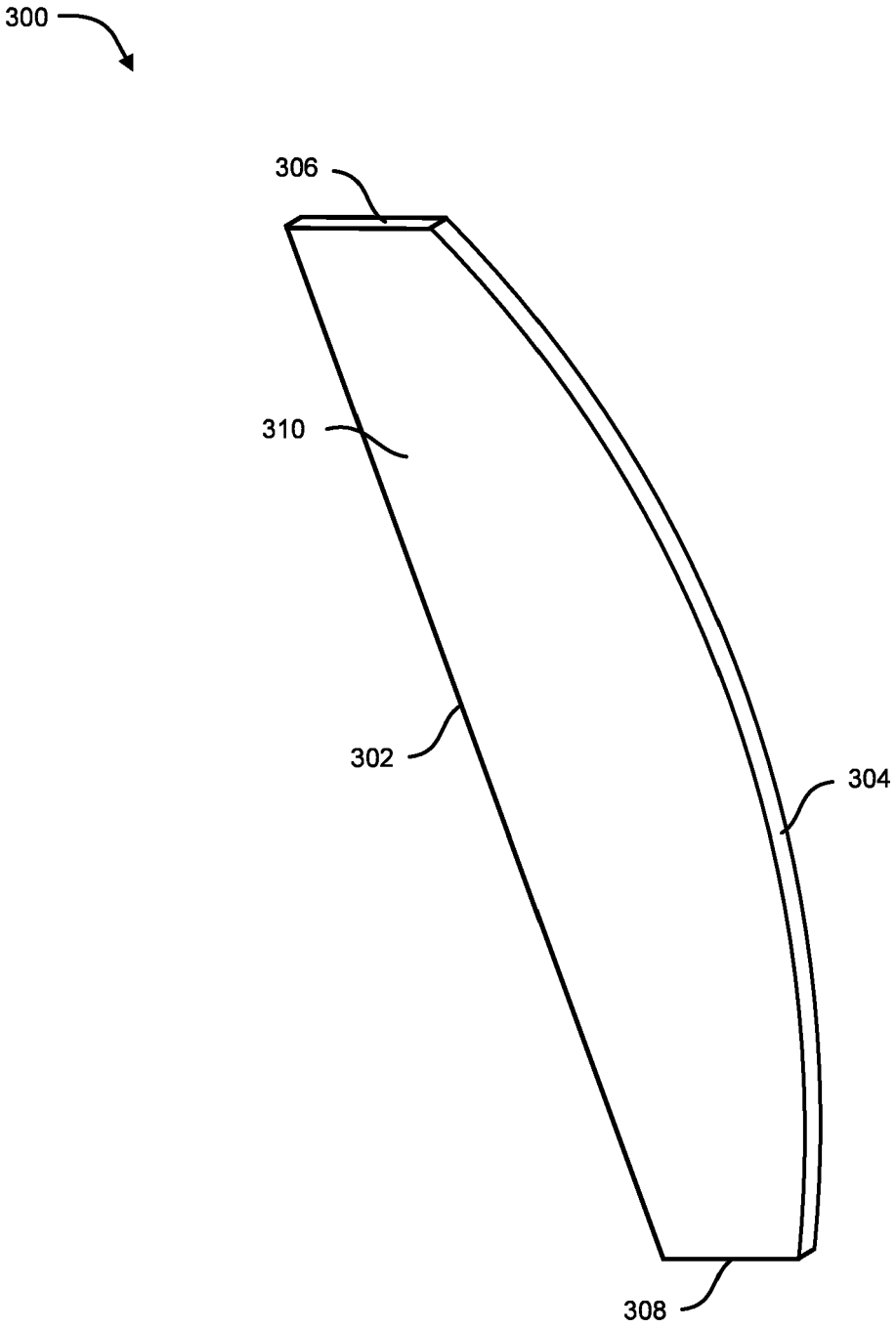


FIG. 3

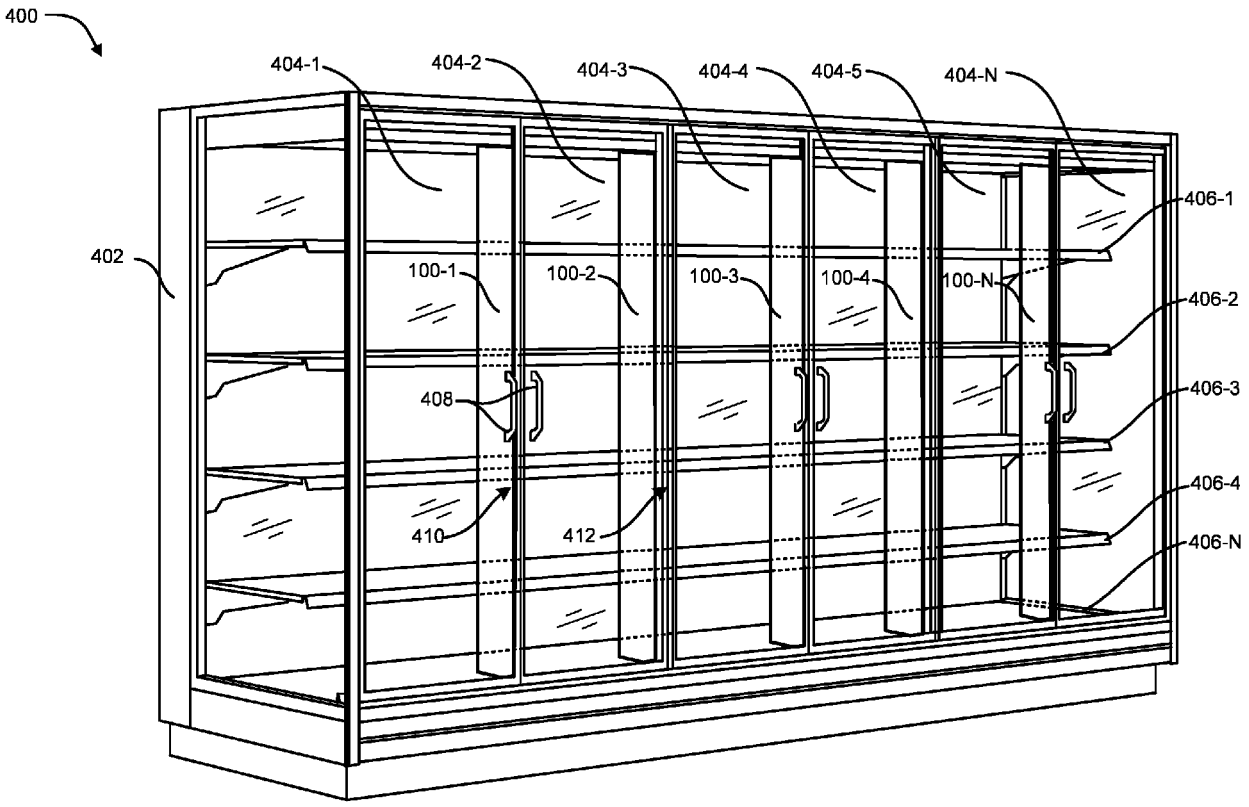

400
404-1
404-2
404-3
404-4
404-5
404-N
406-1
402
100-1
100-2
100-3
100-4
100-N
406-2
408
406-3
406-4
410
412
406-N

FIG. 4A

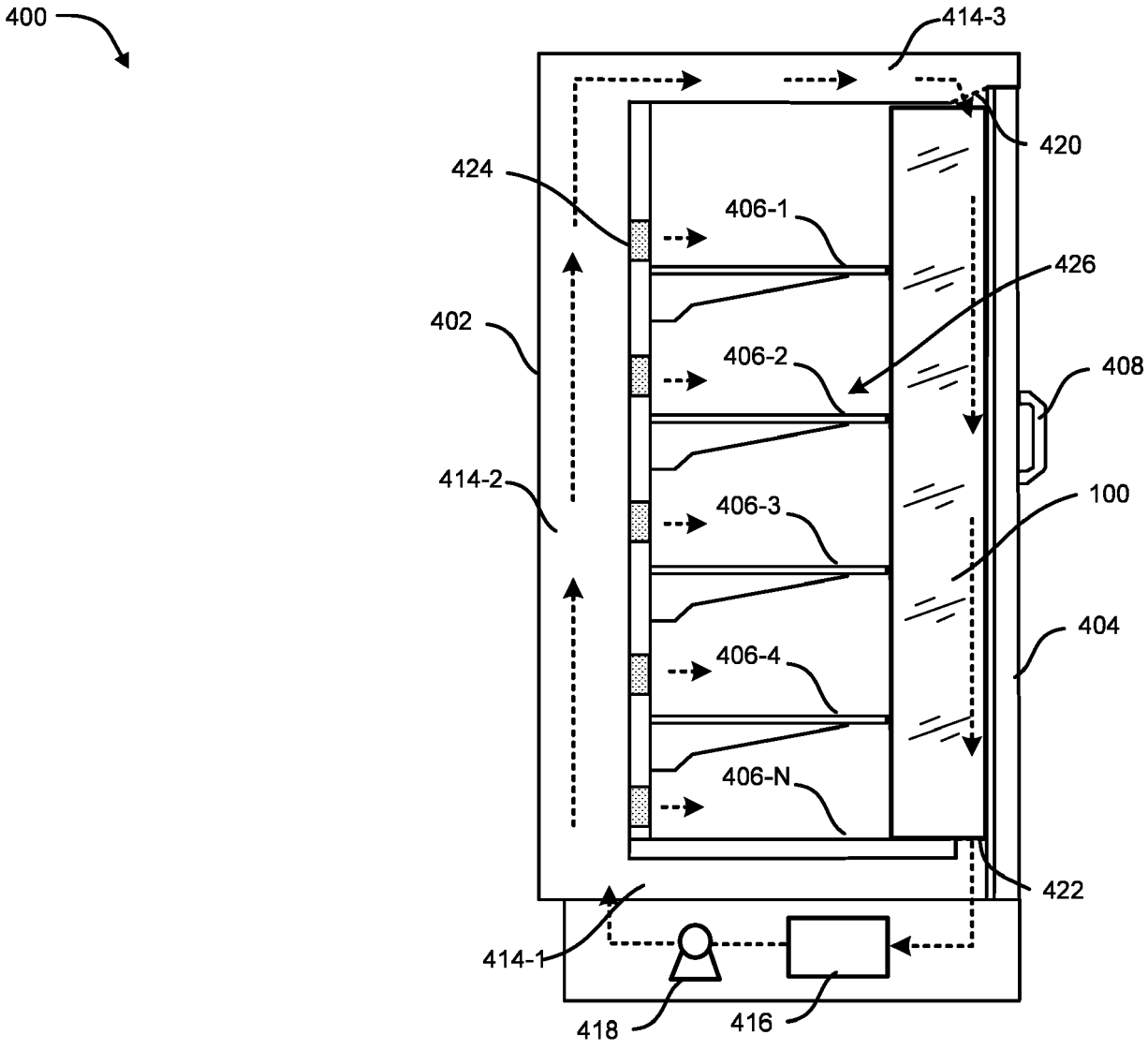

400
414-3
420
424
406-1
426
402
406-2
408
414-2
406-3
100
404
406-4
406-N
422
414-1
418
416

FIG. 4B

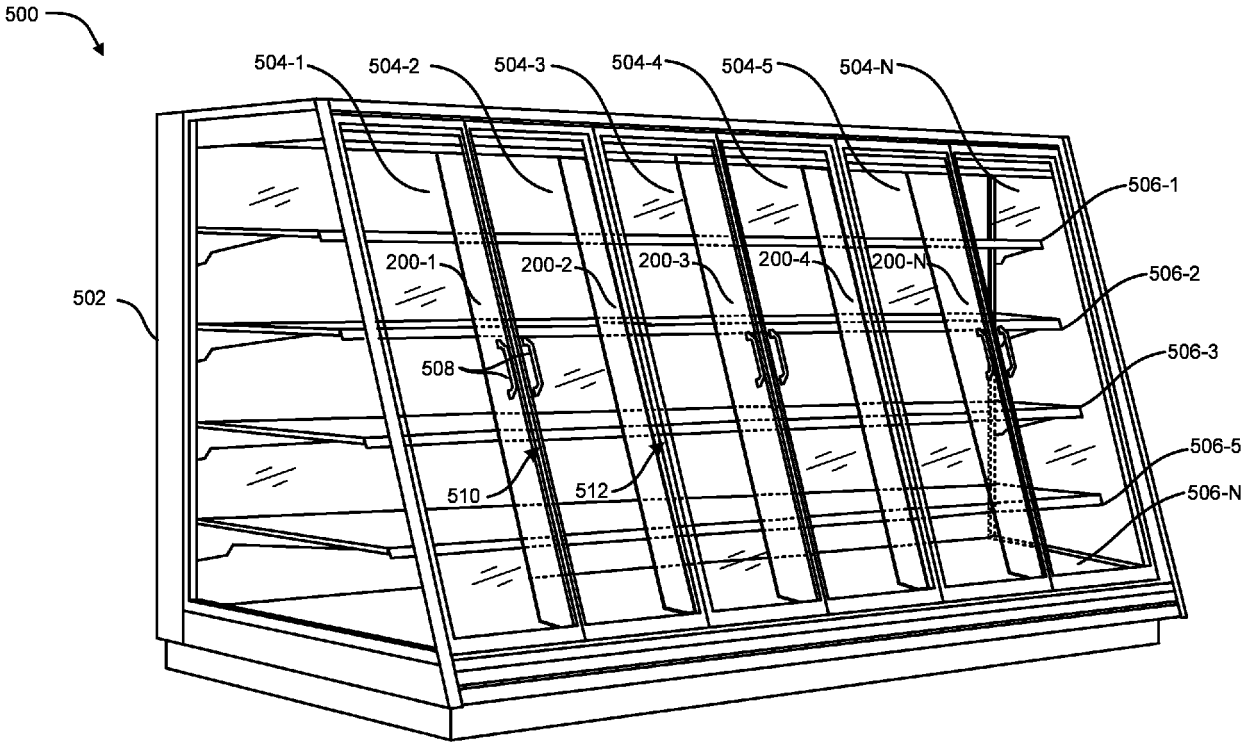

500
504-1
504-2
504-3
504-4
504-5
504-N
506-1
506-2
506-3
506-5
506-N
502
200-1
200-2
200-3
200-4
200-N
508
510
512

FIG. 5A

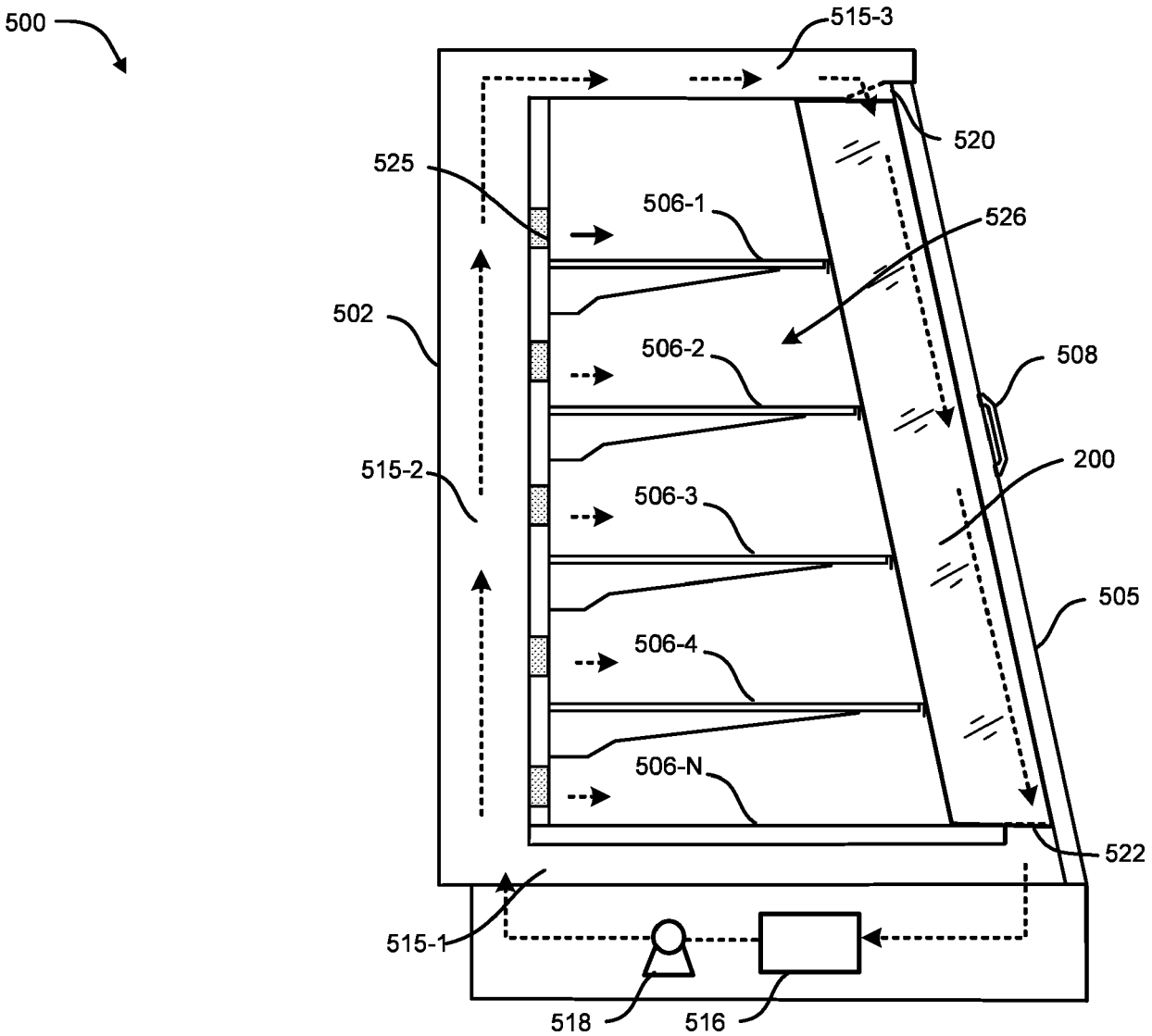

500
515-3
520
525
506-1
526
502
506-2
508
515-2
506-3
200
505
506-4
506-N
522
515-1
518
516

FIG. 5B

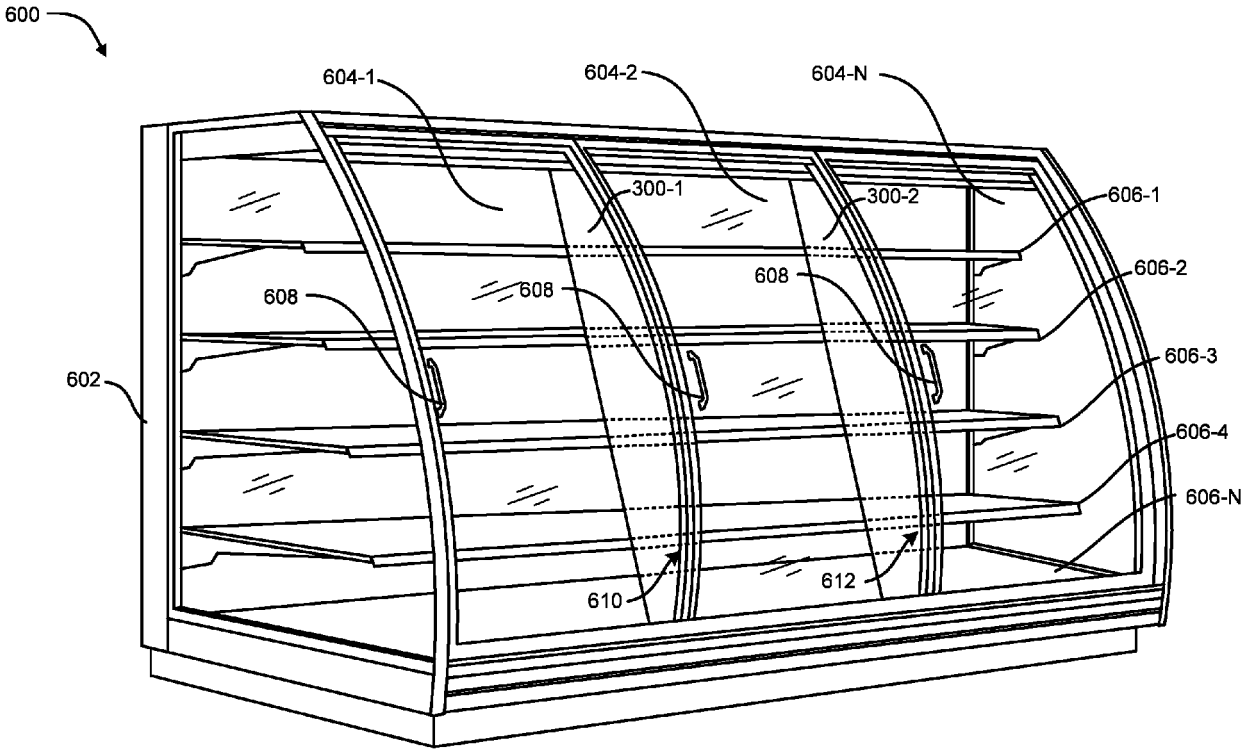

600
604-1
604-2
604-N
300-1
300-2
606-1
606-2
606-3
606-4
606-N
608
608
608
602
610
612

FIG. 6A

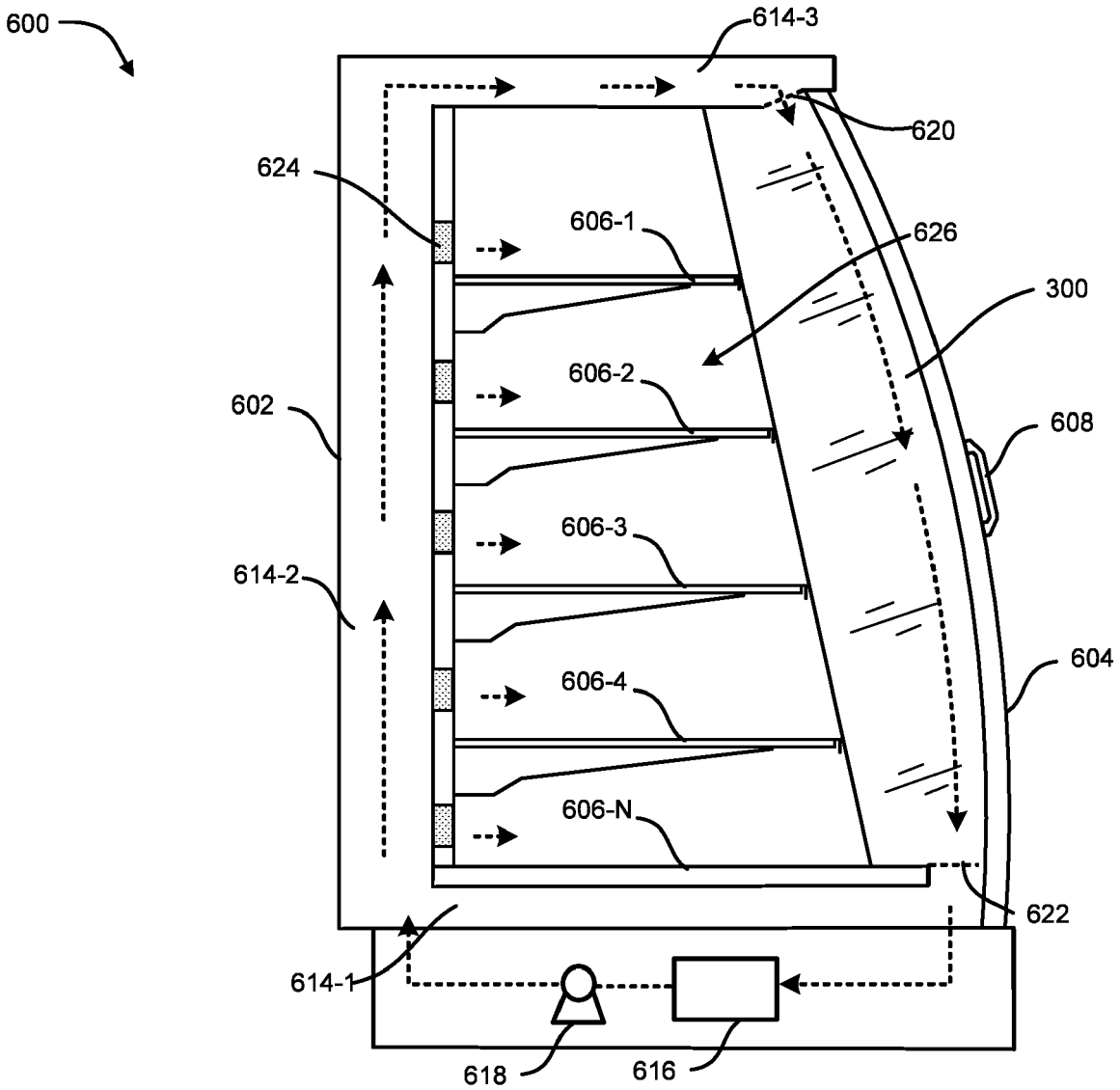

600
614-3
620
624
606-1
626
300
606-2
602
608
606-3
614-2
606-4
604
606-N
622
614-1
618
616

FIG. 6B

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 23 19 6381

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	EP 3 437 524 A1 (SAVENCIA SA [FR]) 6 February 2019 (2019-02-06) * paragraphs [0067], [0075]; figures 6,4,5a *	1-4,7-15 5,6	INV. A47F3/04
X Y	JP 2005 304927 A (NAKANO REITOKI SEISAKUSHO) 4 November 2005 (2005-11-04) * paragraph [0011]; figures 1,2,5 *	1,2 3,4,7-15	
Y	US 4 369 631 A (ABRAHAM FAYEZ F) 25 January 1983 (1983-01-25) * figure 1A *	3,4,7-15	
X	GB 2 555 227 A (AEROFOIL ENERGY LTD [GB]) 25 April 2018 (2018-04-25) * figure 4 *	1-4,8-14	

TECHNICAL FIELDS SEARCHED (IPC)

A47F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 January 2024	Martinez Valero, J

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