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# (54) DEVICE FOR AIR INLET OF REFRIGERATED DISPLAY CABINETS TO COLLECT PARTICULATES, OBJECTS, AND LIQUIDS

(57) A device (200) implemented at an air inlet of a refrigerated display cabinet (100) is disclosed. The device (200) comprises a housing (202) comprising one or more inlets (204), and an air filter (206) configured with a first wall (202-1) of the housing (202). The housing (202) is adapted to be fitted at an air inlet (114-1) of the cabinet (100). The housing (202) has a predefined dimension corresponding to the air inlet (114-1) such that upon fitting the device at the air inlet (114-1), the air filter (206) faces an airflow duct (108) associated with a refrigeration system of the cabinet (100) and the one or more inlets (204) face a conservation space (106) and/or an air curtain (118) associated with the cabinet (100). The device (200) restricts the entry of particulates, objects, and/or liquid within the duct (108), supplies clean filtered air within the duct (108), and allows easier collection, removal, and cleaning of the particulates, objects, and liquid from the device (200).

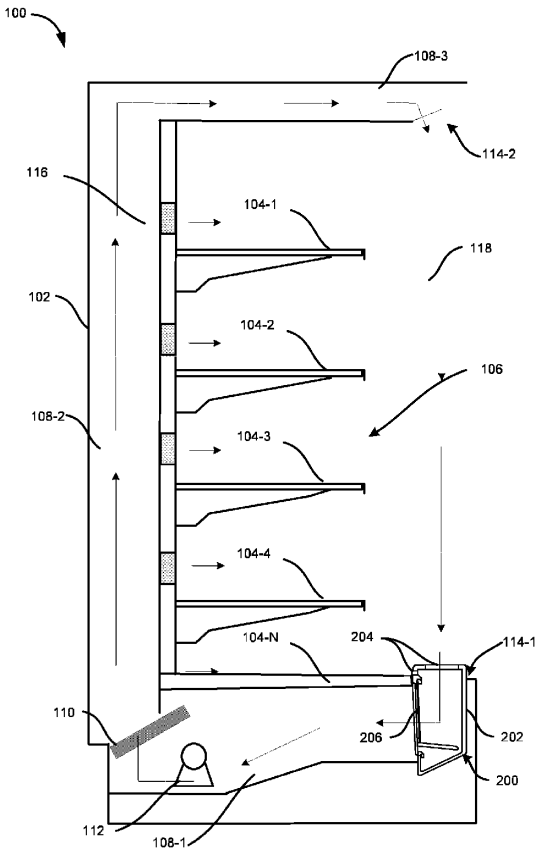



FIG. 1A

EP 4 480 352 A1

## Description

### CROSS-REFERENCE TO RELATED APPLICATION

**[0001]** This patent application claims the benefit of US Provisional Patent Application No. 63/508,943, filed on Jun 19, 2023, which is incorporated by reference herein in its entirety.

### BACKGROUND

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

**[0003]** Refrigerated display cabinets may have an airflow channel or duct extending from an air inlet at the bottom front side of the cabinet to an air outlet at the top front side of the cabinet via a rear side of the cabinet. A refrigeration unit may be installed in the duct to cool the air flowing through the duct, which may then be supplied to a conservation space of the cabinet and further create a cool air curtain in front of the cabinet, where the air curtain may extend from the air outlet at the top front side to the air inlet at the bottom front side of the cabinet. However, dust and pollution may also flow within the duct via the air inlet, along with the air. In addition, objects such as vegetables, product tags, plastics and liquids such as spilled beverages, and condensate from the conservation space may also enter the duct through the air inlet at the bottom front side of the cabinet.

### SUMMARY

**[0004]** According to a first aspect of the invention there is provided a device implemented in a refrigerated display cabinet to collect one or more of particulates, objects, and liquids. The device comprises a housing defining a shape of the device and comprising one or more inlets, wherein the housing is adapted to be fitted at an air inlet of the cabinet; and an air filter configured with a first wall of the housing, wherein the housing has a predefined dimension corresponding to the air inlet such that upon fitting the device at the air inlet, the air filter faces an airflow duct associated with a refrigeration system of the cabinet and the one or more inlets face a conservation space and/or an air curtain associated with the cabinet.

**[0005]** Optionally, the device is configured to receive and collect one or more of objects, and liquids spilled from the conservation space within the housing via the one or more inlets, and allow inflow of air associated with the air curtain within the housing via the one or more inlets, and supply the air into the airflow duct via the air filter to filter particulates from the air and correspondingly supply filtered air into the airflow duct.

**[0006]** Optionally, the air filter is configured with the first wall at a predefined height above a bottom end of the housing, wherein the received objects and liquids are collected at the bottom end of the housing below the air filter. The device may be configured such that the received objects and liquids are collected at the bottom end of the housing below the air filter.

**[0007]** Optionally, the device comprises an outlet that allows removal or discharge of the collected particulates, objects, and liquids from the housing, wherein the particulates, objects, and liquids discharged through the outlet are transferred to a collector tray that is positioned below the device.

**[0008]** Optionally, a meshed grid is provided on the outlet to allow removal or discharge of the collected liquids from the housing and further restrict discharge of the collected object and particulates through the outlet.

**[0009]** Optionally, the device is configured at the air inlet under a return air grid at a bottom front end of the cabinet.

**[0010]** Optionally, the device is integrated with a return air grid at a bottom front end of the cabinet.

**[0011]** Optionally, at least one wall of the housing is removable from the housing to allow access to and/or facilitate cleaning of an interior of the device.

**[0012]** Optionally, at least one wall of the housing comprises a handle and a locking mechanism is configured with the removable wall and the housing, wherein the locking mechanism in a locked position allows users to carry the device using the handle, and wherein the locking mechanism in an unlocked position allows the users to separate the at least one wall from the housing.

**[0013]** Optionally, the air filter is removably fitted to the first wall of the housing.

**[0014]** Optionally, the air filter is fixedly integrated into the first wall of the housing.

**[0015]** Optionally, the device comprises an inclined member extending across a width of the housing and positioned below the air filter within the housing such that a predefined gap remains between a free end of the inclined member and a second wall, opposite to the air filter or the first wall, of the housing.

**[0016]** Optionally, the device comprises an inclined member comprising perforations, which extends across a width of the housing and is inclined at a predefined angle from a horizontal plane in a downward direction or an upward direction within the housing.

**[0017]** Optionally, the inclined member is inclined at a predefined angle from a horizontal plane in a downward direction to facilitate automated movement of the received object and liquids towards the bottom end of the housing through the gap and/or the perforations such that the received object and liquids are collected and secured at the bottom end of the housing beneath the inclined member.

**[0018]** Optionally, the inclined member is adapted to isolate the received air from the object and liquids collected at the bottom end of the housing and/or further facilitate the received air to flow through the air filter into the airflow duct.

**[0019]** Optionally, the one or more inlets are configured at a top end of the housing and have a predefined size based on a size of the objects to be allowed to be

collected within the device.

**[0020]** Optionally, the device comprises a self-cleaning system comprising one or more nozzles fluidically connected to a pump and/or a defrost drainage of the cabinet, wherein the self-cleaning system is configured to supply, through the one or more nozzles, a stream of air or water over the air filter and/or interior walls of the housing to facilitate cleaning of the air filter and/or an interior of the device.

**[0021]** Optionally, the device comprises one or more first sensors configured with the housing to monitor one or more of the presence, weight, volume, and level of the objects and/or the liquids collected within the housing, wherein the one or more first sensors comprise one or more of an optical sensor, a weight sensor, and a proximity sensor.

**[0022]** Optionally, the device comprises one or more second sensors configured with the air filter to monitor a health of the air filter or the level of particulates collected in the air filter, wherein the one or more second sensors comprise one or more of a pressure sensor, a particulate sensor, a contaminant sensor, and a volatile organic compound sensor.

**[0023]** Optionally, the device comprises one or more third sensors configured within the housing to check the occurrence of one or more chemical reactions within the housing.

**[0024]** Optionally, the device comprises a control unit in communication with the one or more first sensors, the one or more second sensors, the one or more third sensors, and the self-cleaning system, wherein the control unit comprises a processor coupled to a memory storing instructions executable by the processor and configured to: receive data collected by the one or more first sensors, the one or more second sensors, and the one or more third sensors; generate a first set of alert signals when the weight, volume, and/or level of the objects and/or the liquids collected within the housing exceeds a first predefined value; generate a second set of alert signals upon detection of the occurrence of the one or more chemical reactions within the housing; and actuate the self-cleaning system to clean the air filter when the level of particulates collected in the air filter exceeds a second predefined value.

**[0025]** Optionally, the control unit is adapted to be operatively coupled to one or more mobile devices, and a remote monitoring system associated with users of the cabinet, and/or a controller and a display device associated with the cabinet.

**[0026]** Optionally, the device comprises a level indicator configured to indicate a level of the liquids collected within the housing.

**[0027]** Optionally, the housing comprises an over-flow hole provided at least below a bottom end of the air filter.

**[0028]** Optionally, the refrigerated cabinet comprises a sealing and drainage system configured to close gaps between the device and the cabinet, such that the sealing and drainage system restricts spillage of the objects, and the liquids from a shelf area of the refrigerated cabinet to enter into the air flow duct and further directs the spillage towards and into the device for collection through the one or more inlets of the device.

**[0029]** 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

**[0030]** 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.

**[0031]** 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. Certain exemplary embodiments will now be described in greater detail by way of example only and with reference to the accompanying drawings in which:

FIGs. 1A to 1C illustrate exemplary views of a device implemented at an air inlet associated with an airflow channel of a refrigerated display cabinet to restrict the entry of particulates, objects, and liquids within the airflow channel.

FIGs. 2A and 2B illustrate exemplary views of the device shown in FIG. 1A.

FIGs. 3A and 3B illustrate exemplary views of the device shown in FIG. 1B.

FIGs. 4A and 4B illustrate exemplary views of the device shown in FIG. 1C.

## DETAILED DESCRIPTION

**[0032]** 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.

**[0033]** 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.

**[0034]** 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 specification, 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, and corresponding components of the refrigerated cabinet and the device, described herein may be oriented in any desired direction.

**[0035]** The refrigerated display cabinet "cabinet" may include an airflow channel or duct extending from an air inlet at the bottom front side of the cabinet to an air outlet at the top front side of the cabinet via a rear side of the cabinet. Further, a refrigeration unit comprising an evaporator/heat exchanger, a fan, and other components may be disposed of in the duct to cool the air while flowing through the duct. The cool air leaving the evaporator/heat exchanger may be delivered into a conservation space of the cabinet to keep the conservation space and the associated stored products cool. In addition, the cool air may be discharged through the air outlet at the top front of the cabinet to provide a flow of cold air that may be again received by the air inlet at the bottom front of the cabinet, thereby creating a cold recirculating air curtain flowing in front of the cabinet which may keep the conservation space thermally isolated from ambient.

**[0036]** However, dust and pollution (particulate matter) may also flow within the duct through the air inlet along with the recirculating air which may contaminate the air, and the conservation space and may also affect the operation of the components disposed of within the duct. Moreover, objects such as solid materials comprising vegetables, fruits, product tags, bottle caps, and wrappers, and liquids such as spilled beverages, and condensate, and other objects such as semi-solid/semi-liquid material comprising yogurt, mayonnaise, but not limited to the like, from the conservation space may also enter the duct through the air inlet. These objects and liquids entering the duct may damage and/or affect the operation of the components disposed of within the duct, and deteriorate the performance of the full-system driving to an energy increase or even to an interruption of the cold chain, if this drive to a full failure of the system. In addition, these liquids, objects, or particulates collected within the duct may degrade after some time which may further contaminate the duct, the conservation space, as well as the air flowing through the duct. Besides, cleaning the interior of the duct may also be very difficult and expensive, especially because access to the area under the return air grid is reserved to trained personnel. There is, therefore, a need to restrict the entry of particulates, objects, and liquid within the airflow channel or duct of the cabinet.

**[0037]** The term "objects" used in the specification relates to any solid and semi-solid or semi-liquid material.

**[0038]** This invention overcomes the drawbacks, shortcomings, and limitations associated with existing cabinets by providing a device that may be easily installed at the air inlet associated with the airflow channel/duct of the cabinet to restrict the entry of particulates, objects, and/or liquid within the duct (airflow channel), which may further supply clean filtered air within the duct and allow easier collection, removal, and cleaning of the particulates, objects, and liquid from the device.

**[0039]** Referring to FIGs. 1A to 4B, a device 200 implemented in a refrigerated display cabinet (also referred to as cabinet 100, hereinafter) is disclosed, which restricts the entry of particulates, objects, and/or liquid within an airflow channel/duct 108 of the cabinet 100, supplies clean filtered air within the airflow channel/duct 108, allows easier collection and removal of the particulates, objects, and liquid from the device 200, and enables easier and automated cleaning of the device 200. The cabinet 100 may include a case 102 comprising one or more shelves 104-1 to 104-N (collectively referred to as shelves 104, herein) extending between the back walls 102-1, 102-2 of case 102, thereby forming a conservation space 106 to support and store products or goods therewithin. The cabinet 100 may further include an airflow channel or duct 108 extending from an air inlet 114-1 (also referred to as return air inlet) at the bottom front side of cabinet 100 to an air outlet 114-2 (also referred to as a discharge air outlet) at the top front side of cabinet 100 via a rear side of cabinet 100. The duct 108 may include a bottom airflow 108-1 extending from the air inlet 114-1 at the bottom front side to the bottom rear side of cabinet 100, a rear airflow zone 108-2 extending on the rear side of the cabinet 100 from the bottom rear side to a top rear side of the cabinet 100 and fluidically connected to the bottom airflow zone 108-1, and a top airflow zone 108-3 extending from the top rear side to the air outlet 114-2 at the top front side of the cabinet and fluidically connected the rear airflow zone 108-3.

**[0040]** The device 200 may be installed at the air inlet 114-1 (at the bottom front side) of the cabinet 100 to restrict the entry of particulates within the duct 108 along with the air, and also restrict the entry of objects and/or liquid from the conservation space 106 and/or ambient within the duct 108. The device 200 may include an air filter 206 (or multiple filters 206) that may filter the incoming air and further supply clean filtered air within the duct 108 for further cooling. Moreover, the device 200 may collect particulates, objects, and liquids which may then be easily removed and cleaned from the device 200.

**[0041]** Referring to FIG. 2A to 4B, the device 200 may

include a housing 202 defining the shape of the device 200, which may be adapted to be fitted at the air inlet 114-1 of the cabinet. The device 200 may include one or more inlets or openings 204 at a top end and/or top rear end and/or top front end of the housing 202 which may have a predefined size based on the size of the objects to be allowed to be collected within the device 200 or to be restricted from entering the device 200. Further, the device 200 may include the air filter 206 configured with a first wall 202-1 of the housing 202. A portion of the first wall 202-1 may be removed to form a frame to accommodate the air filter 206 thereon. Further, multiple cut-outs may be formed on the first wall 202-1 to fit multiple air filters 206 to the housing 202. In one or more embodiments, the air filter 206 may be removably fitted to the first wall 202-1 of the housing 202, however, in other embodiments, the air filter 206 may be fixedly integrated into the first wall 202-1 of the housing 202. The filter 206 may clean/filter the incoming air (received through the air inlet 114-1) and may further supply clean filtered air within the duct 108 for further cooling by a refrigeration or cooling system.

**[0042]** The housing 202 may have a predefined dimension corresponding to the shape and size of the air inlet 114-1 at the bottom front of the cabinet 100 such that upon fitting the device 200 at the air inlet 114-1, the air filter 206 may face the duct 108 and the inlets 204 of the device 200 may face the conservation space 106 and/or an air curtain area 118 associated with the cabinet 100. Further, the size of the device 200 may be small enough to be cleaned in any commercial or industrial dishwasher. The device 200 may receive and collect the objects and/or liquids spilled from the conservation space 106 within the housing 202 via the inlets 204. The device 200 may further allow the inflow of air associated with the air curtain 118 within the housing 202 via the inlets 204, and supply the air into the duct 108 via the air filter 206 to filter particulates from the air and correspondingly supply filtered air into the duct 108.

**[0043]** In one or more embodiments, multiple devices 200 may be installed sequentially at the air inlet 114-1 of the cabinet 100 to cover an entire length of the air inlet 114-1 and such that the air filter 206 of each device 200 may face the duct 108 and the inlets 204 of the devices 200 may face the conservation space 106 and/or an air curtain area 118 associated with the cabinet 100.

**[0044]** In one or more embodiments, the air filter 206 may be configured with the first wall 202-1 at a predefined height above the bottom end of the housing 202, such that the received objects and liquids are collected at the bottom end of the housing 202 below the air filter 206. This may restrict any interaction of collected objects and liquids with the air filter 206 and also restrict the spilling of the collected liquids out of the device 200 through the filter area 206.

**[0045]** In one or more embodiments, as shown in FIGs. 2A and 2B, the device 200 may include an inclined member 208 extending across the width of the housing 202 and positioned below the air filter 206 within the housing 202 such that a predefined gap (G) remains between a free end of the inclined member 208 and a second wall 202-2, opposite to the air filter 206 or the first wall 202-1, of the housing 202. The member 208 may be inclined at a predefined angle from a horizontal plane in a downward direction to facilitate automated movement of the received object and liquids towards the bottom end of the housing 202 through the gap G such that the received object and liquids are collected and secured at the bottom end of the housing 202 under the inclined member 208, without any interaction with the air filter 206. Further, the inclined member 208 may isolate the received/incoming air from the object and/or liquids that are collected at the bottom end of the housing 202 and/or further facilitate the received air to flow through the air filter 206 into the duct 108.

**[0046]** In one or more embodiments, (not shown), the device 200 may include an inclined member comprising perforations. The inclined member may extend across a width of the housing 202 and is positioned below the air filter 206 within the housing 202, with or without any gap between the inclined member and the walls 202-1, 202-2 of the housing 202. The inclined member may be inclined at a predefined angle from a horizontal plane in a downward direction and/or an upward direction, to facilitate automated movement of the received object and liquids towards the bottom end of the housing 202 through the perforations such that the received object and liquids are collected and secured at the bottom end of the housing 202 under the inclined member 208, without any interaction with the air filter 206.

**[0047]** In one or more embodiments, the device 200 may include an outlet that allows the removal or discharge of the collected particulates, objects, and/or liquids from the housing 202. The particulates, objects, and liquids discharged from the device may be transferred to a collector tray 122 that may be positioned below the device 200. In other embodiments, a meshed grid may be provided on the outlet to facilitate the removal or discharge of the collected liquids from the housing 202 while restricting the discharge of the collected object and/or particulates from the housing 202.

**[0048]** In one or more embodiments, the housing 202 may include an over-flow hole that may be provided at least below a bottom end of the air filter 206. This may prevent any interaction of the collected liquid with the air filter 206 in an event of overflow within the device 200.

**[0049]** In one or more embodiments, the cabinet 100 may be an open-type cabinet 100 (without any doors) as shown in FIG. 1A where an aerothermodynamic barrier may be created in front of cabinet 100 by a recirculating air curtain 118 extending between the air outlet 114-2 and the air inlet 114-1 which may keep the conservation space 106 and the environment thermally isolated. In other embodiments, the cabinet 100 may be a door-type cabinet 100 as shown in FIG. 1B that may include multiple doors 120 (collectively referred to as doors, herein) mo-

vably coupled to the front of case 102. The doors 120 may be adapted to move between an open position and a closed position. The doors 120 and/or the aerothermodynamic barrier created in front of the cabinet 100 by a recirculating air curtain 118 may keep the conservation space 106 and the environment thermally isolated. In such cabinets, the air inlet 114-1 of the duct 108 may be at a region between the front end of the bottommost shelf 104-N and the rear side of the doors 120. The device 200 may be fitted in the air inlet 114-1 such that the air filter 206 of the device 200 may face the duct 108 and the inlets 204 of the device 200 may face the conservation space 106 and/or the air curtain 118 formed between the shelves 104 and the doors 120.

**[0050]** In one or more embodiments, the cabinet 100 may include the refrigeration system or cooling unit to maintain a predefined temperature in the conservation space 106 of cabinet 100 and also create the recirculating air curtain 118 in front of the shelves 104 or behind the doors of the cabinet 100 in order to create an aerothermodynamic barrier between the conservation space 106 and environment. The refrigeration system may involve the duct 108 extending from the bottom front side of the cabinet 100 to the top front side of the cabinet 100 via the rear side of the cabinet 100. Further, the outlet 114-2 at the top front side of duct 108 may be configured with a discharge air grille (DAG) and the air inlet 114-1 at the bottom front side of duct 108 may be configured with a return air grille (RAG). The DAG and the RAG may control air directivity and facilitate the creation of the air curtain 118 in front of the shelves 104 or behind the doors 120 of the cabinet 100.

**[0051]** In one or more embodiments, the device 200 may be configured at the air inlet 114-1 under the RAG of the cabinet 100. However, in other embodiments, the device 200 may be integrated with the RAG of the cabinet 100, and all such embodiments are within the scope of this invention which is as defined in the appended claims.

**[0052]** The refrigeration system may further include an evaporator comprising a heat exchanger 110 operable to enable heat exchange between the cool refrigerant and incoming clean air stream supplied by the device 200 to cool the air to a predefined temperature, which may be supplied to the conservation space 106 and/or create the cool air curtain 118 in front of the shelves 104.

**[0053]** Further, the refrigeration system may include a fan 112 that may be positioned adjacent (upstream or downstream) to the heat exchanger 110 within duct 108. The fan 112 may be configured to facilitate the inflow of air within duct 108 through the device 200 at the inlet 114-1 or RAG where the air may get filtered and pass through the heat exchanger 110 that may cool the filtered air and pump out the cool filtered air from the air outlet 114-2 or DAG of the cabinet 100. Accordingly, the cool filtered air pumped out by the DAG or air outlet 114-2 (on the top front side of cabinet 100) may be received by the RAG or air inlet 114-1 (on the bottom front side of cabinet 100) to create a curtain 118 of cool air in front of the shelves 104 or behind the doors 120 of the cabinet 100, which acts as an aerothermodynamic barrier between the conservation space 106 and environment. In addition, the second section of duct 108 on the rear side of cabinet 100 may include perforated wall panels (PWP) 116 behind the shelves 104, which may discharge a portion of the cool filtered air, passing through duct 108, into the conservation space 106 to maintain the predefined temperature within the cabinet 100.

**[0054]** Further, the bottom airflow zone 108-1 of duct 108 may act as a return air duct that may extend substantially along a horizontal axis and is formed below the lowest shelf of cabinet 100. The bottom airflow zone 108-1 or the rear airflow zone 108-2 may house the fan 112 that may be configured to suck air from the conservation space 106 through the device 200 located at the air inlet 114-1 or RAG into the bottom airflow zone 108-1 where the filter 206 of the device 200 may clean the air by collecting particulates and deliver clean air to the evaporator/heat exchanger 110 where it is cooled. The device 200 may further prevent the objects or liquids/-spillage of the conservation space 106 from falling into duct 108 or bottom airflow zone 108-1, which may later be removed from the device 200.

**[0055]** In one or more embodiments, at least one wall of the housing 202 may be removable from the housing 202 to provide access to the interior of the device 200 and/or facilitate cleaning of the device 200 interior. Further, the housing 202 may comprise a handle 210, and a locking mechanism 212 configured between the housing 202 and the removable wall of the device 200. The locking mechanism 212 in a locked position may keep the removable wall attached to the housing 202 and may allow users to remove the device 200 from the air inlet 114-1 and easily carry the device 200 using the handle 210. Further, the locking mechanism 212 in an unlocked position may allow the users to separate the wall from the housing 202 to access the interior of the device 200 and further facilitate the cleaning of the interior of the device 200.

**[0056]** In one or more embodiments, the device 200 may be configured with a self-cleaning system (not shown) that may automatically clean the filter 206 and/or the interior of the device 200. The self-cleaning system may include one or more nozzles fluidically connected to a cleaning fluid source via a pump. The fluid source may store cleaning fluids selected from water, air, liquid soap, and the like. The self-cleaning system, upon actuation, may be configured to supply, through the nozzles, a stream of cleaning fluid over the air filter 206 and/or interior walls of the housing 202 to facilitate the cleaning of the air filter 206 and/or interior of the device 200. Further, any collected fluid or dirt left in the housing 202 after the cleaning of the device 200 may be discharged out of the device 200 into the collector (when the device 200 is fitted in the cabinet 100) or outside (when the device 200 is removed from the cabinet 100) through the outlet provided at the bottom of the housing

202.

**[0057]** In one or more embodiments, (not shown) the device 200 may include one or more first sensors configured within and/or outside the housing 202 to monitor one or more of the presence, weight, volume, and level of the objects and/or the liquids collected within the housing 202. The first sensors may comprise one or more of an optical sensor, a weight sensor, a proximity sensor, and the like. Further, the device 200 may comprise one or more second sensors configured with the air filter 206 to monitor the health of the air filter 206 or the level of particulates or the concentration of contaminants collected in the air filter 206. The second sensors may comprise one or more of a pressure sensor, a particulate sensor, a contaminant sensor, a volatile organic compound sensor, and the like. Furthermore, the device 200 may comprise one or more third sensors configured within the housing 202 to detect/check the occurrence of one or more chemical reactions within the housing 202, which may generally occur due to the degradation or interaction between the collected objects, and liquids. The third sensors may be chemical sensors comprising one or more of thermal sensors, mass sensors, electrochemical sensors, optical sensors, and the like.

**[0058]** In one or more embodiments, (not shown) the device 200 may comprise a control unit in communication with the first sensors, the second sensors, the third sensors, and the self-cleaning system. The control unit may comprise a processor coupled to a memory storing instructions executable by the processor. The control unit may be configured with a communication module known in the art to communicatively couple the device 200 to one or more mobile devices and/or a remote monitoring system of the users associated with the cabinet, and/or a controller and/or a display device associated with the cabinet where the device 200 is installed. The users may be owner, maintenance contracts, and the like associated with the cabinet.

**[0059]** The control unit may be configured to receive the data collected by the first sensors, the second sensors, and/or the third sensors in real time and also store the collected data in a cloud database. The control unit may be configured to generate and transmit a first set of alert signals to the mobile devices of users, and/or the controller and the display device 200 of the cabinet when the weight, volume, and/or level of the objects and/or the liquids collected within the housing 202 exceeds the first predefined values. Further, the control unit may be configured to generate and transmit a second set of alert signals to the mobile devices of users, and/or the controller and the display device of the cabinet 100 upon detection of the occurrence of the chemical reactions within the housing 202.

**[0060]** The control unit may be configured to actuate the self-cleaning system to clean the air filter 206 when the level of particulates collected in the air filter 206 exceeds a second predefined value. Further, the control unit may be configured to actuate the self-cleaning system to clean the interior of the device 200 when the level of objects and/or liquids collected in the housing 202 exceeds the first predefined values and/or when the occurrence of a chemical reaction is detected within the device 200.

**[0061]** In one or more embodiments, the device 200 may include a level indicator to indicate the level of liquids or objects collected within the device 200. The level indicator may be visible to users from the outside of the device 200 and/or cabinet 100. This may allow users to empty and clean the device 200 before their level exceed the first predefined values. In one or more embodiments, the level indicator may be a mechanical indicator configured within the device 200 which may provide a visual indication about the level of the collected liquids and objects from outside of the device 200. In other embodiments, the level indicator may involve the first sensors that may monitor the level of the collected liquids and objects within the device 200 and correspondingly actuate the control unit to display the monitored level on the mobile devices of the user and/or the display device associated with the cabinet.

**[0062]** Thus, this invention overcomes the drawbacks, shortcomings, and limitations associated with existing cabinets by providing a device that may be easily installed at the air inlet associated with the airflow channel/duct of the cabinet to restrict the entry of particulates, objects, and/or liquid within the duct. Moreover, the device may supply clean filtered air within the duct and further allow easier collection and removal of the particulates, objects, and liquid from the device. In addition, the device is also equipped with a self-cleaning system that may clean the interior of the device either upon manual actuation by users or when the level/weight of the collected liquid or objects exceeds a threshold level, or upon detection of the occurrence of chemical reactions within the device. This may help keep the device clean and hygienic. Further, the device may monitor the health of the air filter and may further clean the filters using the self-cleaning system and/or alert users about replacement or cleaning the filters.

**[0063]** 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.

**[0064]** 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.

## Claims

**1.** A device (200) implemented in a refrigerated display cabinet (100) to collect one or more of particulates, objects, and liquids, the device comprising:

a housing (202) defining a shape of the device and comprising one or more inlets (204), wherein the housing is adapted to be fitted at an air inlet (114-1) of the cabinet; and
an air filter (206) configured with a first wall (202-1) of the housing;
wherein the housing has a predefined dimension corresponding to the air inlet such that upon fitting the device at the air inlet, the air filter faces an airflow duct (108) associated with a refrigeration system of the cabinet and the one or more inlets face a conservation space (106) and/or an air curtain (118) associated with the cabinet.

**2.** The device of claim 1, wherein the device is configured to:

receive and collect one or more of objects and liquids spilled from the conservation space within the housing via the one or more inlets; and
allow inflow of air associated with the air curtain within the housing via the one or more inlets, and supply the air into the airflow duct via the air filter to filter particulates from the air and correspondingly supply filtered air into the airflow duct.

**3.** The device of claim 1 or 2, wherein the air filter is configured with the first wall at a predefined height above a bottom end of the housing, wherein the received objects and liquids are collected at the bottom end of the housing below the air filter.

**4.** The device of any of claims 1, 2 or 3, wherein the device comprises an outlet that allows removal or discharge of the collected particulates, objects, and liquids from the housing, wherein the particulates, objects, and liquids discharged through the outlet are transferred to a collector tray (122) that is positioned below the device; optionally
wherein a meshed grid is provided on the outlet to facilitate removal or discharge of the collected liquids from the housing and further restrict discharge of the collected objects and particulates through the outlet.

**5.** The device of any preceding claim, wherein the device is configured at the air inlet under a return air grid at a bottom front end of the cabinet.; or
wherein the device is integrated with a return air grid at a bottom front end of the cabinet.

**6.** The device of any preceding claim, wherein at least one wall of the housing is removable from the housing to allow access to and/or facilitate cleaning of an interior of the device; optionally
wherein at least one wall of the housing comprises a handle (210) and a locking mechanism (212) is configured with the removable wall and the housing, wherein the locking mechanism in a locked position allows users to carry the device using the handle, and wherein the locking mechanism in an unlocked position allows the users to separate the at least one wall from the housing.

**7.** The device of any preceding claim, wherein the air filter is removably fitted to the first wall of the housing; or
wherein the air filter is fixedly integrated into the first wall of the housing.

**8.** The device of any preceding claim, wherein the device comprises an inclined member (208) extending across a width of the housing and positioned below the air filter within the housing such that a predefined gap (G) remains between a free end of the inclined member and a second wall (202-2), opposite to the air filter or the first wall, of the housing; or
wherein the device comprises an inclined member comprising perforations, which extends across a width of the housing and is inclined at a predefined angle from a horizontal plane in a downward direction and/or an upward direction within the housing.

**9.** The device of claim 8, wherein the inclined member is inclined at a predefined angle from a horizontal plane in a downward direction to facilitate automated movement of the received objects and liquids towards the bottom end of the housing through the gap or the perforations such that the received object and liquids are collected and secured at the bottom end of the housing beneath the inclined member; and/or
wherein the inclined member is adapted to isolate the received air from the objects and liquids collected at the bottom end of the housing and/or further facilitate the received air to flow through the air filter into the airflow duct.

**10.** The device of any preceding claim, wherein the one

or more inlets are configured at a top end of the housing and have a predefined size based on a size of the objects to be allowed to be collected within the device.

**11.** The device of any preceding claim, wherein the device comprises a self-cleaning system comprising one or more nozzles fluidically connected to a pump and/or a defrost drainage of the cabinet, wherein the self-cleaning system is configured to supply, through the one or more nozzles, a stream of air or water over the air filter and/or interior walls of the housing to facilitate cleaning of the air filter and/or an interior of the device.

**12.** The device of any preceding claim, wherein the device comprises one or more first sensors configured with the housing to monitor one or more of the presence, weight, volume, and level of the objects and/or the liquids collected within the housing, wherein the one or more first sensors comprise one or more of an optical sensor, a weight sensor, and a proximity sensor; optionally

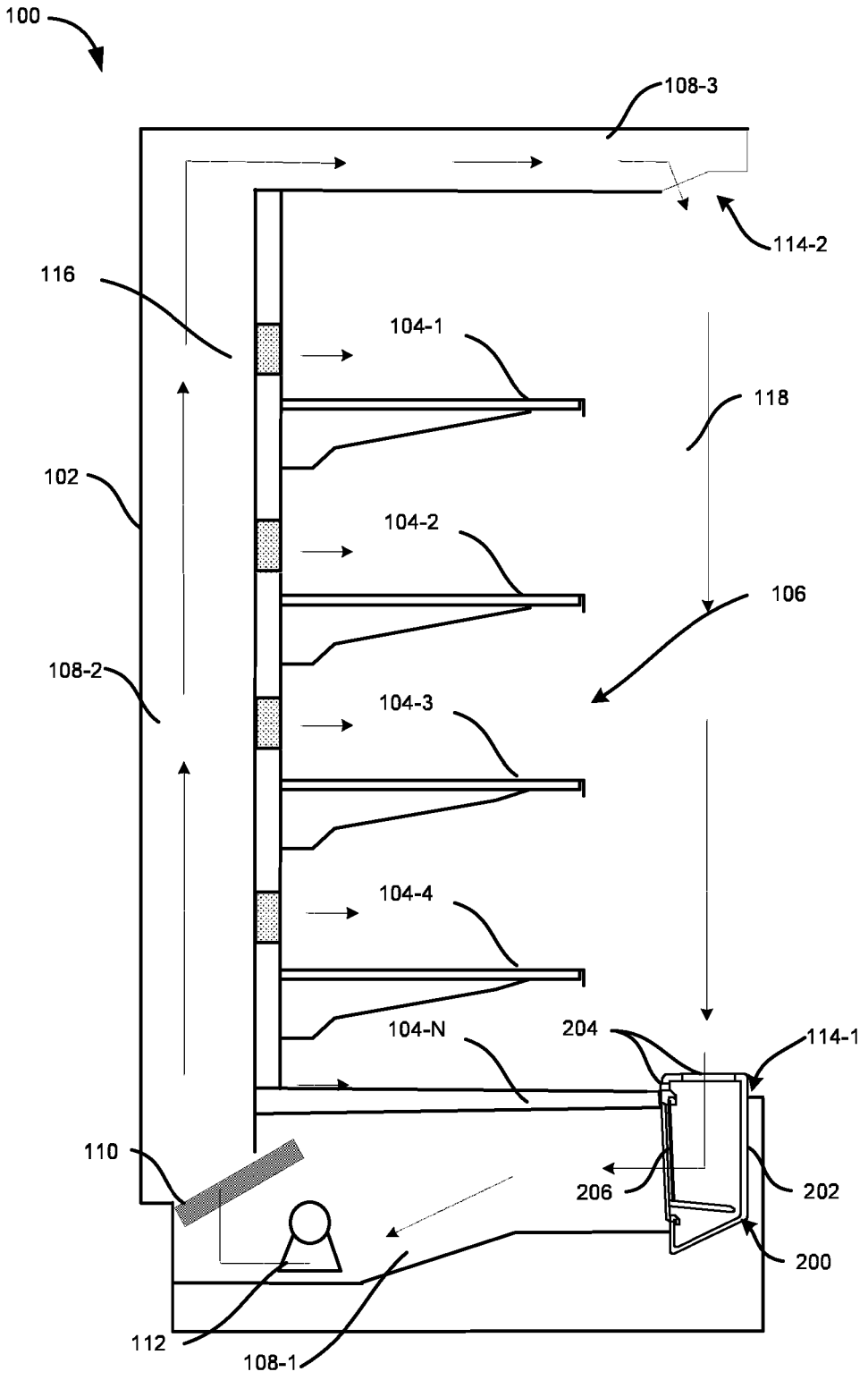
wherein the device comprises one or more second sensors configured with the air filter to monitor a health of the air filter or the level of particulates collected in the air filter, wherein the one or more second sensors comprise one or more of a pressure sensor, a particulate sensor, a contaminant sensor, and a volatile organic compound sensor; optionally
wherein the device comprises one or more third sensors configured within the housing to check the occurrence of one or more chemical reactions within the housing.

**13.** The device of claim 12 when dependent on claim 11, wherein the device comprises a control unit in communication with the one or more first sensors, the one or more second sensors, the one or more third sensors, and the self-cleaning system,
wherein the control unit comprises a processor coupled to a memory storing instructions executable by the processor and configured to:

receive data collected by the one or more first sensors, the one or more second sensors, and the one or more third sensors;
generate a first set of alert signals when the weight, volume, and/or level of the objects and/or the liquids collected within the housing exceeds a first predefined value;
generate a second set of alert signals upon detection of the occurrence of the one or more chemical reactions within the housing; and
actuate the self-cleaning system to clean the air filter when the level of particulates collected in the air filter exceeds a second predefined value; optionally wherein the control unit is adapted to be operatively coupled to one or more mobile devices and/or a remote monitoring system associated with users of the cabinet, and/or a controller and a display device associated with the cabinet.

**14.** The device of any preceding claim, wherein the device comprises a level indicator configured to indicate a level of the liquids collected within the housing; and/or
wherein the housing comprises an over-flow hole provided at least below a bottom end of the air filter.

**15.** The device of any preceding claim, wherein the refrigerated cabinet comprises a sealing and drainage system configured to close gaps between the device and the cabinet, such that the sealing and drainage system restricts spillage of the objects, and the liquids from a shelf area of the refrigerated cabinet to enter into the air flow duct and further directs the spillage towards and into the device for collection through the one or more inlets of the device.


100
108-3
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104-N
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110
206
202
200
112
108-1

FIG. 1A

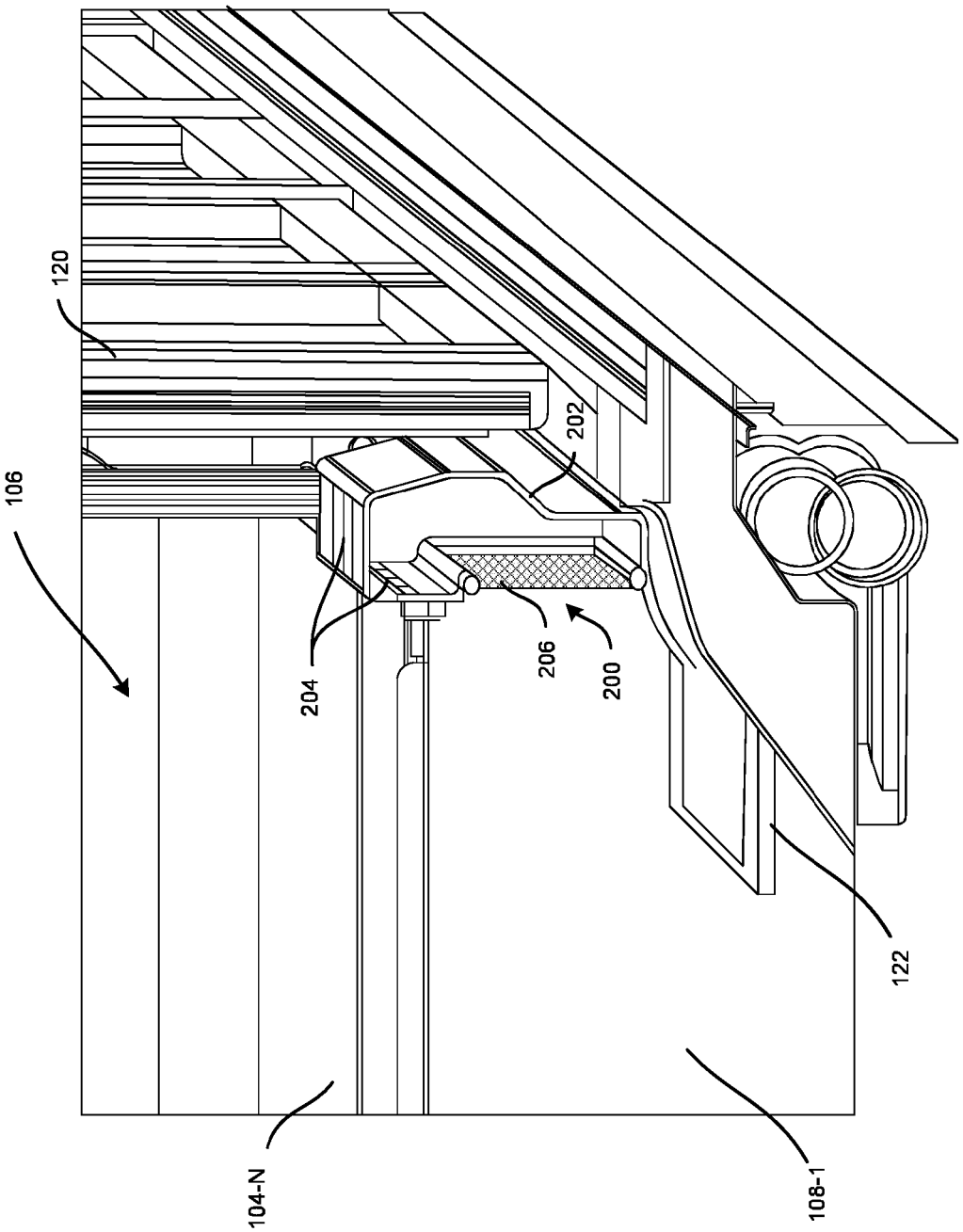


FIG. 1B

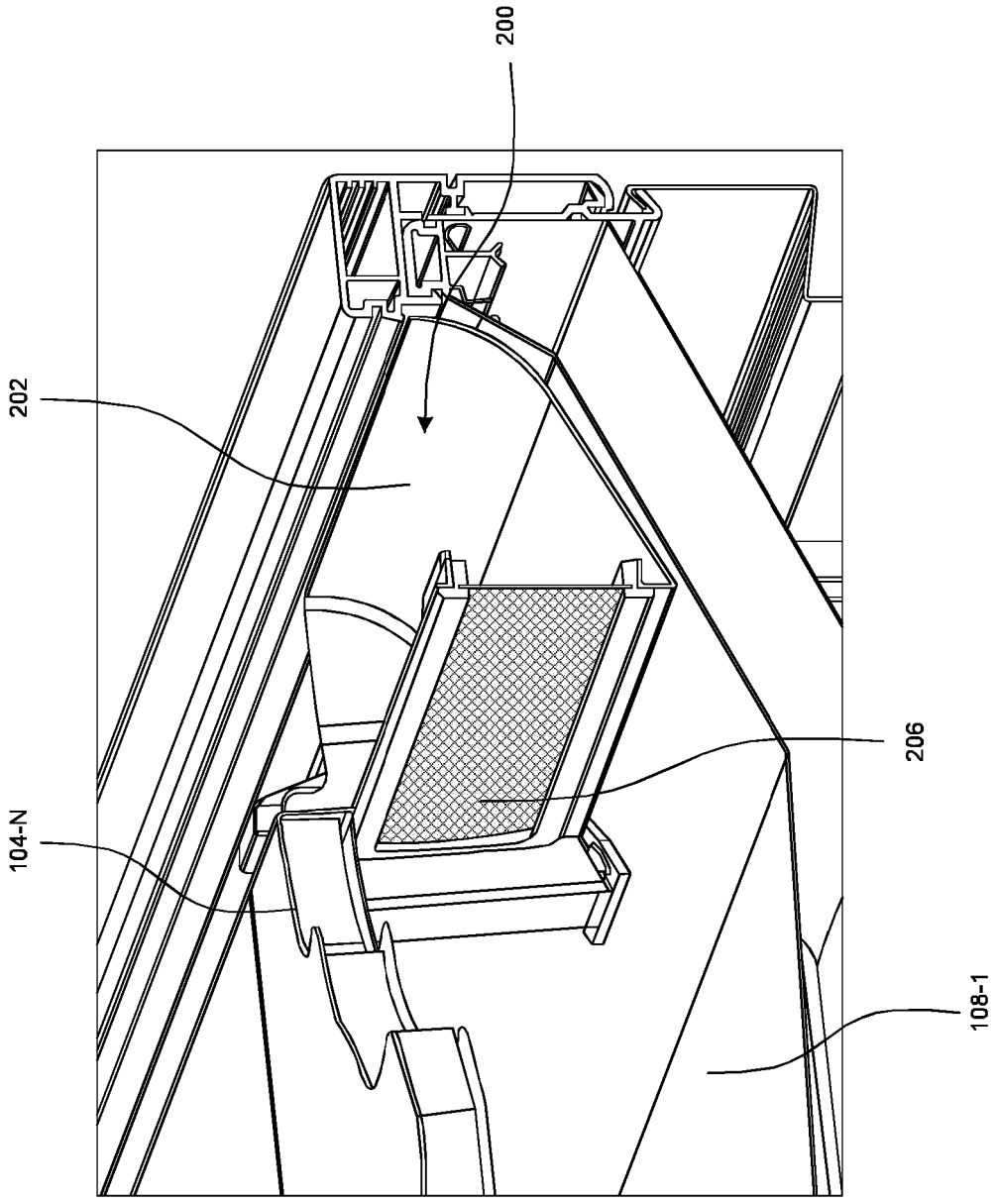


FIG. 1C

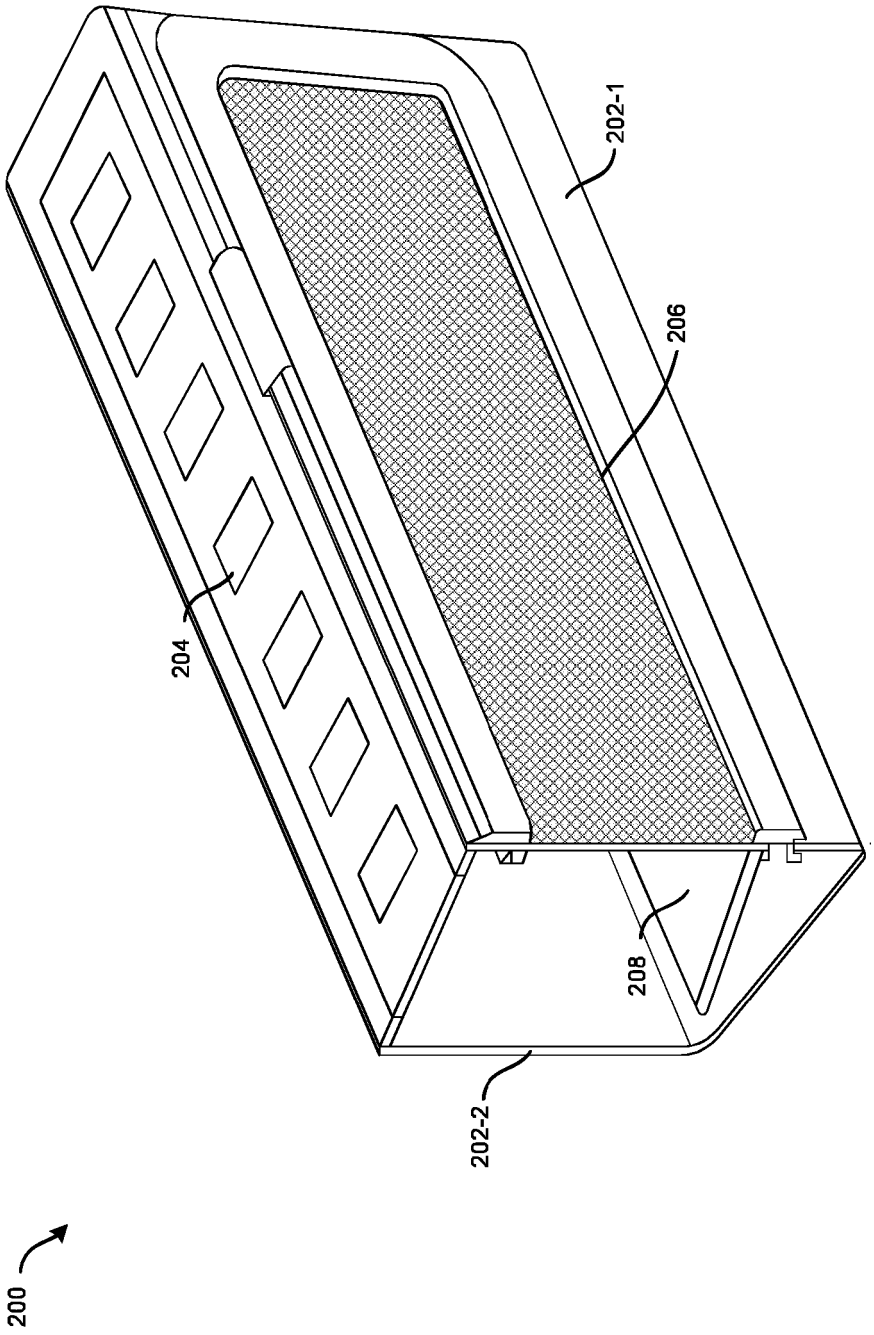


FIG. 2A

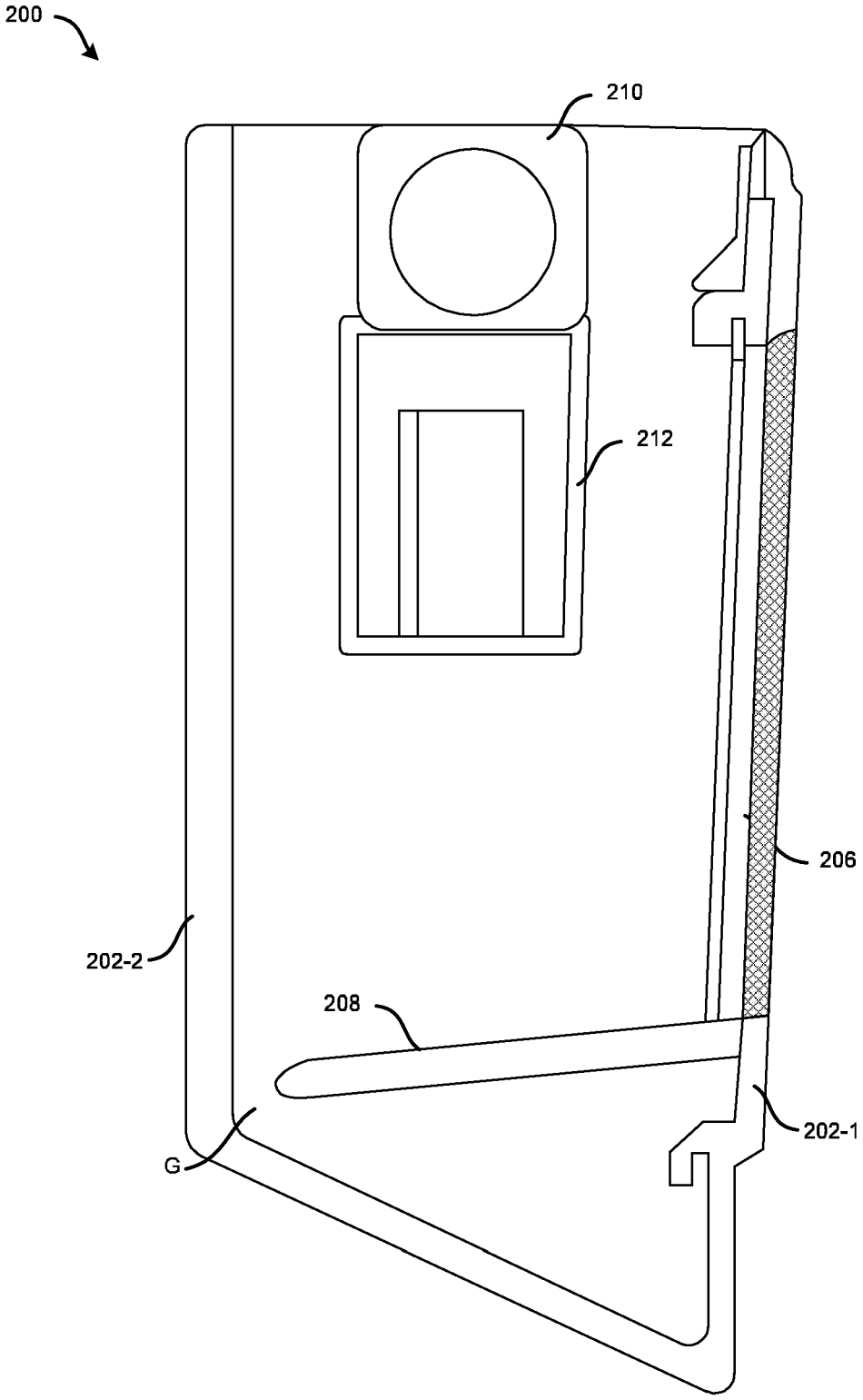


FIG. 2B

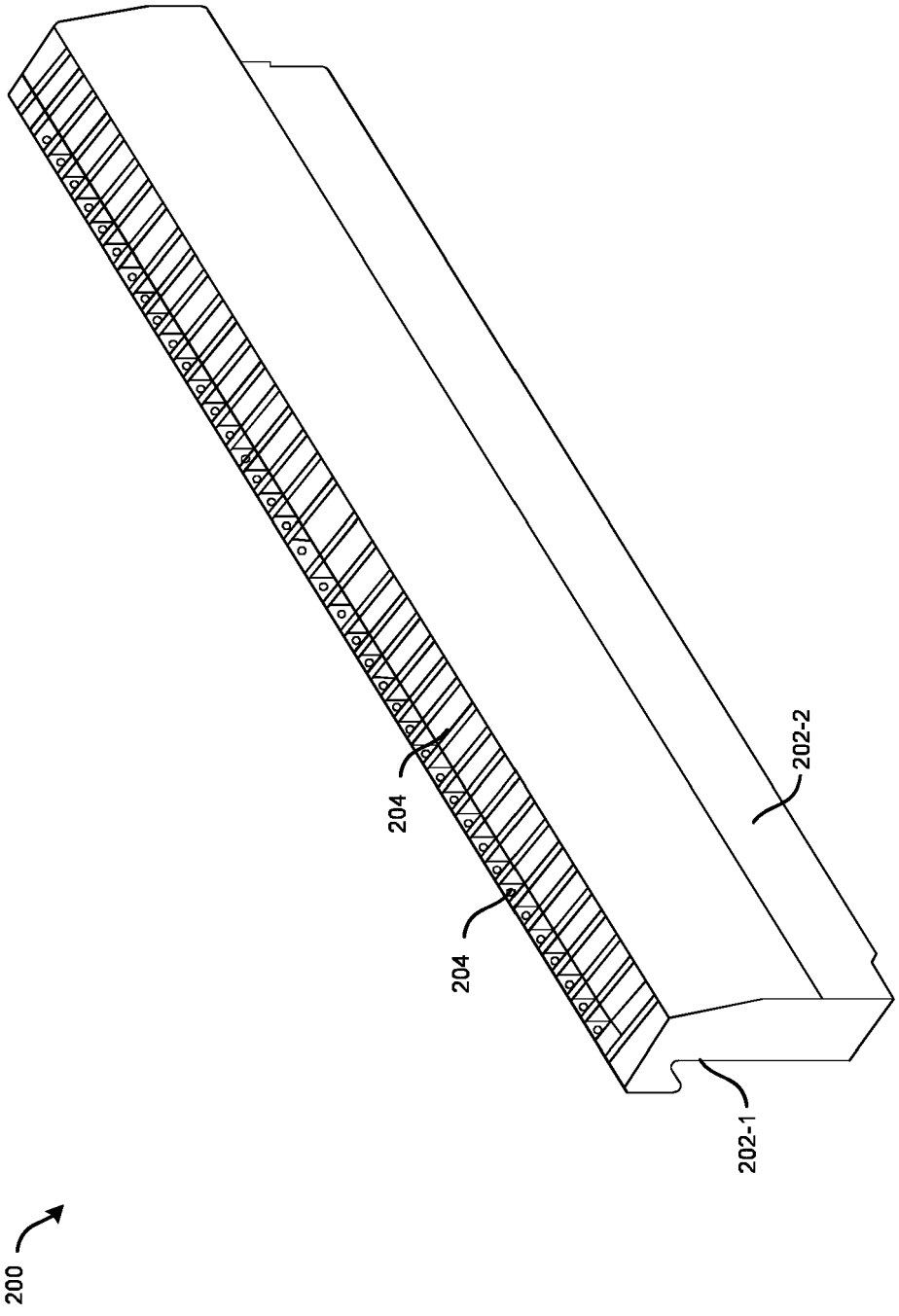


FIG. 3A

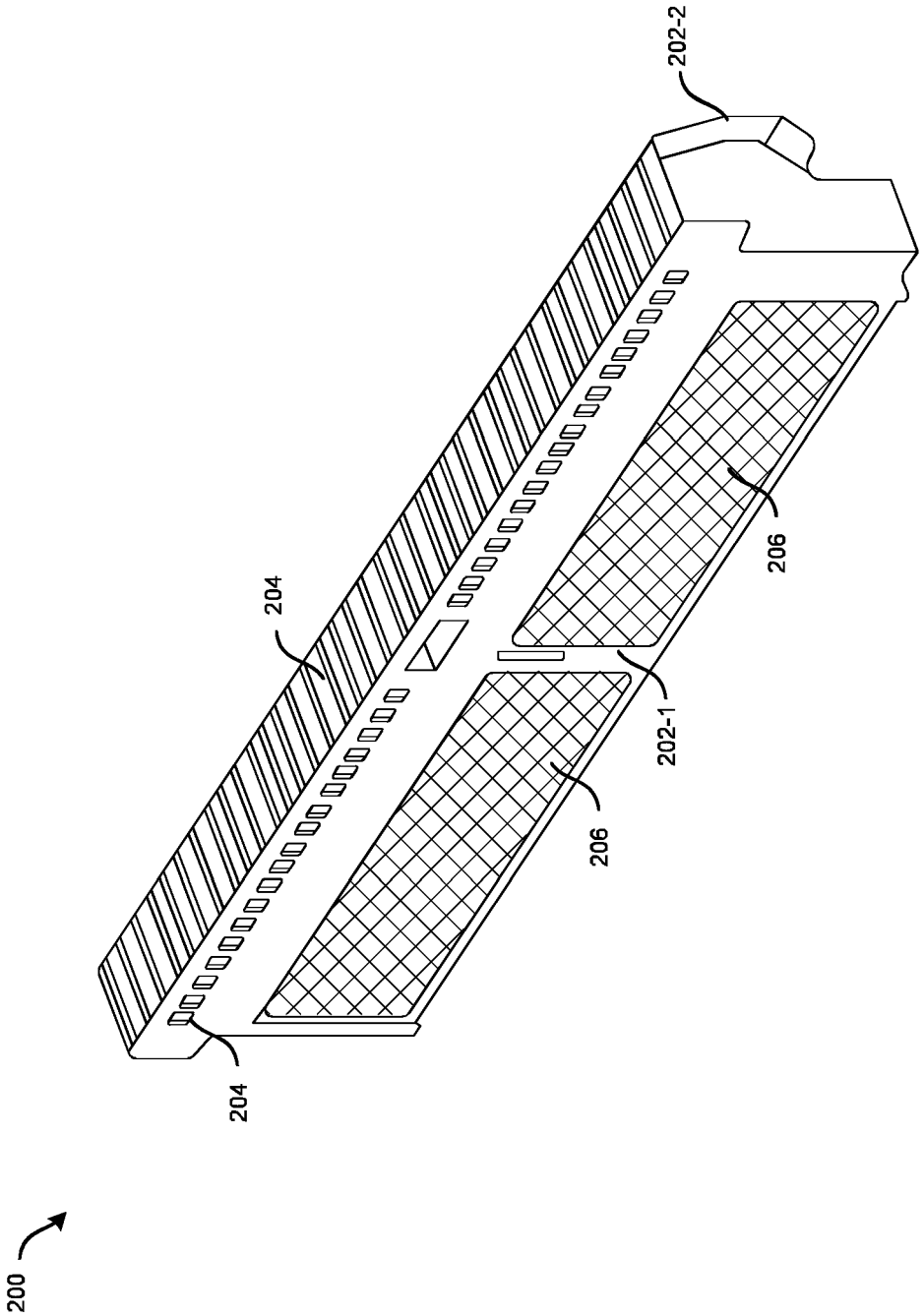


FIG. 3B

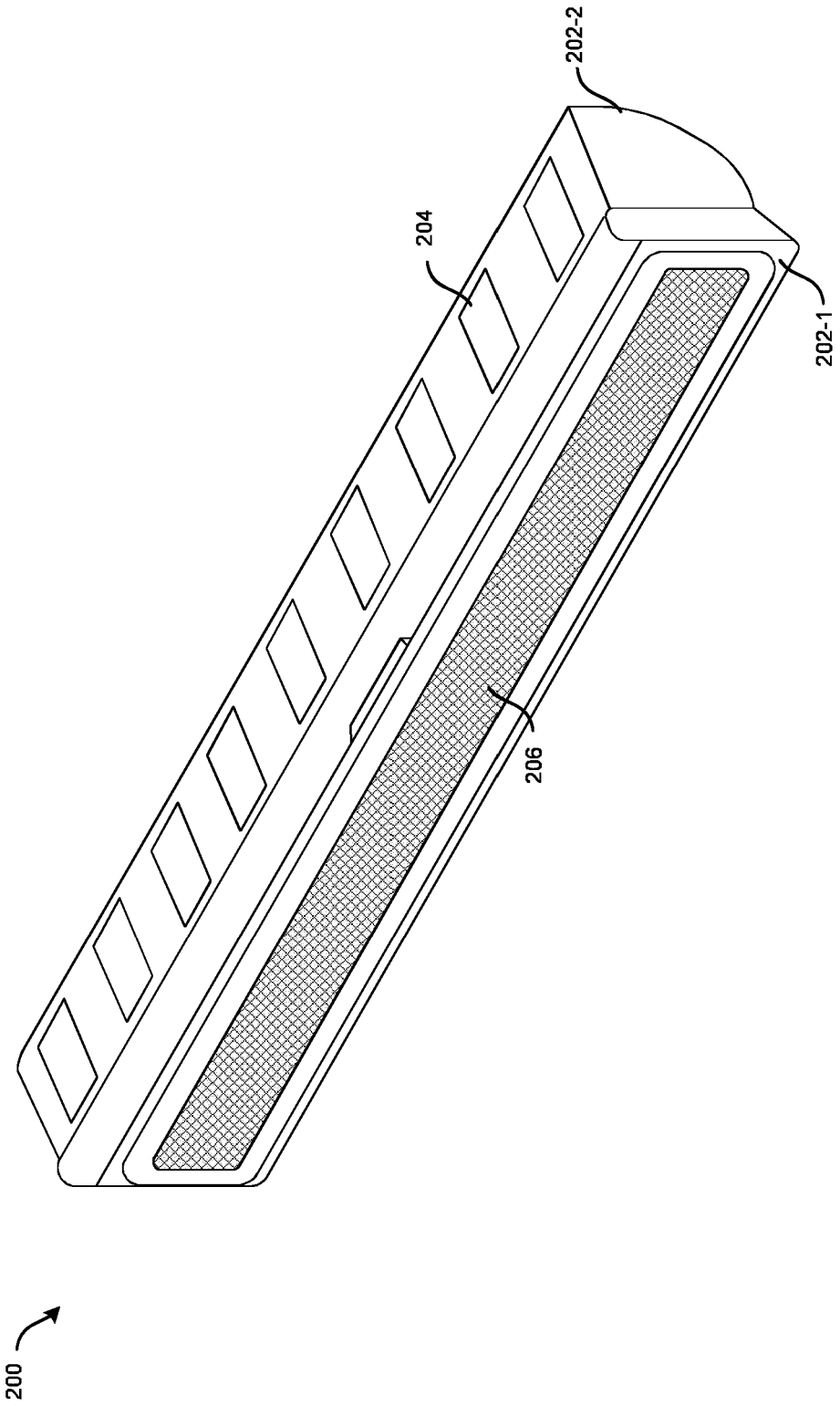


FIG. 4A

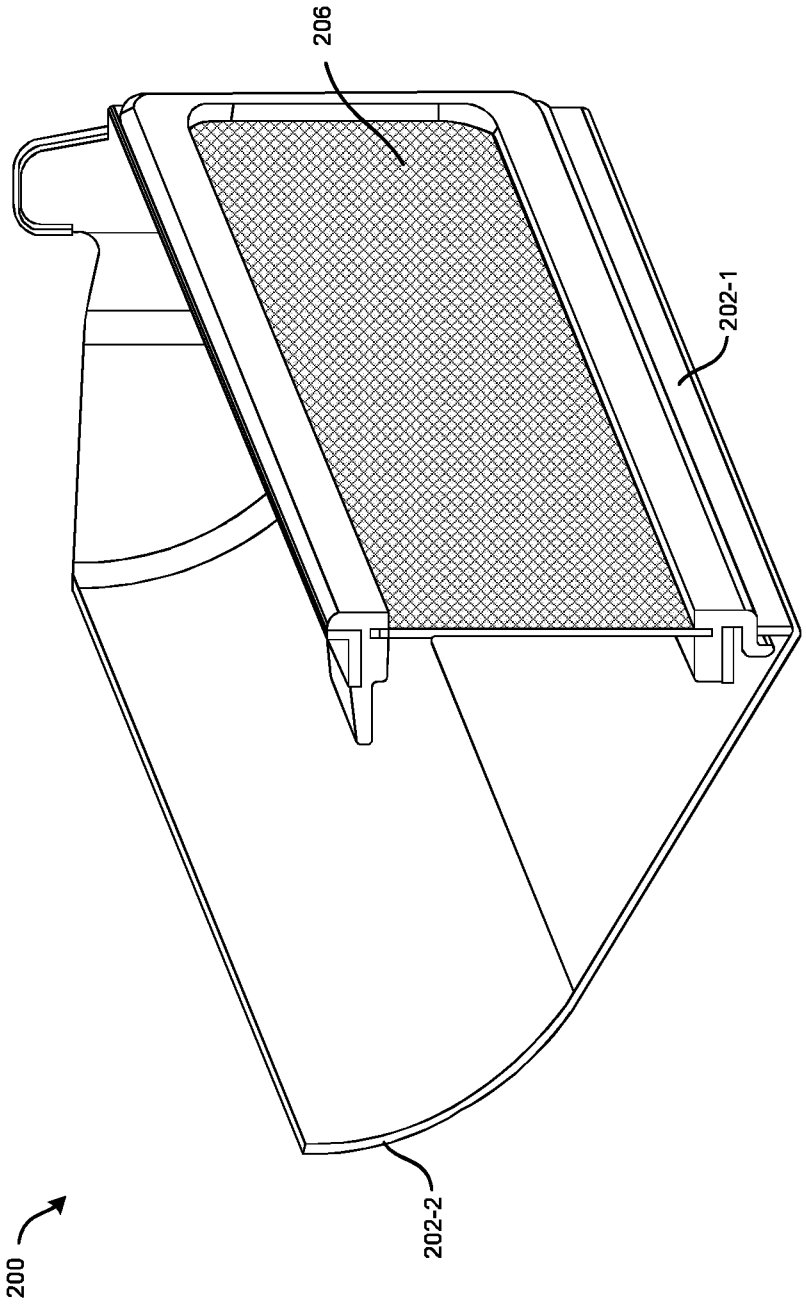


FIG. 4b

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# EUROPEAN SEARCH REPORT

Application Number
EP 24 18 2683

## 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 | JP H07 91807 A (SANYO ELECTRIC CO) 7 April 1995 (1995-04-07) * abstract; figures 2-5 * | 1-15 | INV. A47F3/04 ADD. B01D45/08 |
| X<br>A | JP 2005 034304 A (SANDEN CORP) 10 February 2005 (2005-02-10) * abstract; figures 2-6 * | 1-7, 10-15<br>8,9 | |
| X<br>A | JP 2017 131369 A (TOSHIBA CARRIER CORP) 3 August 2017 (2017-08-03) * abstract; figures 1-4 * | 1-7, 10-15<br>8,9 | |

TECHNICAL FIELDS SEARCHED (IPC)

F25D
B01D
A47F

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 28 October 2024 | Bitton, Alexandre |

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 18 2683

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28-10-2024

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| JP H0791807 A | 07-04-1995 | JP 3139660 B2 | 05-03-2001 |
| | | JP H0791807 A | 07-04-1995 |
| | | KR 950009192 A | 21-04-1995 |
| JP 2005034304 A | 10-02-2005 | NONE | |
| JP 2017131369 A | 03-08-2017 | NONE | |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- US 63508943 **[0001]**