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(54) BUILDING TERMINAL FAN COIL UNIT WITH GAS CONTAMINENTS REMOVAL, TRANSPORT REFRIGERATION SYSTEM WITH GAS CONTAMINENTS REMOVAL, AND METHODS FOR SAME

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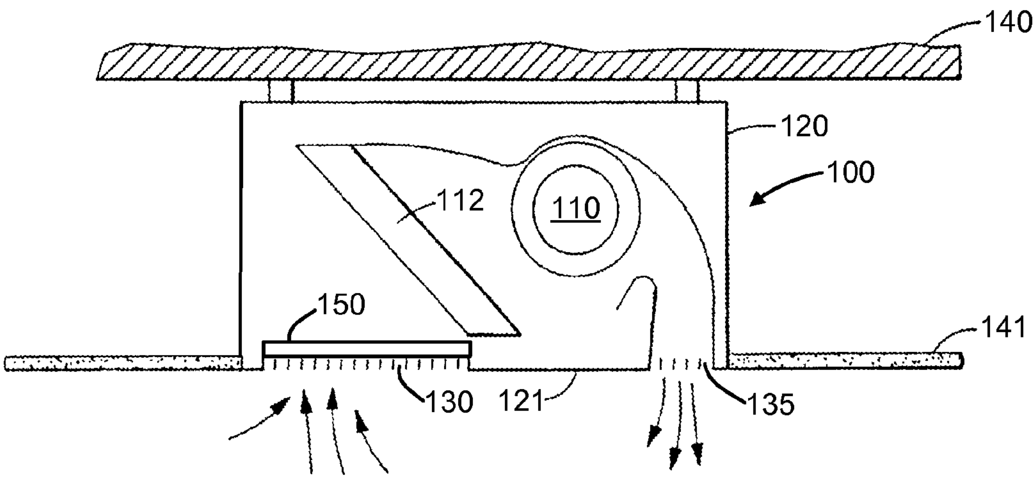
(57) **ABSTRACT**

Embodiments of systems, apparatus, and/or methods can provide conditioning building terminal fan coil units (e.g., ceiling mounted) configured with a filter to remove particles, selected gases such as formaldehyde, or provide biocidal capability while retaining sufficient FCU airflow. Embodiments of systems, apparatus, and/or methods according to the application can provide a transport refrigeration system and/or components to regulate ethylene gas levels in airflow, for example, of air conditioned by the transport refrigeration system. In one embodiment, a portion of the air conditioned by the transport refrigeration system can pass through an ethylene filter.



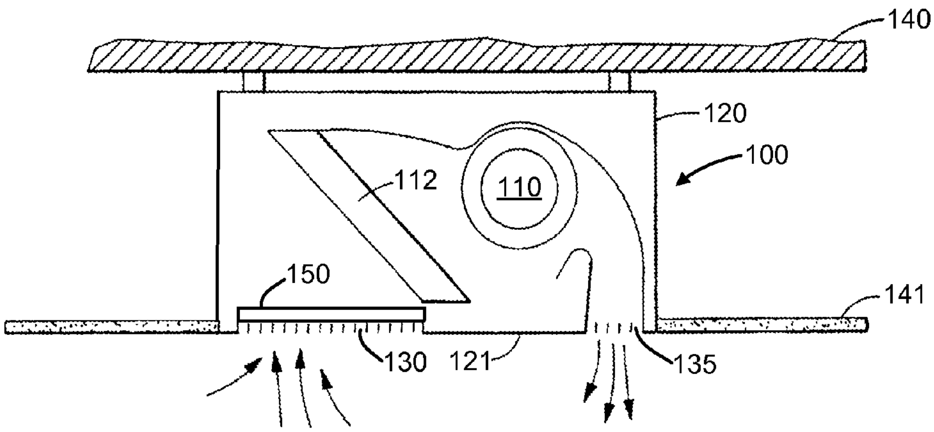


FIG. 1

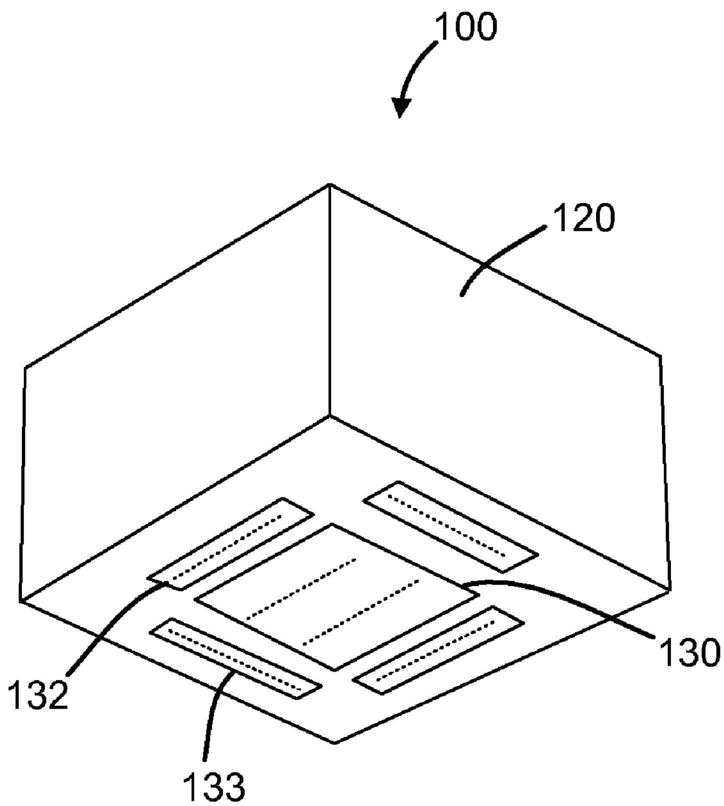


FIG. 2

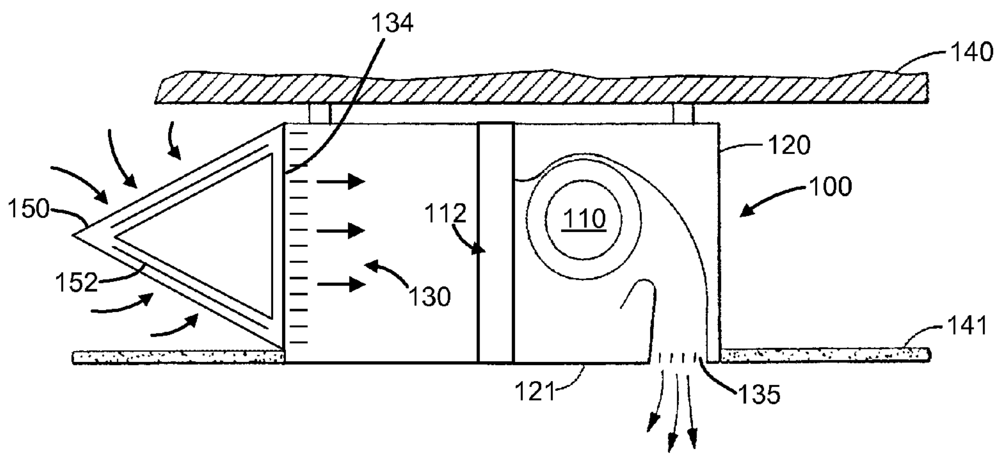


FIG. 3

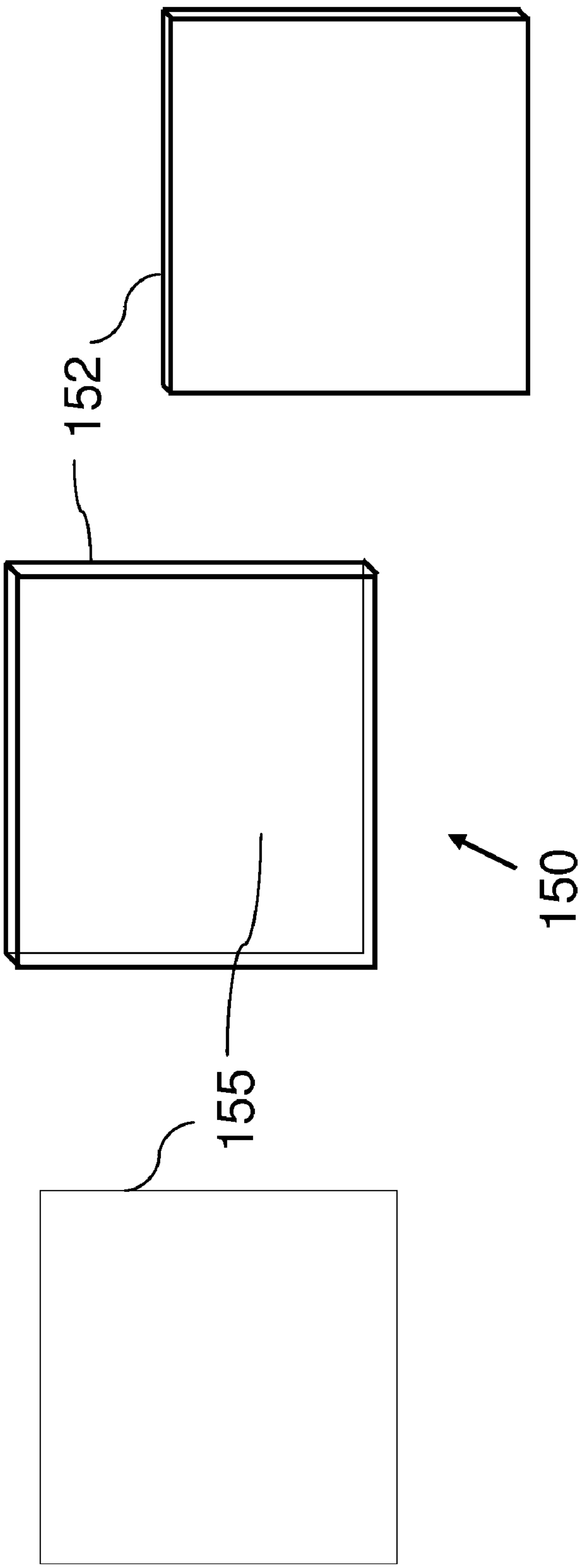


FIG. 4A

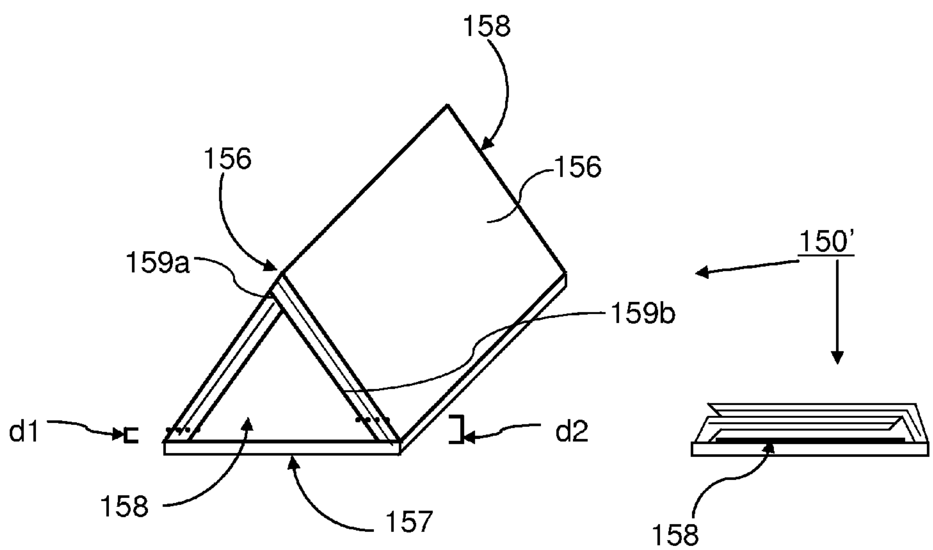
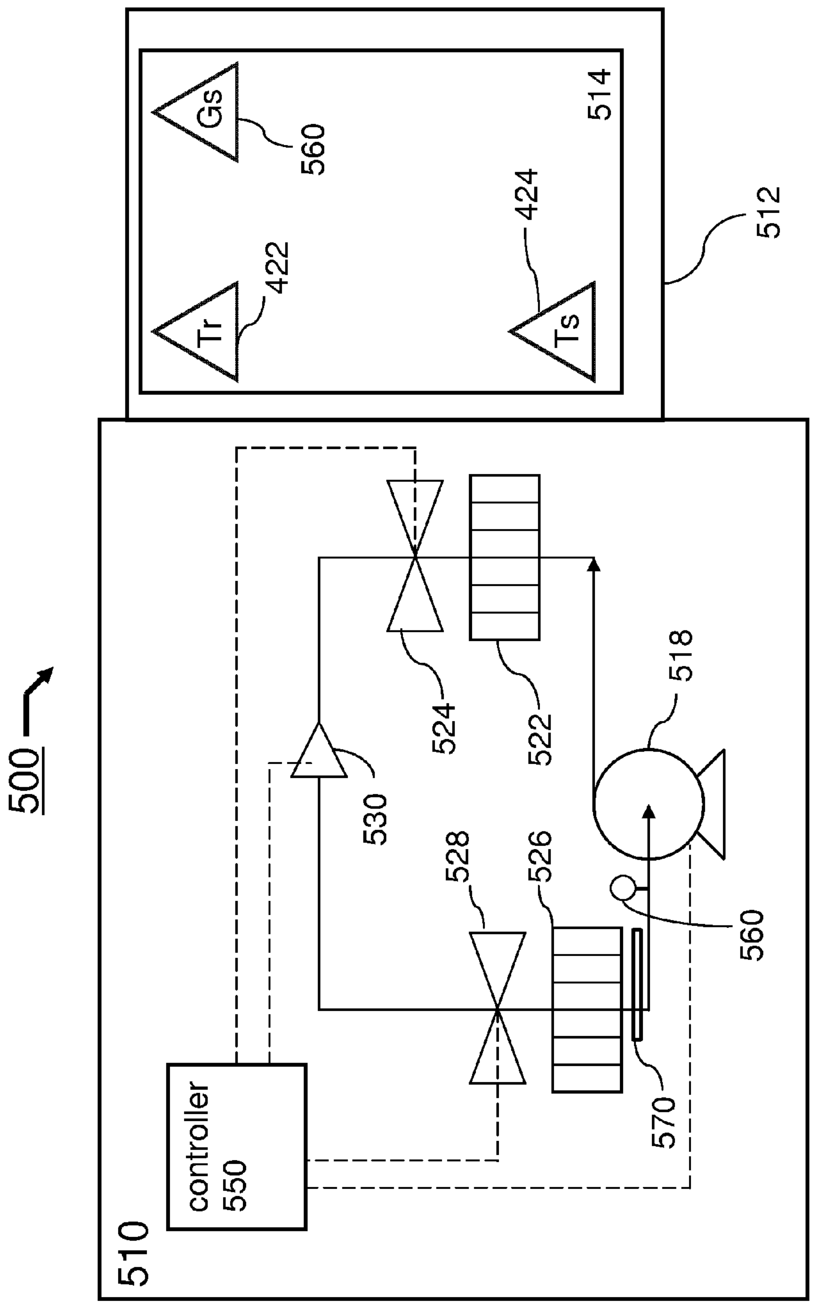


FIG. 4B



500
510
512
514
Gs
560
Tr
422
Ts
424
controller
550
524
522
518
530
528
526
560
570

FIG. 5

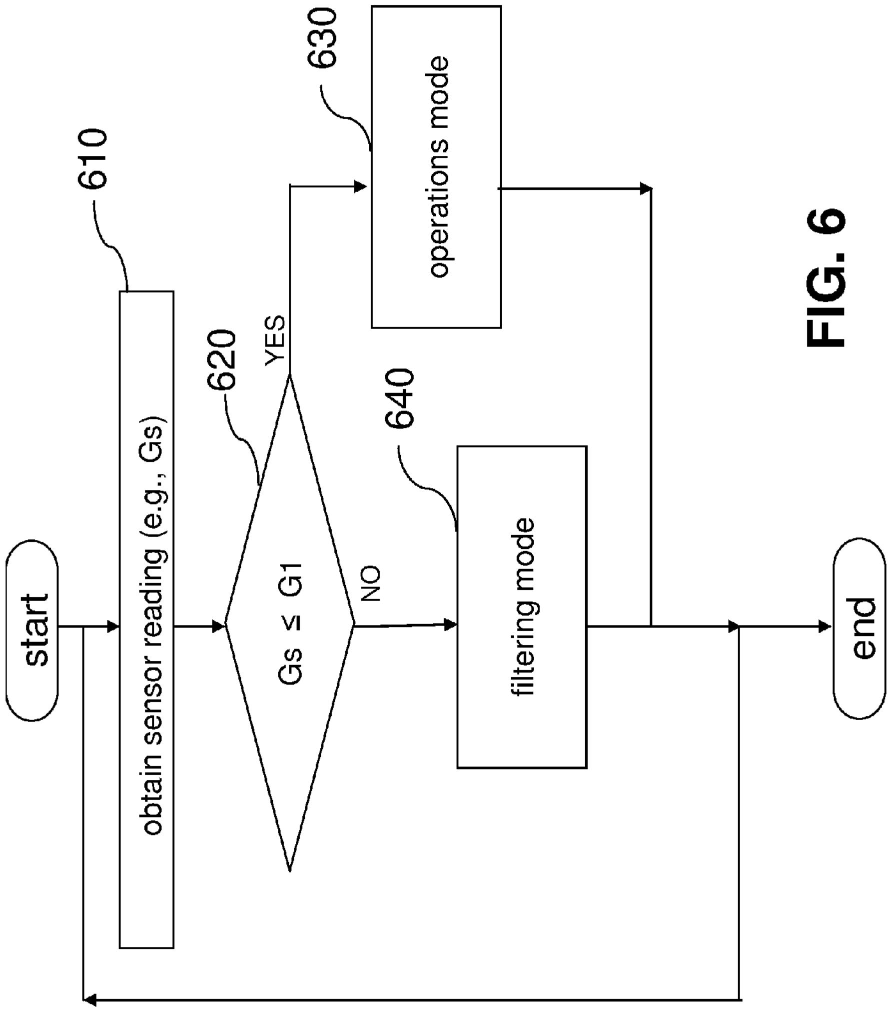

start
610
obtain sensor reading (e.g., Gs)
620
Gs ≤ G1
YES
NO
630
operations mode
640
filtering mode
end

FIG. 6

BUILDING TERMINAL FAN COIL UNIT WITH GAS CONTAMINENTS REMOVAL, TRANSPORT REFRIGERATION SYSTEM WITH GAS CONTAMINENTS REMOVAL, AND METHODS FOR SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] Reference is made to and this application claims priority from and the benefit of U.S. Provisional Application Ser. No. 61/250,761, filed Oct. 12, 2009, and entitled BUILDING TERMINAL FAN COIL UNIT WITH GAS CONTAMINANTS REMOVAL, TRANSPORT REFRIGERATION SYSTEM WITH GAS CONTAMINANTS REMOVAL, AND METHODS FOR SAME, which application is incorporated herein in its entirety by reference.

FIELD OF THE INVENTION

[0002] This invention relates generally to the field of building terminal fan coil units (FCU), transport refrigeration systems, and methods of operating the same.

BACKGROUND OF THE INVENTION

[0003] Building terminal fan coil units can be used in buildings to control thermal comfort (e.g., temperature and humidity) and air quality. Building terminal fan coil units can be mounted on or above a ceiling, on or in the wall, or on or below the floor of a room. The related art removal of airborne indoor contaminants, which include particles, gases, and biologicals, is limited because of hardware size limitations and fan pressure constraints. Related art building terminal fan coil units provide only limited particle removal capabilities and no gases and biological removal attributes.

[0004] Perishable items must be maintained within a temperature range to reduce or prevent, depending on the items, spoilage, or conversely damage from freezing during transport. A transport refrigeration unit is used to maintain proper conditions within a transport cargo space. The transport refrigeration unit can regulate conditioned air delivery by the transport refrigeration unit to a container or the transport cargo space. Further, the presence of harmful gases or biologicals should be reduced or eliminated within the refrigerated storage area. For gases, related art transportation refrigeration units can use outdoor air ventilation to reduce gas concentration levels through dilution.

SUMMARY OF THE INVENTION

[0005] In view of the background, it is an object of the application to provide building terminal fan coil units and methods for same.

[0006] Another object of the application is to provide a building terminal fan coil unit and methods for same that incorporate an integrated airborne particle and gas removal capability into the FCU design.

[0007] One embodiment of a building terminal fan coil unit according to the application can include a formaldehyde gas removal filter as an integral component of the FCU.

[0008] In view of the background, it is an object of the application to provide a transport refrigeration system, transport refrigeration unit, and methods of operating same that can maintain cargo quality or environment by selectively controlling transport refrigeration system components.

[0009] One embodiment according to the application can include an ethylene filter for a transport refrigeration system. The ethylene filter can be selectively mounted in the transport refrigeration system. The ethylene filter can be an integral component of the transport refrigeration unit.

[0010] One embodiment according to the application can include a control module for a transport refrigeration system for controlling the transport refrigeration system to regulate airflow, for example, of air conditioned by the transport refrigeration system, so that a portion of the airflow can pass through the ethylene filter.

[0011] One embodiment of a transport refrigeration system according to the application can include a sensing and a control module to control the portion of airflow passing through the ethylene filter and/or ventilation airflow to regulate the concentration of ethylene gas inside the refrigerated space.

[0012] In an aspect of the invention, a building terminal fan coil unit can include an airflow inlet opening and a airflow outlet opening and a fan disposed in the enclosure, and operable to cause air to flow into the airflow inlet opening and out of the airflow outlet opening, a heat exchanger positioned inside the enclosure so that the airflow will pass therethrough; and an integrated gas removal filter positioned so that the airflow will pass therethrough, said filter operable to provide a physical material removal capability and a formaldehyde gas removal capability with one percent (1%) or more formaldehyde gas removal by filter media weight and less than a 30 Pascal pressure drop at a face airflow rate of 1 m/sec.

[0013] In an aspect of the invention, an apparatus for controlling ethylene concentration to perishable goods in a mobile container having a refrigeration module for delivering conditioned air into the container, the apparatus can include an outlet port to supply air from the refrigeration unit; an inlet port to return air to the refrigeration unit, at least one filter to remove ethylene gas mounted at the refrigeration unit, and a controller coupled to control operation of the refrigeration unit.

[0014] In an aspect of the invention, a method of operating a transport refrigeration unit can include determining an ethylene gas level, comparing said ethylene gas level to a corresponding threshold value, entering a filtering mode of said transport refrigeration unit to reduce the ethylene gas level when the ethylene gas level is greater than the threshold value, and exiting the filtering mode of the transport refrigeration unit when the ethylene gas level is less than the threshold value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Novel features that are characteristic of exemplary embodiments of the invention are set forth with particularity in the claims. Embodiments of the invention itself may be best be understood, with respect to its organization and method of operation, with reference to the following description taken in connection with the accompanying drawings in which:

[0016] FIG. **1** is a schematic view of an embodiment of a building terminal fan coil unit according to the application where an exemplary single air inlet and an exemplary single air outlet are shown;

[0017] FIG. **2** is an isometric view of an embodiment of a building terminal fan coil unit according to the application where an exemplary single air inlet and exemplary multiple air outlets are shown;

[0018] FIG. 3 is a schematic view of an embodiment of a building terminal fan coil unit located above a dropped ceiling according to the application where an exemplary single unducted return air inlet above the ceiling and an exemplary single supply air outlet into a room are shown;

[0019] FIG. 4A is a diagram illustrating an exemplary filter for a building terminal fan coil unit according to an embodiment of the application;

[0020] FIG. 4B is a diagram illustrating another exemplary filter for a building terminal fan coil unit according to an embodiment of the application;

[0021] FIG. 5 is a diagram that shows an embodiment of a transport refrigeration system according to the application;

[0022] FIG. 6 is a flowchart that shows an embodiment of a method for operating a transport refrigeration system according to the application.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0023] Reference will now be made in detail to exemplary embodiments of the application, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts.

[0024] FIG. 1 is a diagram that shows an exemplary embodiment of a building terminal fan coil unit according to the application. As shown in FIG. 1, a building terminal fan coil unit **100** can be stand alone mounted in a room. In one embodiment, a building terminal fan coil unit **100** can be mounted attached to building structure **140** and recessed in drop ceiling **141**. Inside a housing **120** of a building terminal fan coil unit **100** are a fan **110** and a heat exchanger **112**. In a bottom wall **121** of housing **120** can be at least one fan inlet **130** and at least one fan outlet **135**. The fan **110** can draw air from the corresponding room (e.g., through the inlet **130**) and through the heat exchanger **112**, and to discharge conditioned air back to the room through the outlet **135**. In one embodiment, a building terminal fan coil unit **100** can be a room air conditioning unit.

[0025] As shown in FIG. 2, additional fan outlets **132**, **133** can be provided on a lower surface of the housing **120** of a building terminal fan coil unit **100**. Alternatively, more than one fan inlet can be used.

[0026] In operation, the fan **110** draws air in through the inlet **130** (e.g., return air), passes the air through a filter **150**, passes the air through the heat exchanger **112** where it is conditioned, and then the air discharges back into the room via outlet **135** (e.g., **132**, **133**). Alternatively, components of the building terminal fan coil unit **100** can use other arrangements, for example, the heat exchanger **112** can be located after the fan **110** in the airflow or the components can surround the fan **110** as in a cassette FCU arrangement.

[0027] FIG. 3 is a schematic view of an embodiment of a building terminal fan coil unit according to the application where a single ducted air inlet/a return air plenum above the ceiling and a single air outlet into the room are shown. As shown in FIG. 3, fan inlet **134** can be formed in side walls (e.g., a single side wall) respectively of the housing **120** and are to be in fluid flow communication with that normally dead air space between the building structure **140** and the drop ceiling **141**. In one embodiment, return air (e.g., ducts, vents) components are not integrated as part of a building fan coil unit **100**. Accordingly, a duct (not shown)/a return air plenum providing fluid flow connection from the room through the drop ceiling **141** can be spaced apart from a building fan coil unit **100**. Alternatively, the spaced apart return air component can be coupled to a fan inlet (e.g., **134**) of the building terminal fan coil unit **100**. Accordingly, a duct (not shown)/a supply air plenum providing fluid flow connection to the room through the drop ceiling **141** can be spaced apart from a building fan coil unit **100**. Alternatively, the spaced apart supply air component can be coupled to a fan outlet (e.g., fan outlet **135**) in a sidewall of the building terminal fan coil unit **100** to eliminate an airflow outlet directly through the housing **120** to the room.

[0028] In one embodiment, building terminal fan coil units can be mounted on or above a ceiling, on or in the wall, or on or in the floor of a room. Further, embodiments of a building terminal fan coil unit according to the application may also be mounted in a room that does not have a drop ceiling.

[0029] In one embodiment, the building terminal fan coil unit **100** can be a fan coil unit to include the filter **150** positioned in the airflow of the indoor unit (e.g., between the inlet **130** and the outlet **135**). The filter **150** can be mounted outside the housing **120** or inside the housing **120** or at the airflow inlet for easy maintenance. The filter **150** can be configured to reduce contaminants including combinations of particles, gases, and biologicals.

[0030] The inventors developed a low-pressure-drop, flat filter **150** that can be installed (e.g., at the return air inlet of building terminal fan coil units) to provide an effective gas contaminants removal capability. As shown in FIG. 4A, in one embodiment, the filter **150** is constructed from four major elements. These include the filter media **152**, a cover web **155** on either side of the filter media, and filter frame. The filter media **152** has been specifically designed to increase or maximize gas removal capabilities while reducing or minimizing pressure drop characteristics. The cover web **155** has been designed to provide both a particle removal and biological neutralization capability while reducing or minimizing pressure drop characteristics. In one embodiment, a biocide agent can be sprayed to adhere to the cover web **155**. Filter media **152** is an adsorption media found to meet the range of specific particle removal criteria, airflow rates, filter pressure drop budgets, and volatile organic compound (e.g., formaldehyde) gas adsorption properties required while properly working within the operating envelop of the building terminal fan coil unit.

[0031] In one embodiment, the filter media **152** comprises activated carbon or charcoal to provide (a) one percent (1%) or more formaldehyde gas removal by filter media weight, (b) and less than a 25-30 Pascal pressure drop (e.g., 0.120439 inches of water [4° C.]) at 1 meter per second face air velocity. In one embodiment, the filter media **152** can provide a 0.5%-1% or more formaldehyde gas removal by filter media weight and less than a 20-10 Pascal pressure drop at 1 m/s face air velocity (e.g., 0.080293-0.041463 inches of water [4° C]).).

[0032] In one embodiment, the filter **150** can be a low-pressure-drop, flat activated carbon filter (e.g., 5-10 mm thickness or 0.19-0.39 inches). In one embodiment, the filter **150** can be a "deep-V" activated charcoal filter. In one embodiment, the filter **150** can be a low-pressure-drop, pleated activated carbon filter. The activated carbon granules can be attached to a woven or non-woven polymer net structure that results in an open structure in the mesh to improve airflow and granule density, while maintaining granule adhesion. In one embodiment, exemplary filter media **152** employs activated carbon, impregnated with a chemisorbant that targets formaldehyde. Exemplary chemisorbants include tris-hydroxyaminomethyl, solid amine, sodium manganese oxide, ethylene urea and phosphoric acid.

[0033] As show in FIG. **3**, the filter **150** can be constructed in a "deep-V" configuration. In one embodiment, a deep-V configuration filter **150'** as shown in FIG. **4**B can include a shipping position and an operating position or installation position (e.g., FIG. **3**). The deep-V configuration of the filter **150'** can provide at least two surfaces that incorporate filter material **152**. Thus, a surface area of filter media in the filter **150'** that can pass air therethrough can be located in two places (e.g., to double a filter area) to decrease the pressure at the same airflow or increase the airflow at the same pressure. In either of the two previous examples, the deep-V filter **150'** can increase longevity of the filter or increase the time during which contaminants (e.g., formaldehyde) are effectively removed (e.g., lifetime) of the filter **150'** relative to filter **150**.

[0034] In one embodiment as shown in FIG. **4**B, the filter **150'** includes two filtering side surfaces **156**, an air passing bottom surface **157**, (e.g., without a pressure drop or filtering), and two relatively thin airflow-blocking end surfaces **158**. An exemplary length of the side surface can be approximately equal to or larger than a width of the bottom surface **157**. In one embodiment, the shipping position of the filter **150'** is flat or includes substantially two flat top and bottom surfaces.

[0035] In one embodiment, the filter **150'** rotatably connects the end surfaces **158** to the bottom surface **157**. As shown in FIG. **4**B, an edge connection rotatably connects a first side surface **156** at a first offset distance dl from the bottom surface **157**, and rotatably connects the second side surface **156** at a second offset distance d2 from the bottom surface **157**. The second offset distance d2 can be greater or less than the first offset distance d**1**. Further, a first connector **159***a* can connect the side surfaces together and a second connector **159***b* can connect the end surfaces **158** to the at least one side surface **156** in the installation position. The connectors **159***a*, **159***b* such as for example, releasable relatively airtight mechanical connectors such as, but not limited to slit and tab connectors, hook and groove connectors or the like.

[0036] In one embodiment, the side surfaces **156** are hingedly connected to the bottom surface **157**, and the end surfaces **158** are hingedly connected to the bottom surface **157**. In one embodiment, the shipping position of the filter **150'** is flat or includes substantially two parallel top and bottom surfaces. For example, a first parallel surface (e.g., lower) can be provided by the bottom surface **157** and a second parallel surface (e.g., upper) can be provided by the side surface **156**. In one embodiment, the filter **150'** can be mounted inside or outside the housing **120**.

[0037] FIG. **5** is a diagram that shows an embodiment of a transport refrigeration system. As shown in FIG. **5**, a transport refrigeration system **500** can include a transport refrigeration unit **510** coupled to a container **512**, which can be used with a trailer, an intermodal container, a train railcar, a ship or the like, used for the transportation or storage of goods requiring a temperature controlled environment, such as, for example foodstuffs and medicines (e.g., perishable or frozen). The transport refrigeration unit **510** is configured to maintain a prescribed environment (e.g., thermal, humidity, cargo respiration, presence of gases, presence of chemicals, schedule, or species concentration of the enclosed volume) within the container **512** (e.g., cargo in an enclosed volume). The container **512** can include an enclosed volume **514** for the transport/storage of such goods. The enclosed volume **514** may be an enclosed space having an interior atmosphere isolated from the outside (e.g., ambient atmosphere or conditions) of the container **512**.

[0038] In one embodiment, the transport refrigeration unit **510** can include a compressor **518**, a condenser heat exchanger unit **522**, a condenser fan **524**, an evaporation heat exchanger unit **526**, an evaporation fan **528**, and a controller **550**. The transport refrigeration unit **510** can include an optional filter **570** that can be selectively coupled to a conditioned airflow exiting the transport refrigeration unit **510**.

[0039] The compressor **518** can be powered by single phase electric power, three phase electrical power, and/or a diesel engine and can, for example, operate at a constant speed. The compressor **518** may be a scroll compressor, a rotary compressor, a reciprocal compressor, or the like. The transport refrigeration system **500** requires electrical power from, and can be connected to a power supply unit (not shown) such as a standard commercial power service, an external power generation system (e.g., shipboard), a generator (e.g., diesel generator), or the like.

[0040] The condenser heat exchanger unit **522** can be operatively coupled to an outlet port of the compressor **518**. The evaporator heat exchanger unit **526** can be operatively coupled to an input port of the compressor **518**. An expansion valve **530** can be connected between an output of the condenser heat exchanger unit **522** and an input of the evaporator heat exchanger unit **526**.

[0041] The condenser fan **524** can be positioned to direct an air stream onto the condenser heat exchanger unit **522**. The air stream from the condenser fan **524** can allow heat to be removed from the coolant circulating within the condenser heat exchanger unit **522**. Alternatively, the condenser **522** can be implemented as a gas cooler.

[0042] The evaporator fan **528** can be positioned to direct an air stream onto the evaporation heat exchanger unit **526**. The evaporator fan **528** can be located and ducted so as to circulate the air contained within the enclosed volume **514** of the container **512**. In one embodiment, the evaporator fan **530** can direct the stream of air across the surface of the evaporator heat exchanger unit **526**. Heat can thereby be removed from the air, and the reduced temperature air can be circulated within the enclosed volume **514** of the container **512** to lower the temperature of the enclosed volume **514**. As shown in FIG. **5**, first and second temperature sensors **424**, **422** of the transport refrigeration unit **510** can provide the supply air temperature Ts and the return air temperature Tr to the transport refrigeration unit **510**, respectively.

[0043] The controller **550** such as, for example, a MicroLink™ **2***i* controller available from Carrier Corporation of Syracuse, N.Y., USA, can be electrically connected to the compressor **518**, the condenser fan **524**, and/or the evaporator fan **528**. The controller **550** can be configured to operate the transport refrigeration unit **510** to maintain a predetermined environment (e.g., thermal environment) within the enclosed volume **514** of the container **512**. The controller **550** can maintain the predetermined environment by selectively controlling modes of operation, or operations of one or more components of the transport refrigeration unit **510**.

[0044] In one embodiment, the filter **570** is constructed from four major elements including filter media, a cover web on either side of the filter media, and filter frame. The filter media has been specifically designed to increase or maximize ethylene gas removal capabilities while reducing or minimizing pressure drop characteristics or satisfying airflow requirement of the transport refrigeration unit. In one embodiment, exemplary filter media in the filter **570** employs activated carbon or charcoal, impregnated with a catalyst that targets ethylene. An exemplary catalyst for the filter **570** can be palladium.

[0045] In one embodiment, the filter **570** can be configured to be mounted through a thermal wall or barrier separating the transport refrigeration unit **510** into a first conditioned portion (e.g., housing the evaporator) and a second ambient portion. In this configuration, the filter **570** can be accessed (e.g., removed or changed) through a door or access panel on the ambient side of the transport refrigeration unit **510**. For example, the filter **570** can be accessed without exposing the conditioned side of the transport refrigeration unit **510** or disconnecting the transport refrigeration unit **510** from the cargo.

[0046] In one embodiment, the filter **570** can be mounted in a stand-alone unit configured to operate in the enclosed space **514** or the container **512**.

[0047] In one embodiment, the filter **570** can be mounted in a prescribed passage or duct configured to selectively pass a portion of the conditioned air to be output by the transport refrigeration unit **510**. When the passageway is open, conditioned air impinges the filter **570**, and filtered conditioned air is output by the transport refrigeration unit **510**. When the passageway is closed, conditioned air does not impinge the filter **570**.

[0048] An embodiment of a method of operating a transport refrigeration system according to the application will now be described. The method embodiment shown in FIG. **6**, can be implemented in and will be described using a transport refrigeration system embodiment shown in FIG. **5**, however, the method embodiment is not intended to be limited thereby.

[0049] As shown in FIG. **6**, after a process starts, a sensor reading such as concentration of gas (e.g., Gs) is obtained (operation block **610**). In one embodiment, the gas concentration of gas can be ethylene measured by a sensor **560** mounted in the transport refrigeration unit **510** or a remote sensor **562** mounted in the enclosed space **514**. Then, the sensor reading can be compared to a corresponding selected threshold value or range (e.g., G**1**) for the concentration of gas (operation block **320**). In one embodiment, when the sensor reading Gs is less than or equal to the selected value (G**1**) or within a selected range, an operations mode of the transport refrigeration system **510** is entered (operation block **630**). Otherwise, a filtering mode of the transport refrigeration unit **510** is entered (operation block **640**). From either operation block **630** or operations block **640**, control can jump back to repeatedly obtain and compare the sensor reading (operations blocks **610**, **620**) until the process ends.

[0050] In the embodiment of a method of operating a transport refrigeration unit of FIG. **6**, an ethylene gas concentration sensor reading can be repeatedly compared to a selected operating range. For example, the repeated sensor reading can be determined periodically, aperiodically, intermittently, checked once per second while operating in a first mode, checked one per minute when operating in a second mode, based on prescribed criteria or responsive to an operator action. Accordingly, embodiments of the application can control or use ethylene characteristics for reducing or preventing damage (e.g., spoilage) or to control ripening to cargo such as perishable goods in transit.

[0051] In one embodiment, the filter **570** can be mounted in a prescribed passage or duct configured to pass a portion of the supply air discharged to the enclosed space **514**. Thus, in a first mode (e.g., selected by the controller **550**), the prescribed passage is opened and the filter **570** can operate to remove ethylene from the air (e.g., conditioned air) impinging filter **570** and passing therethrough. In a second mode (e.g., selected by the controller **550**), the prescribed passage is closed and the filter **570** is prevented from removing ethylene or significantly affecting levels of ethylene in the container **512** or in the conditioned air output by the transport refrigeration unit **510**. In one embodiment, the filter **570** can be configured to cover an outlet port discharging supply air to the enclosed space **514** or to cover an inlet port conveying return air from the enclosed space **510** to the transport refrigeration unit **510**.

[0052] Although embodiments of the application have described an integrated sensor or a remote cargo sensor as capable of monitoring gas levels of the cargo (e.g., directly or indirectly), embodiments of the application are not intended to be so limited. For example, the remote cargo sensor may monitor other transport container characteristics such as temperature, humidity, species concentration (e.g., CO, O_3, CO_2, N_2, or the like), cargo respiration, or similar ambient conditions outside the container. Such monitoring can result in controlling (e.g., by the controller **550** or refrigeration unit **510**) the monitored characteristic to be below a selected value or within a selected range as known to one skilled in the art. For example, if a CO_2 level were too high in the container, outdoor air can replace a portion of the enclosed volume of air to reduce the CO_2 level until it is considered appropriate again.

[0053] The container **512** illustrated in FIG. **5** may be towed by a semi-truck for road transport. However, those having ordinary skill in the art will appreciate that exemplary containers according to embodiments of the application is not limited to such trailers and may encompass, by way of example only and not by way of limitation, trailers adapted for piggy-back use, railroad cars, and container bodies contemplated for land and sea service.

[0054] Components of the transport refrigeration unit (e.g., motors, fans, sensors), as known to one skilled in the art, can communicate with a controller (e.g., transport refrigeration unit **10**) through wire or wireless communications. For example, wireless communications can include one or more radio transceivers such as one or more of 802.11 radio transceiver, Bluetooth radio transceiver, GSM/GPS radio transceiver or WIMAX (802.16) radio transceiver. Information collected by sensor and components can be used as input parameters for a controller to control various components in transport refrigeration systems. In one embodiment, sensors may monitor additional criteria such as humidity, species concentration or the like in the container.

[0055] Embodiments of the application have been described herein with reference to a heat evaporation type heat exchanger. However, embodiments of the application are not intended to be so limited. For example, a heat absorption type heat exchanger can replace a heat evaporation type heat exchanger. Further, circulating fluid heat exchanges can replace fans (e.g., condenser fan).

[0056] While the present invention has been described with reference to a number of specific embodiments, it will be understood that the true spirit and scope of the invention should be determined only with respect to claims that can be supported by the present specification. Further, while in numerous cases herein wherein systems and apparatuses and methods are described as having a certain number of elements it will be understood that such systems, apparatuses and methods can be practiced with fewer than the mentioned certain number of elements. Also, while a number of particular embodiments have been set forth, it will be understood that features and aspects that have been described with reference to each particular embodiment can be used with each remaining particularly set forth embodiment. For example, aspects and/or features of embodiments described with respect to FIG. **5** can be combined with aspects or features of embodiments described with respect to FIG. **6**.

We claim:

1. A building terminal fan coil unit comprising:

an airflow inlet opening and an airflow outlet opening in an enclosure;

a fan disposed in the enclosure, and operable to cause air to flow into the airflow inlet opening and out of the airflow outlet opening;

a heat exchanger positioned inside the enclosure so that the airflow will pass therethrough; and

a gas removal filter positioned so that the airflow will pass therethrough, said filter operable to provide a physical material removal capability and a formaldehyde gas removal capability.

2. The building terminal fan coil unit of claim **1**, said filter operable to provide a biocide capability.

3. The building terminal fan coil unit of claim **1**, where the filter is flat.

4. The building terminal fan coil unit of claim **1**, where the filter has a deep-V configuration.

5. The building terminal fan coil unit of claim **1**, where the filter is pleated.

6. The building terminal fan coil unit of claim **1**, where the filter is mounted inside or outside the enclosure, the formaldehyde gas removal capability to provide one percent (1%) or more formaldehyde gas removal by filter media weight and less than a 30 Pascal pressure drop at a face airflow rate of 1 msec.

7. The building terminal fan coil unit of claim **1**, where the filter is mounted to cover the airflow inlet opening or the airflow outlet opening.

8. The building terminal fan coil unit of claim **1**, where the airflow inlet opening is in one or more side walls of the housing above a false ceiling, where the airflow inlet opening includes a plurality of openings, when the airflow outlet opening includes a plurality of outlet openings.

9. Apparatus for controlling ethylene concentration to perishable goods in a mobile container having a refrigeration module for delivering conditioned air into the container, said apparatus comprising:

a refrigeration unit including:

an outlet port to supply air from the refrigeration unit;

an inlet port to return air to the refrigeration unit;

at least one filter to remove ethylene gas mounted at the refrigeration unit; and

a controller coupled to control operation of the refrigeration unit.

10. The apparatus of claim **9**, comprising at least one sensor unit to detect an ethylene gas level.

11. The apparatus of claim **10**, the filter mounted in the container area.

12. The apparatus of claim **10**, the filter mounted in a configurable passageway that can be selectively connected between the outlet port and the inlet port.

13. The apparatus of claim **12**, where the filter is accessed through a panel door at an ambient side of the refrigeration unit.

14. The apparatus of claim **10**, where the sensor unit is in the refrigeration unit or the container.

15. A method of operating a transport refrigeration unit, comprising:

determining an ethylene gas level;

comparing said ethylene gas level to a corresponding threshold value;

entering a filtering mode of said transport refrigeration unit to reduce the ethylene gas level when the ethylene gas level is greater than the threshold value; and

exiting the filtering mode of the transport refrigeration unit when the ethylene gas level is less than the threshold value.

16. The method of claim **15**, wherein said filtering mode passes a portion of supply air provided by the transportation refrigeration unit through a filter treated with a catalyst for ethylene decomposition.

17. The method of claim **15**, wherein said sensing activates a filtering unit separate from the transport refrigeration unit, the filtering unit to include a filter treated with a catalyst for ethylene.

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