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### ENERGY RECOVERY VENTILATOR OF AN AIR CONDITIONING APPLIANCE

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#### Abstract

An energy recovery ventilator for an air conditioner unit includes a ventilator cabinet defining a primary flow path and an energy recovery path, a heat exchanger positioned within the ventilator cabinet, wherein the primary flow path and the energy recovery path are fluidly isolated and thermally coupled within the heat exchanger; a primary fan fluidly coupled to the primary flow path for urging a flow of make-up air into an indoor portion of the air conditioner unit, and an auxiliary fan fluidly coupled to the energy recovery path for drawing a flow exhaust air through the energy recovery path.

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#### Background/Summary

## FIELD OF THE INVENTION

[0001] The present subject matter relates generally to air conditioning appliances, and more particularly to features for energy recovery in air conditioning appliances.

## BACKGROUND OF THE INVENTION

[0002] Air conditioner or conditioning units are conventionally utilized to adjust the temperature indoors, e.g., within structures such as dwellings and office buildings. Such units commonly include a closed refrigeration loop to heat or cool the indoor air. Typically, the indoor air is recirculated while being heated or cooled. A variety of sizes and configurations are available for such air conditioner units. For example, some units may have one portion installed indoors that is connected to another portion located outdoors, e.g., by tubing or conduit carrying refrigerant. These types of units are typically used for conditioning the air in larger spaces.

[0003] Another type of air conditioner unit, commonly referred to as single-package vertical units (SPVU) or package terminal air conditioners (PTAC), may be utilized to adjust the temperature in, for example, a single room or group of rooms of a structure. These units typically operate like split heat pump systems, except that the indoor and outdoor portions are defined by a bulkhead and all system components are housed within a single package that is installed in a wall sleeve positioned within an opening of an exterior wall of a building. In this regard, such units commonly include an indoor portion that communicates (e.g., exchanges air) with the area within a building and an outdoor portion that generally communicates (e.g., exchanges air) with the area outside a building. Accordingly, the air conditioner unit generally extends through, for example, an outer wall of the structure, or is otherwise ducted to the outdoors.

[0004] SPVUs often need to draw air from the outdoor portion into the indoor portion. Accordingly, certain SPVUs allow for the introduction of make-up air into the indoor space, e.g., through a make-up air plenum or duct that extends between the indoor and outdoor side of the unit. The make-up air duct is usually equipped with a fan and/or make-up air module to urge a flow of make-up air from the outdoor side of the SPVU into the conditioned room. Notably, SPVUs that use a make-up air module for supplying make-up air from outdoors often suffer from inefficiencies. For example, the addition of outdoor make-up air adds a large amount of heating or cooling load to the space being conditioned.

[0005] Accordingly, an air conditioner unit with improved efficiency would be useful. More specifically, an SPVU that is capable of utilizing make-up air without excessive energy losses associated with the use of outdoor make-up air would be particularly beneficial.

## BRIEF DESCRIPTION OF THE INVENTION

[0006] Aspects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

[0007] In one exemplary embodiment, an air conditioner unit defining a vertical, a lateral, and a transverse direction is provided. The air conditioner unit includes a cabinet defining an indoor inlet and an indoor outlet, a bulkhead mounted within the cabinet to define an indoor portion and an outdoor portion, and an energy recovery ventilator mounted to the cabinet. The energy recovery ventilator includes a ventilator cabinet defining a primary flow path and an energy recovery path, a heat exchanger positioned within the ventilator cabinet, wherein the primary flow path and the energy recovery path are fluidly isolated and thermally coupled within the heat exchanger, a primary fan fluidly coupled to the primary flow path for urging a flow of make-up air into the indoor portion, and an auxiliary fan fluidly coupled to the energy recovery path for drawing a flow exhaust air through the energy recovery path.

[0008] In another exemplary embodiment, an energy recovery ventilator for an air conditioner unit, the energy recovery ventilator including a ventilator cabinet defining a primary flow path and an energy recovery path, a heat exchanger positioned within the ventilator cabinet, wherein the

primary flow path and the energy recovery path are fluidly isolated and thermally coupled within the heat exchanger, a primary fan fluidly coupled to the primary flow path for urging a flow of make-up air into an indoor portion of the air conditioner appliance, and an auxiliary fan fluidly coupled to the energy recovery path for drawing a flow exhaust air through the energy recovery path.

[0009] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

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## **Description**

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0010] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.

[0011] FIG. 1 provides a perspective view of an air conditioning appliance including an energy recovery ventilator according to an example embodiment of the present subject matter.

[0012] FIG. 2 provides a front view of the exemplary air conditioning appliance of FIG. 1 according to an example embodiment of the present subject matter.

[0013] FIG. 3 provides a section view of the exemplary air conditioning appliance of FIG. 1 according to an example embodiment of the present subject matter.

[0014] FIG. 4 provides an exploded view of the example energy recovery ventilator of FIG. 1 according to an exemplary embodiment of the present subject matter.

[0015] FIG. 5 provides a perspective view of the example energy recovery ventilator of FIG. 1 according to an exemplary embodiment of the present subject matter.

[0016] FIG. 6 provides a perspective view of the example energy recovery ventilator of FIG. 1 with a front cover removed according to an exemplary embodiment of the present subject matter.

[0017] FIG. 7 provides a perspective view of the front cover of the example energy recovery ventilator of FIG. 1 according to an exemplary embodiment of the present subject matter.

[0018] FIG. 8 provides a side, cross-sectional view of the example air conditioner unit and energy recovery ventilator of FIG. 1 according to an exemplary embodiment of the present subject matter.

[0019] FIG. 9 provides another side, cross-sectional view of the example air conditioner unit and energy recovery ventilator of FIG. 1 according to an exemplary embodiment of the present subject matter.

[0020] FIG. 10 provides a front view of the example energy recovery ventilator of FIG. 1 according to an example embodiment of the present subject matter.

[0021] Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.

### **DETAILED DESCRIPTION**

[0022] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0023] As used herein, the terms “includes” and “including” are intended to be inclusive in a manner similar to the term “comprising.” Similarly, the term “or” is generally intended to be inclusive (i.e., “A or B” is intended to mean “A or B or both”). The terms “upstream” and “downstream” refer to the relative flow direction with respect to fluid flow in a fluid pathway. For example, “upstream” refers to the flow direction from which the fluid flows, and “downstream” refers to the flow direction to which the fluid flows. As used herein, terms of approximation, such as “substantially,” “generally,” or “about” include values within ten percent greater or less than the stated value. When used in the context of an angle or direction, such terms include within ten degrees greater or less than the stated angle or direction. For example, “generally vertical” includes directions within ten degrees of vertical in any direction, e.g., clockwise or counter-clockwise.

[0024] Turning now to the figures, FIGS. **1** through **3** illustrate an exemplary air conditioner appliance (e.g., air conditioner **100**). Specifically, FIG. **1** provides a perspective view of air conditioner **100**, FIG. **2** provides a front view of air conditioner **100**, and FIG. **3** provides a cross sectional view of air conditioner **100**. As shown, air conditioner **100** may be provided as a one-unit type air conditioner **100**, such as a single-package vertical unit (SPVU). However, it should be appreciated that aspects of the present subject matter may be used with other suitable air conditioning units or air filtering devices, such as a packaged terminal air conditioner unit (PTAC), a split heat pump system, etc.

[0025] Air conditioner **100** includes a package housing or cabinet **102** supporting and defining an indoor portion **104** and an outdoor portion **106**. Generally, air conditioner **100** generally defines a vertical direction V, a lateral direction L, and a transverse direction T. Each direction V, L, T is perpendicular to each other, such that an orthogonal coordinate system is generally defined.

[0026] In some embodiments, cabinet **102** contains various other components of the air conditioner **100**. Cabinet **102** may include, for example, a rear opening **110** (e.g., with or without a grill or grate thereacross) and a front opening **112** (e.g., with or without a grill or grate thereacross) may be spaced apart from each other along the transverse direction T. The rear opening **110** may be part of the outdoor portion **106**, while the front opening **112** is part of the indoor portion **104**. Components of the outdoor portion **106**, such as an outdoor heat exchanger **120**, outdoor fan **124**, and compressor **126** may be enclosed within cabinet **102** between front opening **112** and rear opening **110**. In certain embodiments, one or more components of outdoor portion **106** are mounted on a base pan **136**, as shown. According to exemplary embodiments, base pan **136** may be received within a drain pan, e.g., for collecting condensation formed during operation.

[0027] During certain operations, air **114** may be drawn to outdoor portion **106** through rear opening **110**. Specifically, an outdoor inlet **128** defined through cabinet **102** may receive outdoor air **114** motivated by outdoor fan **124**. Within cabinet **102**, the received outdoor air **114** may be motivated through or across outdoor fan **124**. Moreover, at least a portion of the outdoor air **114** may be motivated through or across outdoor heat exchanger **120** before exiting the rear opening **110** at an outdoor outlet **130**. It is noted that although outdoor inlet **128** is illustrated as being defined above outdoor outlet **130**, alternative embodiments may reverse this relative orientation (e.g., such that outdoor inlet **128** is defined below outdoor outlet **130**) or provide outdoor inlet **128** beside outdoor outlet **130** in a side-by-side orientation, or another suitable orientation.

[0028] As shown, indoor portion **104** may include an indoor heat exchanger **122**, a blower fan **142**, and a heating unit **132**. These components may, for example, be housed behind the front opening **112**. A bulkhead **134** may generally support or house various other components or portions thereof of the indoor portion **104**, such as the blower fan **142**. Bulkhead **134** may generally separate and define the indoor portion **104** and outdoor portion **106** within cabinet **102**. Additionally, or alternatively, bulkhead **134** or indoor heat exchanger **122** may be mounted on base pan **136** (e.g., at a higher vertical position than outdoor heat exchanger **120**), as shown.

[0029] During certain operations, air **116** may be drawn to indoor portion **104** through front opening **112**. Specifically, an indoor inlet **138** defined through cabinet **102** may receive indoor air

**116** motivated by blower fan **142**. At least a portion of the indoor air **116** may be motivated through or across indoor heat exchanger **122** (e.g., before passing to bulkhead **134**). From blower fan **142**, indoor air **116** may be motivated (e.g., across heating unit **132**) and returned to the indoor area of the room through an indoor outlet **140** defined through cabinet **102** (e.g., above indoor inlet **138** along the vertical direction V). Optionally, one or more conduits (not pictured) may be mounted on or downstream from indoor outlet **140** to further guide air **116** from air conditioner **100**. It is noted that although indoor outlet **140** is illustrated as generally directing air upward, it is understood that indoor outlet **140** may be defined in alternative embodiments to direct air in any other suitable direction.

[0030] Outdoor and indoor heat exchanger **120**, **122** may be components of a thermodynamic assembly (i.e., sealed system), which may be operated as a refrigeration assembly (and thus perform a refrigeration cycle) or, in the case of the heat pump unit embodiment, a heat pump (and thus perform a heat pump cycle). Thus, as is understood, exemplary heat pump unit embodiments may be selectively operated perform a refrigeration cycle at certain instances (e.g., while in a cooling mode) and a heat pump cycle at other instances (e.g., while in a heating mode). By contrast, exemplary A/C exclusive unit embodiments may be unable to perform a heat pump cycle (e.g., while in the heating mode), but still perform a refrigeration cycle (e.g., while in a cooling mode).

[0031] The sealed system may, for example, further include compressor **126** (e.g., mounted on base pan **136**) and an expansion device (e.g., expansion valve or capillary tube—not pictured), both of which may be in fluid communication with the heat exchangers **120**, **122** to flow refrigerant therethrough, as is generally understood. The outdoor and indoor heat exchanger **120**, **122** may each include coils **146**, **148**, as illustrated, through which a refrigerant may flow for heat exchange purposes, as is generally understood.

[0032] According to an example embodiment, compressor **126** may be a variable speed compressor. In this regard, compressor **126** may be operated at various speeds depending on the current air conditioning needs of the room and the demand on the sealed system. For example, according to an exemplary embodiment, compressor **126** may be configured to operate at any speed between a minimum speed, e.g., 1500 revolutions per minute (RPM), to a maximum rated speed, e.g., 3500 RPM. Notably, the use of variable speed compressor **126** enables efficient operation of the sealed system, minimizes unnecessary noise when compressor **126** does not need to operate at full speed, and ensures a comfortable environment within the room.

[0033] According to exemplary embodiments, air conditioner **100** may further include a plenum **144** to direct air to or from cabinet **102**. When installed, plenum **144** may be selectively attached to (e.g., fixed to or mounted against) cabinet **102** (e.g., via a suitable mechanical fastener, adhesive, gasket, etc.) and extend through a structure wall **150** (e.g., an outer wall of the structure within which air conditioner **100** is installed) and above a floor of the structure. In particular, plenum **144** extends along an axial direction X (e.g., parallel to the transverse direction T) through a hole or channel **152** in the structure wall **150** that passes from an internal surface **154** to an external surface **156**. In addition, it should be appreciated that plenum **144** may be formed from two or more telescoping structures, e.g., to accommodate different thicknesses of structure wall **150**.

[0034] The operation of air conditioner **100** including compressor **126** (and thus the sealed system generally), blower fan **142**, outdoor fan **124**, heating unit **132**, and other suitable components may be controlled by a control board or controller **158**. Controller **158** may be in communication (via for example a suitable wired or wireless connection) to such components of the air conditioner **100**. By way of example, the controller **158** may include a memory and one or more processing devices such as microprocessors, CPUs or the like, such as general or special purpose microprocessors operable to execute programming instructions or micro-control code associated with operation of air conditioner **100**. The memory may be a separate component from the processor or may be included onboard within the processor. The memory may represent random access memory such as

DRAM, or read only memory such as ROM or FLASH.

[0035] Air conditioner **100** may additionally include a control panel **160** and one or more user inputs **162**, which may be included in control panel **160**. The user inputs **162** may be in communication with the controller **158**. A user of the air conditioner **100** may interact with the user inputs **162** to operate the air conditioner **100**, and user commands may be transmitted between the user inputs **162** and controller **158** to facilitate operation of the air conditioner **100** based on such user commands. A display **164** may additionally be provided in control panel **160** and may be in communication with the controller **158**. Display **164** may, for example be a touchscreen or other text-readable display screen, or alternatively may simply be a light that can be activated and deactivated as required to provide an indication of, for example, an event or setting for the air conditioner **100**.

[0036] As explained briefly above, it may be desirable to periodically supplement the indoor air with make-up air from the outdoors. For example, in some cases it may be desirable to allow outside air (i.e., “make-up air”) to flow into the room, e.g., in order to meet government regulations, to compensate for negative pressure created within the room, etc. In addition, it may be desirable to treat or condition make-up air prior to blowing it into the room, e.g., when there is a relatively large difference between the outdoor air temperature or humidity relative to target indoor temperature or humidity levels. For example, if it is very cold outside, it may be desirable to heat the flow of make-up air prior to passing it into the room, e.g., for improved occupant comfort and improved system efficiency. Accordingly, aspects of the present subject matter are generally directed to features of air conditioner **100** that may facilitate the supply of conditioned make-up air into the room.

[0037] Referring now generally to FIGS. **1** through **10**, air conditioner **100** may generally include an energy recovery ventilator **200** that is generally configured for supplying a flow of make-up air (e.g., identified herein generally by reference numeral **202**) into indoor portion **104**, e.g., for mixing with a flow of indoor air **116**. In addition, energy recovery ventilator **200** may be configured for collecting a flow of exhaust air (e.g., identified herein generally by reference numeral **204**) and transferring thermal energy between the flow of make-up air **202** and the flow of exhaust air **204**. Energy recovery ventilator **200** will be described in more detail below according to an example embodiment. However, it should be appreciated that the embodiment described as only exemplary and is not intended to limit the scope of the present subject matter in any manner.

[0038] According to the illustrated embodiment, energy recovery ventilator **200** may generally be mounted or fixed to cabinet **102** of air conditioner **100**. Specifically, according to the illustrated embodiment, energy recovery ventilator **200** is positioned on top of cabinet **102**, though other suitable positions are possible and within the scope of the present subject matter. According to an example embodiment, energy recovery ventilator **200** generally includes a ventilator cabinet **210** through which the flow of make-up air **202** and the flow of exhaust air **204** are passed. Specifically, ventilator cabinet **210** may generally define a primary flow path **212** through which the flow of make-up air **202** passes and an energy recovery path **214** through which the flow of exhaust air **204** passes.

[0039] Although energy recovery ventilator **200** and ventilator cabinet **210** are described herein as being used with air conditioner unit **100** and being mounted directly thereon, it should be appreciated that energy recovery ventilator **200** and ventilator cabinet **210** may be used with any suitable air conditioner/heat pump system. Furthermore, any suitable positioning of the ventilator cabinet **210** is possible (e.g., remote from air conditioner unit) and any suitable routing or ducting of the primary flow path **212** and the energy recovery path **214** are possible and within the scope of the present subject matter.

[0040] Specifically, according to the illustrated embodiment, ventilator cabinet **210** may generally include a rear wall **220**, the front wall **222**, and a plurality of sidewalls **224** that generally define a square or rectangular box that defines a ventilator plenum **226**. Notably, according to an example

embodiment, in order to retain thermal energy within the ventilator cabinet **210**, ventilator cabinet **210** may generally be an insulated housing, e.g., such that the interior surfaces of ventilator cabinet **210** may be covered in an insulating material, may be formed from insulative layers, or may otherwise be suitably thermally insulated.

[0041] Referring now specifically to FIGS. **4** through **10**, ventilator cabinet **210** may generally define a fresh air inlet **230** that is fluidly coupled to an ambient environment (e.g., the outdoors). In this manner, air conditioner **100** may draw in the flow of make-up air **202** from outside of the building where air conditioner **100** is located and may pass the flow of make-up air **202** through ventilator plenum **226**. In addition, ventilator cabinet **210** may define a fresh air outlet **232** that is fluidly coupled to the indoor portion **104** of air conditioner **100**. As best shown in FIGS. **8** through **10**, fresh air inlet **230** and fresh air outlet **232** generally form a portion of primary flow path **212**.

[0042] In addition, ventilator cabinet **210** may generally define an exhaust inlet **234** that is fluidly coupled to an interior space where air conditioner **100** is located. In this regard, for example, exhaust inlet **234** may be fluidly coupled to a return air duct system from an indoor space that is conditioned by air conditioner **100**. For example, this return air duct system may collect indoor air from a connected bathroom, multiple rooms of a suite, or other areas within the indoor space. Ventilator cabinet **210** may further define an exhaust outlet **236** that is fluidly coupled to the ambient environment (e.g., the outdoors). Exhaust inlet **234** and exhaust outlet **236** may generally form a portion of energy recovery path **214**.

[0043] Notably, as described briefly above, the flow of make-up air **202** from outdoor portion **106** may have a temperature that would be uncomfortable if directed into the indoor portion **104** without being conditioned. For example, if it is very cold outside, the flow of make-up air **202** may be cool or frigid, and injecting such air into the flow of indoor air **116** may result in poor system efficiency and user dissatisfaction. By contrast, if it is very warm outside, it may be desirable to lower the temperature of the flow of make-up air **202** before injecting it into the room.

[0044] Accordingly, energy recover ventilator **200** may further include a heat exchanger **240** that is positioned within ventilator plenum **226** for transferring thermal energy to or from the flow of make-up air **202** such that the temperature of the flow of make-up air **202** is more desirable and appropriate to the conditioning needs of the room. Specifically, according to the illustrated embodiment, heat exchanger **240** may generally define a portion of primary flow path **212** through which the flow of make-up air **202** passes into the room. In addition, heat exchanger **240** may define a portion of energy recovery path **214**. As explained herein, energy recovery path **214** may generally be configured for receiving the flow of exhaust air **204** that is configured for transferring heat with the flow of make-up air **202**, e.g., via heat exchanger **240**.

[0045] More specifically, according to example embodiments, primary flow path **212** and energy recovery path **214** are fluidly isolated from each other while being thermally coupled to each other. For example, according to the illustrated embodiment, heat exchanger **240** is a crossflow air-to-air heat exchanger. In this regard, the flow of make-up air **202** and the flow of exhaust air **204** may flow through fluidly isolated passages perpendicular to each other such that thermal energy may pass between the two flows while they may remain fluidly isolated. For example, according to the illustrated embodiment, heat exchanger **240** comprises a plurality of thin plates stacked along the transverse direction T. These plates at least partially define primary flow path **212** and energy recovery path **214** and may be used to separate the two flows.

[0046] According to the illustrated embodiment, energy recovery ventilator **200** may generally include a plurality of retainer brackets that are positioned within ventilator plenum **226** and generally define a boundary of a heat exchanger cavity **244**. For example, according to the illustrated embodiment, energy recovery ventilator **200** includes four retainer brackets **242** that are positioned on the four sidewalls **224** of ventilator cabinet **210**. These retainer brackets **242** generally extend from sidewalls **224** into ventilator plenum **226** to sealingly engage respective corners of heat exchanger **240**. More specifically, a distal end **246** of each of retainer brackets **242**

may generally define a notch or V-shaped slot for receiving heat exchanger **240**. In addition, it should be appreciated that distal ends **246** may include a sealing material or gasket (not shown) for preventing air leakage between retainer brackets **242** and heat exchanger **240**.

[0047] In addition, energy recovery ventilator **200** may include a plurality of mounting gaskets **250** that are positioned between retainer brackets **242** and ventilator cabinet **210** to provide a fluid seal and to divide ventilator plenum **226** into four quadrants that are at least partially fluidly isolated from each other, e.g., thereby defining primary flow path **212** and energy recovery path **214**. In operation, the flow of make-up air **202** may enter fresh air inlet **230** and may pass through heat exchanger **240** before exiting fresh air outlet **232** along the primary flow path **212**. Similarly, the flow of exhaust air **204** may enter exhaust inlet **234** and may pass through heat exchanger **240** before exiting exhaust outlet **236** along the energy recovery path **214**. Notably, the flow of make-up air **202** and the flow of exhaust air **204** may transfer thermal energy between each other in heat exchanger **240** while remaining fluidly isolated.

[0048] According to the illustrated embodiment, energy recover ventilator **200** may include one or more fan assemblies for selectively urging the flow of make-up air **202** and the flow of exhaust air **204**. In this regard, as illustrated, energy recover ventilator **200** may generally include a primary fan **260** fluidly coupled to primary flow path **212** for urging the flow of make-up air **202** into indoor portion **104**, e.g., via fresh air outlet **232**. According to the illustrated embodiment, primary fan **260** may be positioned on a downstream end of heat exchanger **240**. In addition, energy recover ventilator **200** may include an auxiliary fan **262** that is fluidly coupled to energy recovery path **214** for drawing a flow of exhaust air **204** through energy recovery path **214**. According to the illustrated embodiment, auxiliary fan **262** may be positioned on the downstream end of heat exchanger **240**. According to the illustrated embodiment, primary fan **260** and auxiliary fan **262** are positioned within ventilator cabinet **210**, though other suitable positions are possible and within the scope of the present subject matter.

[0049] According to the illustrated embodiment, both primary fan **260** and auxiliary fan **262** are centrifugal fans. However, it should be appreciated that any other suitable number, type, and configuration of fan or blower could be used to urge a flow of make-up air **202** and the flow of exhaust air **204** according to alternative embodiments. In addition, primary fan **260** and auxiliary fan **262** may be positioned in any other suitable location within energy recover ventilator **200**. The embodiments described herein are only exemplary and are not intended to limit the scope of the present subject matter.

[0050] As best shown in FIGS. **1**, **2**, **8**, and **9**, air-conditioner **100** may further define a standoff plenum **270** that at least partially define indoor inlet **138** of cabinet **102**. In this regard, standoff plenum **270** may generally be positioned upstream of indoor heat exchanger **122** and may be configured to receive the flow of indoor air **116** and the flow of make-up air **202**. In addition, air-conditioner **100** may further include a make-up air duct **272** that provides fluid communication with fresh air outlet **232** and a make-up air supply port **274** that is defined on standoff plenum **270**. In this manner, the conditioned flow of make-up air **202** may exit energy recovery ventilator **200**, pass through make-up air duct **272**, and interior into standoff plenum **270** where it mixes with the flow of indoor air **116**.

[0051] According to example embodiments, controller **158** of air conditioner **100** may be operably coupled to primary fan **260** and auxiliary fan **262** for regulating the flow of make-up air **202** and the flow of exhaust air **204**, respectively. It should be appreciated that these fans may be operated at the same speed or at a different speed depending on ambient conditions in the room or outside conditions. For example, the flow rate of the flow of make-up air **202** is typically dictated by the make-up air needs within the room, e.g., based on government regulations, occupancy, bathroom fan operation, etc. Similarly, the outside temperature and humidity may require different flow rates of the flow of exhaust air **204** to suitably condition the flow of make-up air **202** prior to introduction into the room.



[0052] Thus, according to example embodiments, controller **158** may dynamically adjust the flow rates of each of the flow of make-up air **202** and the flow of exhaust air **204** depending on various atmospheric and operating conditions. According to an example embodiment, it may be desirable to operate the primary fan **260** and the auxiliary fan **262** at the same flow rate. In general, the target flow rate for the flow of make-up air **202** and the flow of exhaust air **204** may be between about 10 and 60 cubic feet per minute (cfm), between about 20 and 50 cfm, between about 30 and 40 cfm, or about 35 cfm.

[0053] In addition, it should be appreciated that primary fan **260**, auxiliary fan **262**, and blower fan **142** may be collectively operated in order to ensure that the flow of make-up air **202** is provided at a target flow rate while the outlet temperature of indoor air **116** remains within a desired range. For example, according to an example embodiment, these fans are operating to mix one part of the flow of make-up air **202** to every three parts of the flow of indoor air **116**. Other suitable mix ratios are possible and within the scope of the present subject matter.

[0054] Notably, it may be desirable to periodically stop the flow of make-up air **202** and/or the flow of exhaust air **204**. Accordingly, air conditioner **100** or energy recover ventilator **200** may further include one or more doors that are pivotable between an open and closed position to permit or restrict the respective flows of air. For example, vent doors (not shown) may be positioned in the energy recovery ventilator **200** or any other suitable location within air conditioner **100** for selectively restricting the flow of make-up air **202** and/or the flow of exhaust air **204**.

[0055] Referring still to FIGS. **1**, **2**, **8**, and **9**, it may be desirable to filter the flow of make-up air **202** before introducing it into indoor portion **104**. Accordingly, air conditioner **100** may further include a filter **276** that is positioned within primary flow path **212** for filtering the flow of make-up air **202**. It should be appreciated that filter **276** may be any suitable type, position, and configuration of filtering mechanisms. For example, filter **276** may be a screen filter, a pleated filter, an electrostatic filter, a carbon filter, a fiber glass filter, or any other suitable type of filter. Although filter **276** is illustrated as being positioned within make-up air duct **272**, e.g., at make-up air supply port **274**, it should be appreciated that filter **276** may alternatively be positioned at any other suitable location within primary flow path **212**.

[0056] Notably, it may be desirable to have access to heat exchanger **240**, e.g., for periodic maintenance, to clear clogs, or to otherwise improve the operating efficiency of energy recovery ventilator **200**. Accordingly, ventilator cabinet **210** may generally define an access opening **280** for providing access to heat exchanger cavity **244**. Notably, it is desirable to maintain a good fluid seal between ventilator cabinet **210** and heat exchanger **240**, e.g., to ensure a fluid isolation between primary flow path **212** and energy recovery path **214**. Accordingly, heat exchanger **240** may define a tight or snug fit within heat exchanger cavity **244**.

[0057] Specifically, according to an example embodiment, mounting gaskets **250** may be compressible such that retainer brackets **242** may move or flex slightly relative to sidewalls **224** of ventilator cabinet **210**. In this manner, as a user is inserting heat exchanger **240** into heat exchanger cavity **244**, retainer brackets **242** may be displaced to insert heat exchanger **240** while the resilient nature of mounting gaskets **250** rebound to form a strong seal with heat exchanger **240** when the retainer brackets **242** are no longer manually displaced.

[0058] As best shown in FIGS. **4** and **5**, energy recovery ventilator **200** may further include an access cover **282** that is removably mounted over access opening **280** for providing selective access to heat exchanger cavity **244**. Notably, due to the limited space available in locations where air conditioner **100** is typically installed, access cover **282** may be fully removable instead of being a hinged cover. It should be appreciated that a gasket (not shown) may be positioned or defined on an inner face of access cover **282**, e.g., to form a fluid seal with a front **284** of heat exchanger **240**. In addition, according to the illustrated embodiment, heat exchanger **240** includes a handle **286** that extends from front **284** and access cover **282** finds an aperture **288** for receiving the handle **286**.

[0059] According to the illustrated embodiment, in order to secure access cover **282** over access

opening **280**, energy recovery ventilator **200** may further include a plurality of rotatable clips **290** that are positioned on an outside of ventilator cabinet **210**. More specifically, according to an example embodiment, rotatable clips **290** may be rotatable and slidable relative to front wall **222** of ventilator cabinet **210**. In this manner, rotatable clips **290** may be fully recessed or moved out of the way relative to access opening **280**, e.g., to facilitate the insertion of heat exchanger **240** into a heat exchanger cavity **244**. After heat exchanger **240** is properly installed, rotatable clips **290** may be rotated and slid to secure access cover **282** against front wall **222** of ventilator cabinet **210** and front **284** of heat exchanger **240**.

[0060] Specifically, according to the illustrated embodiment, rotatable clips **290** are mounted directly to retainer brackets **242** such that movement of retainer brackets **242** (e.g., through compression of mounting gaskets **250**) permit the rotatable clips **290** to be retracted relative to access opening **280** while springing back toward access opening **280** when released after heat exchanger **240** is installed. In this manner, rotatable clips **290** securely and sealingly engage access cover **282** over access opening **280**. For example, the plurality of retainer brackets **242** and the plurality of rotatable clips **290** may be configured to slide between about 1/32 and 1/2 of an inch, between about 1/16 and 1/4 of an inch, or about 1/8 of an inch.

[0061] Notably, in order to permit the sliding of rotatable clips **290**, front wall **222** of ventilator cabinet **210** may generally define an elongated slot **292** (e.g., as shown in FIG. 7). In addition, retainer brackets **242** may each define a stud **294** is configured for engaging a mounting aperture **296** of each respective rotatable clip **290**, thereby rotatably coupling rotatable clips **290** to retainer brackets **242**. As shown, elongated slots **292** permit the movement of retainer brackets **242** and rotatable clips **290** during installation of heat exchanger **240** (e.g., relative to fixed front wall **222** of ventilator cabinet **210**). Although four retainer brackets **242** and rotatable clips **290** are illustrated, it should be appreciated that energy recovery ventilator **200** may include any other suitable number, type, position, and configuration of retaining brackets and rotatable clips.

[0062] As explained herein, aspects of the present subject matter are generally directed to a method of mixing fresh air (e.g., make-up air) in a vertical air conditioner. A ventilator kit with an air-to-air heat exchanger may be located atop the vertical air conditioner. Fresh air may be introduced via a duct into the ventilator kit on the lower right-hand side where air is then sucked into a cross flow plate exchanger with the unconditioned exhaust stream of the building moving perpendicular to the fresh air intake. Once passing through the crossflow plate (air to air) heat exchanger and exchanging sensible and latent energy with the exhaust stream, the conditioned fresh air stream may be collected in an insulated cavity on the upper left-hand side of the ventilator. A centrifugal fan may induce a vacuum within the upper left hand side cavity drawing air from the plate heat exchanger and pushing it out the front of the ventilator. A duct may then be connected between the upper left hand side cavity to the front stand-off plenum of the vertical air conditioner. The standoff plenum may direct the conditioned fresh air in front of the room recirculation path of the vertical air conditioner such that room air is mixed with the conditioned fresh air being provided by the ventilator.

[0063] In addition, aspects of the present subject matter are generally directed to a vertical air conditioner unit with an opening in front of the energy recovery ventilator (ERV) to access a plate heat exchanger. A removable access cover for the ERC may be used to facilitate easy, space conserving access to the plate heat exchanger, e.g., for servicing, replacement, cleaning, etc. For example, four rotatable clips may secure the detachable access cover onto the front cover and the air conditioner unit and pressurize the heat exchange chamber. The clips may attach to retainer brackets within the ERV to allow outward adjustment and some movement around the plate heat exchanger during installation, while returning to a tight seal between the retainers and the plate heat exchanger after adjustment.

[0064] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and

using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

## Claims

1. An air conditioner unit defining a vertical, a lateral, and a transverse direction, the air conditioner unit comprising: a cabinet defining an indoor inlet and an indoor outlet; a bulkhead mounted within the cabinet to define an indoor portion and an outdoor portion; and an energy recovery ventilator mounted to the cabinet, the energy recovery ventilator comprising: a ventilator cabinet defining a primary flow path and an energy recovery path; a heat exchanger positioned within the ventilator cabinet, wherein the primary flow path and the energy recovery path are fluidly isolated and thermally coupled within the heat exchanger; a primary fan fluidly coupled to the primary flow path for urging a flow of make-up air into the indoor portion; and an auxiliary fan fluidly coupled to the energy recovery path for drawing a flow exhaust air through the energy recovery path.
2. The air conditioner unit of claim 1, wherein the ventilator cabinet is positioned on top of the cabinet of the air conditioner unit.
3. The air conditioner unit of claim 1, wherein the primary fan and the auxiliary fan are positioned within the ventilator cabinet.
4. The air conditioner unit of claim 1, wherein the ventilator cabinet defines an exhaust inlet fluidly coupled to an interior space and an exhaust outlet fluidly coupled to an ambient environment, the exhaust inlet and the exhaust outlet forming a portion of the energy recovery path.
5. The air conditioner unit of claim 1, wherein the ventilator cabinet defines a fresh air inlet fluidly coupled to an ambient environment and a fresh air outlet fluidly coupled to the indoor portion, the fresh air inlet and the fresh air outlet forming a portion of the primary flow path.
6. The air conditioner unit of claim 5, further comprising: a standoff plenum that at least partially defines the indoor inlet of the cabinet; and a make-up air duct providing fluid communication between the fresh air outlet and a make-up air supply port defined on the standoff plenum.
7. The air conditioner unit of claim 6, wherein the standoff plenum is positioned upstream of an indoor heat exchanger such that the flow of make-up air mixes with a flow of indoor air.
8. The air conditioner unit of claim 7, wherein the primary fan and an indoor fan are operated to mix one part of the flow of make-up air to three parts of the flow of indoor air.
9. The air conditioner unit of claim 1, wherein the ventilator cabinet is an insulated housing.
10. The air conditioner unit of claim 1, further comprising: a filter positioned in the primary flow path for filtering the flow of make-up air.
11. The air conditioner unit of claim 1, further comprising: a controller operably coupled to the primary fan and the auxiliary fan, the controller being configured to operate the primary fan and the auxiliary fan at a target fan speed for generating a target flow rate.
12. The air conditioner unit of claim 11, wherein the target flow rate is between about 30 and 40 cubic feet per minute.
13. The air conditioner unit of claim 1, wherein the heat exchanger is a crossflow air-to-air heat exchanger.
14. The air conditioner unit of claim 1, wherein the air conditioner unit is a single package vertical unit, a vertical terminal air conditioner unit, or a packaged terminal air conditioner unit.
15. An energy recovery ventilator for an air conditioner unit, the energy recovery ventilator comprising: a ventilator cabinet defining a primary flow path and an energy recovery path; a heat exchanger positioned within the ventilator cabinet, wherein the primary flow path and the energy

recovery path are fluidly isolated and thermally coupled within the heat exchanger; a primary fan fluidly coupled to the primary flow path for urging a flow of make-up air into an indoor portion of the air conditioner appliance; and an auxiliary fan fluidly coupled to the energy recovery path for drawing a flow exhaust air through the energy recovery path.

**16.** The energy recovery ventilator of claim 15, wherein the ventilator cabinet is positioned on top of a cabinet of the air conditioner unit and the primary fan and the auxiliary fan are positioned within the ventilator cabinet.

**17.** The energy recovery ventilator of claim 15, wherein the ventilator cabinet defines an exhaust inlet fluidly coupled to an interior space and an exhaust outlet fluidly coupled to an ambient environment, the exhaust inlet and the exhaust outlet forming a portion of the energy recovery path.

**18.** The energy recovery ventilator of claim 15, wherein the ventilator cabinet defines a fresh air inlet fluidly coupled to an ambient environment and a fresh air outlet fluidly coupled to the indoor portion, the fresh air inlet and the fresh air outlet forming a portion of the primary flow path.

**19.** The energy recovery ventilator of claim 18, further comprising: a standoff plenum that at least partially defines an indoor inlet of a cabinet of the air conditioner unit; and a make-up air duct providing fluid communication between the fresh air outlet and a make-up air supply port defined on the standoff plenum.

**20.** The energy recovery ventilator of claim 15, wherein the ventilator cabinet is an insulated housing.

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