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(54) **AUTOMATED FRESH AIR COOLING SYSTEM**

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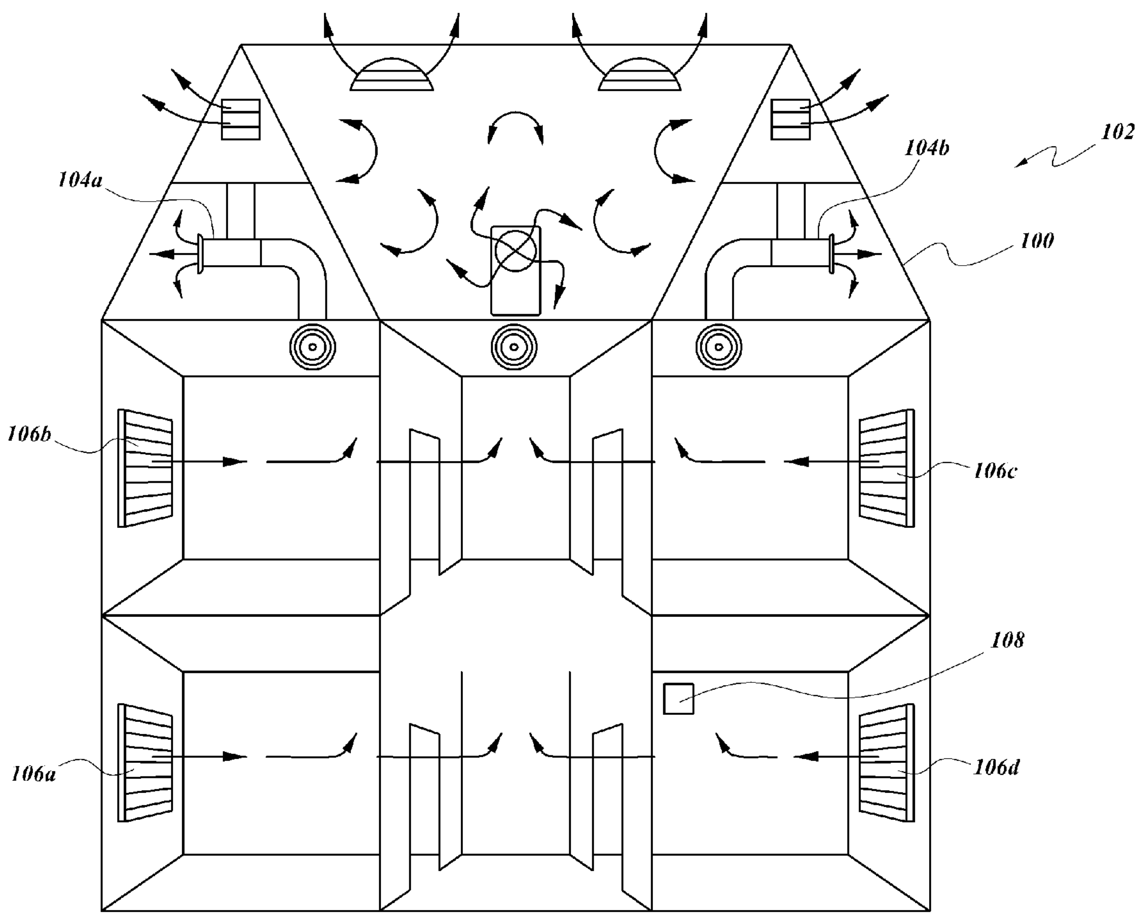
(57) **ABSTRACT**

Embodiments of the present disclosure are directed to an automated fresh air cooling system. The automated fresh air cooling system can include a whole house fan, an air intake, an air conditioner, and at least one controller. The controller can adjust the usage of the different components of the fresh air cooling system in order to reduce overall energy consumption as well as cost to a consumer. The system can be completely automated and no user input is required.



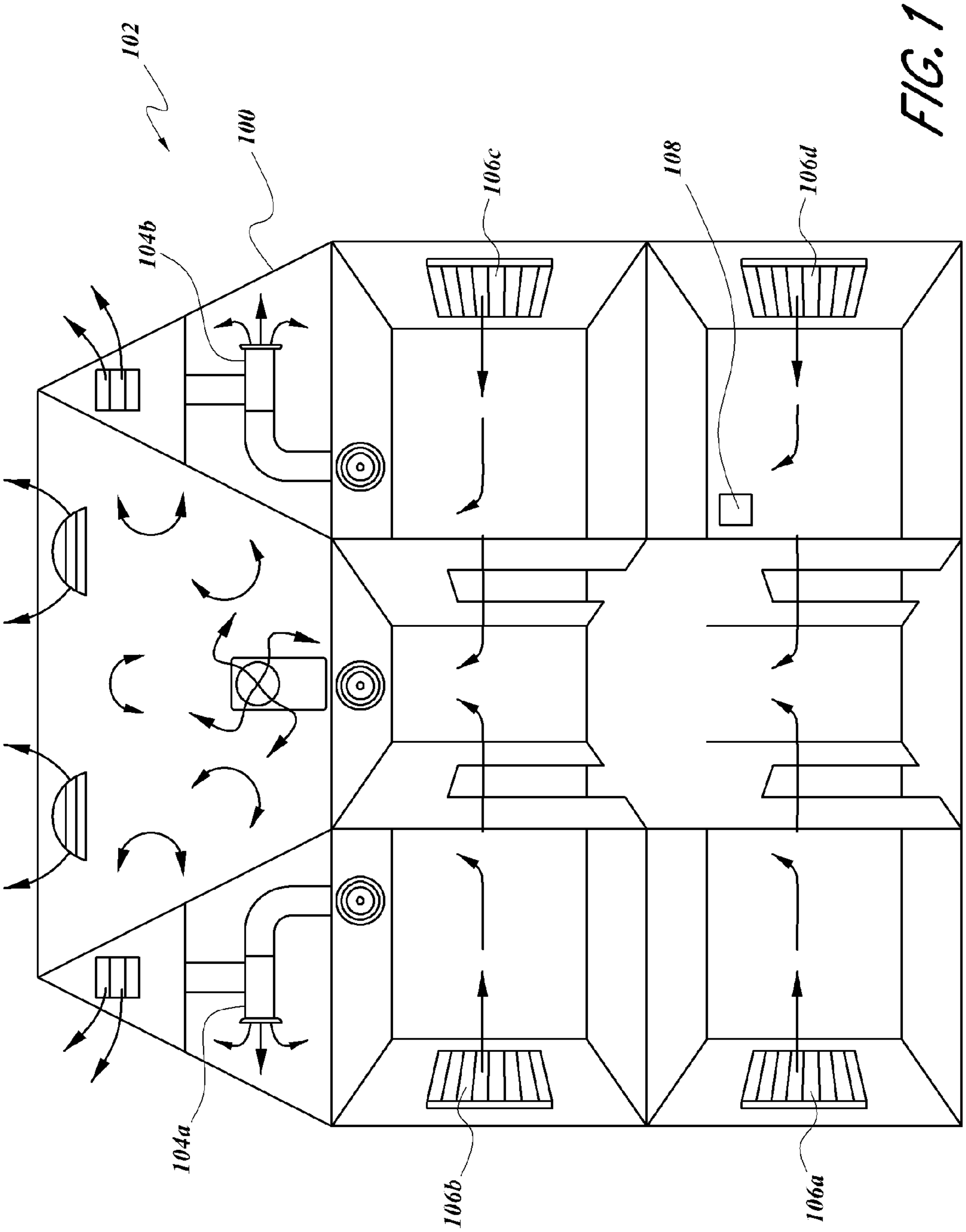


FIG. 1

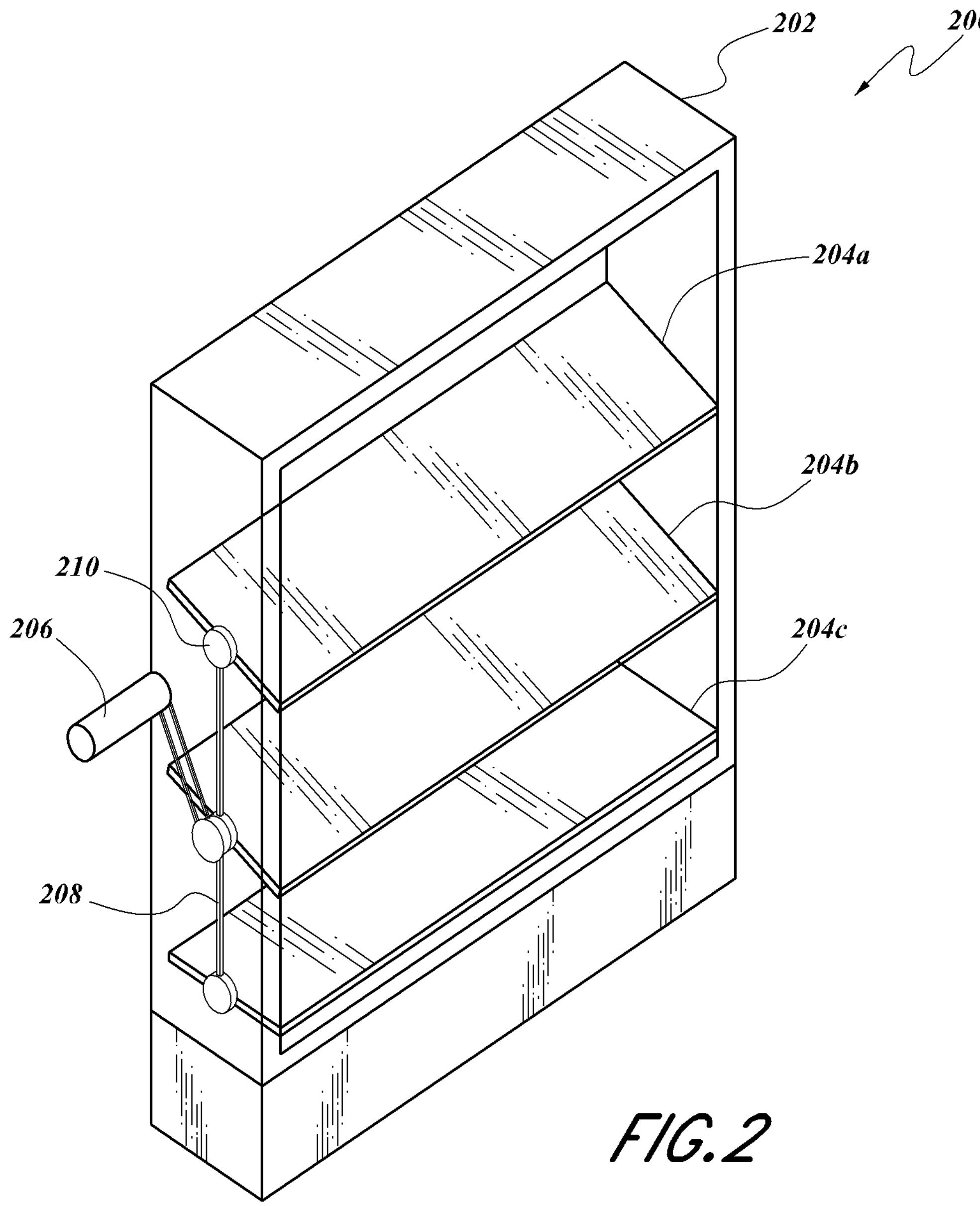


FIG. 2

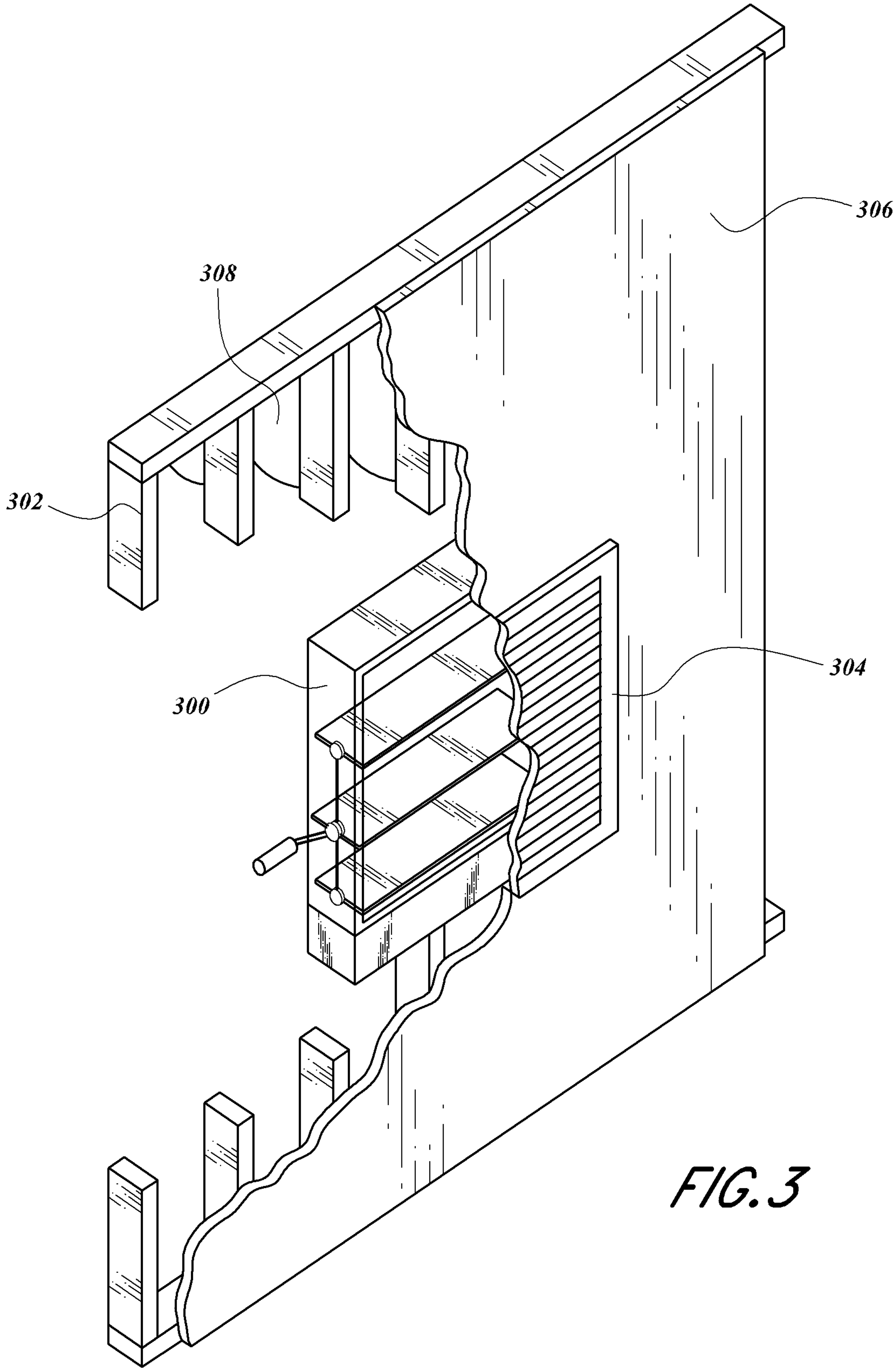


FIG. 3

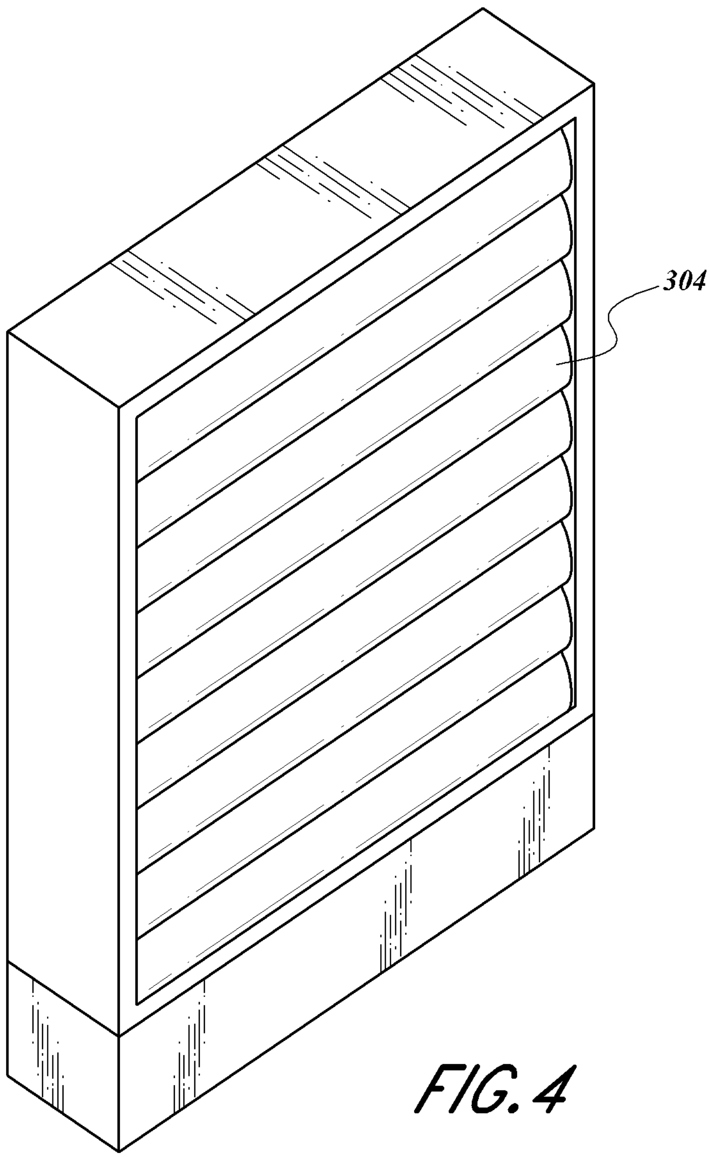


FIG. 4

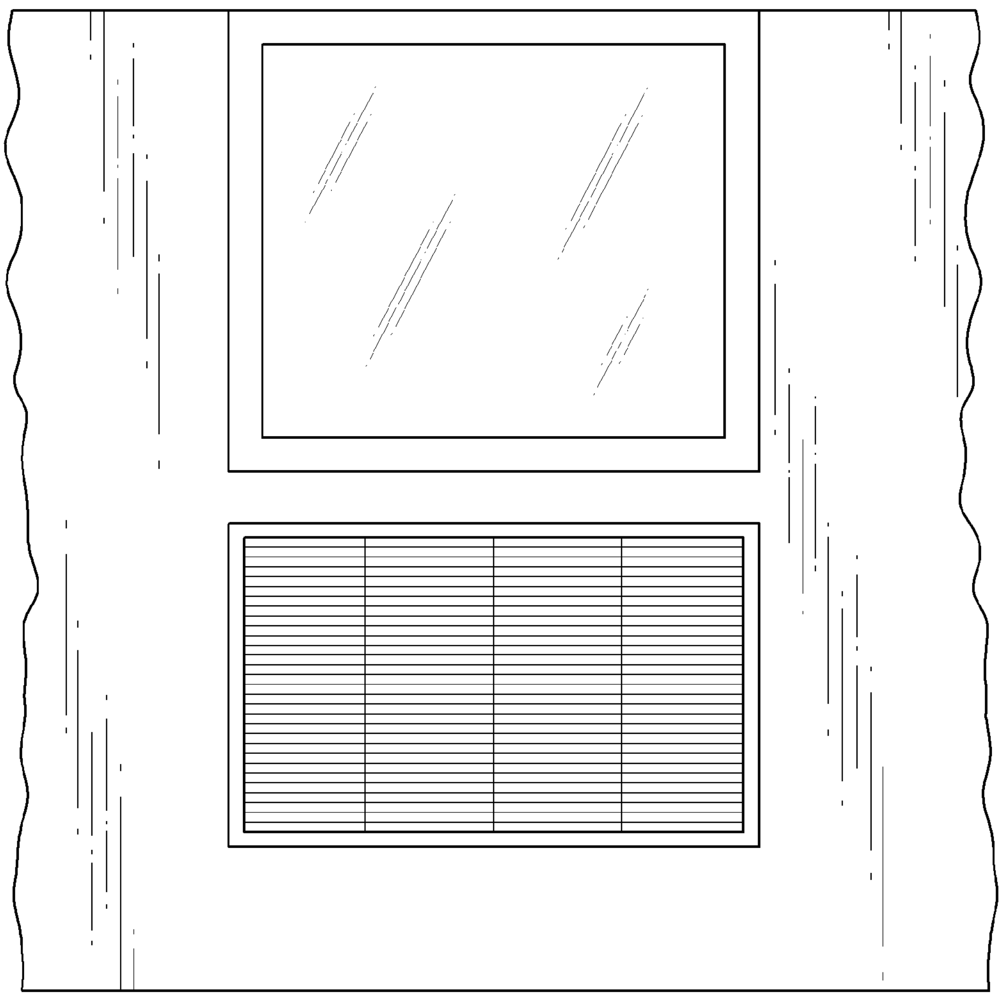


FIG. 5

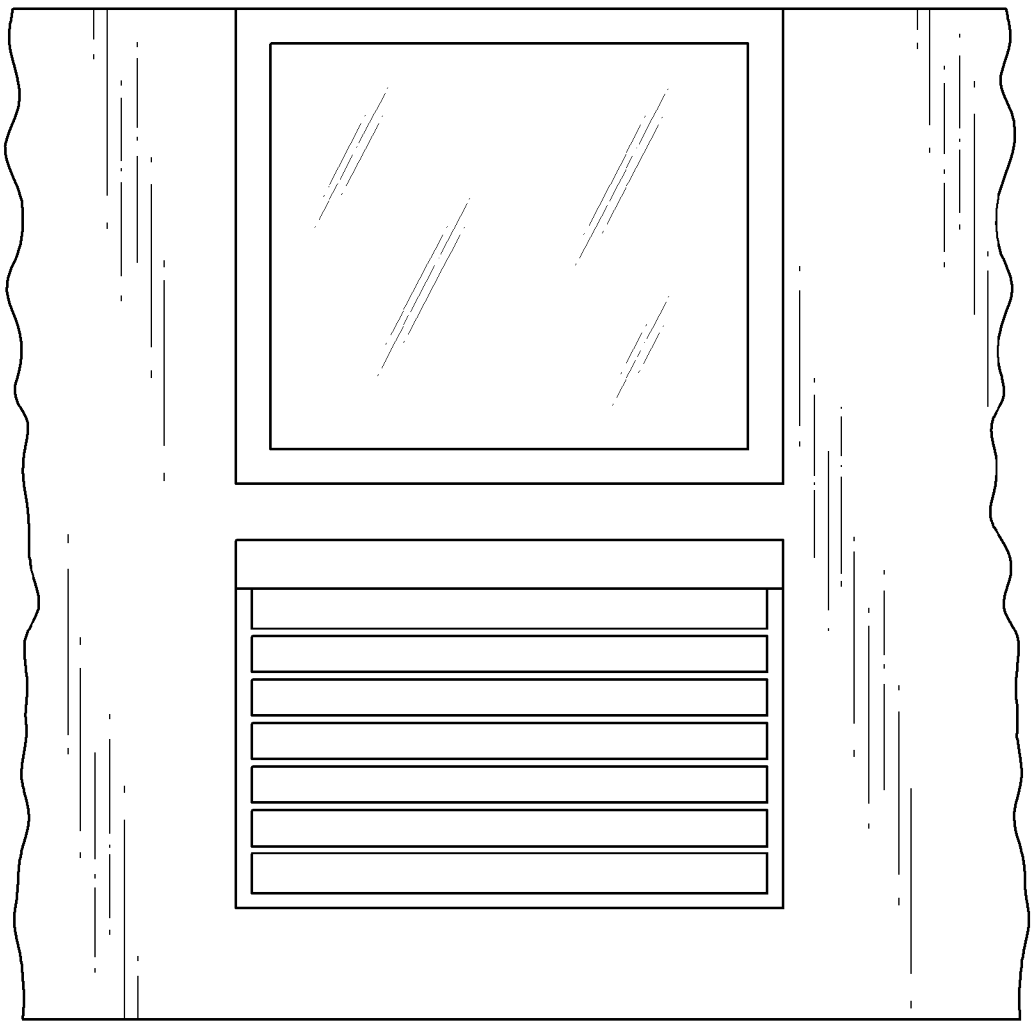


FIG. 6

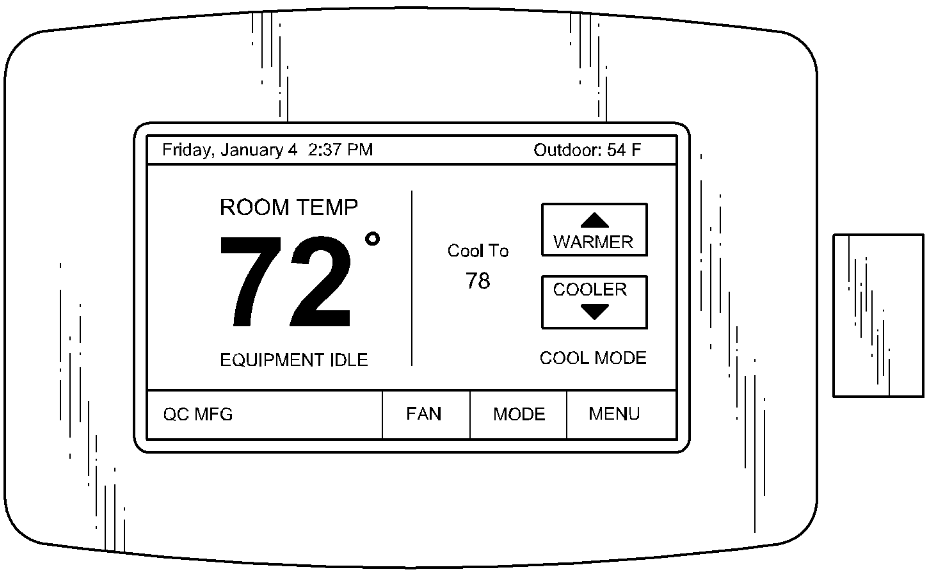

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FIG. 7

AUTOMATED FRESH AIR COOLING SYSTEM

BACKGROUND

[0001] 1. Field

[0002] The present disclosure generally relates to automated cooling and ventilation systems for building structures, and more particularly, to the combination of a whole house fan system, an air intake system, an air conditioning system, and an integrated thermostat with interior and exterior building temperature sensors to reduce building energy consumption.

[0003] 2. Description of the Related Art

[0004] It is well known that heating and cooling the space in residential and commercial buildings accounts for a primary share of building energy consumption. Space heating and cooling combined in residential buildings accounts for 54% of residential site energy consumption and 22% of total primary energy consumption in the U.S. See Table 2.1.5 2010 Residential Energy End-Use Splits, by Fuel Type in 2011 Buildings Energy Data Book, U.S. Department of Energy, March 2012, hereby incorporated by reference in its entirety.

[0005] Existing buildings utilize either an air conditioning system or a whole house fan for cooling and ventilating residential and commercial building structures. Traditional air conditioning systems function by altering the temperature and humidity of the air and then pump the treated air throughout the structure. The thermostat powers on the air conditioner until the home reaches a set point temperature. While effective at conditioning the air, such traditional air conditioning systems are costly to run and are not energy efficient. Additionally, when the outside ambient air temperature is lower than the internal air temperature, outside ambient air could instead be used to effectively cool the home, reducing the need to run a costly air conditioning system. Further, air conditioning systems merely circulate air located within a building, and do not bring any outside air, so any harmful environmental elements (e.g. dust, disease, chemicals) remain within the building.

[0006] In response to such problems, some homes instead utilize whole house fans to force air through the home. Whole house fans consist of one or more exhaust fans, typically placed in the attic or an upper floor, and function by creating a negative pressure inside of the home to draw cooler air in from the outside. The cooler outside air is forced up through the ceiling into the attic where the air is exhausted out through a vent. Louvered shutters are often placed over the vent to prevent cooled or heated air from escaping when the fan is not in use. Whole house systems move large amounts of air and allow for the entire home air volume to be recycled with multiple air exchanges per hour, removing latent heat within the home. Traditional whole house fans are installed on the attic floor such that they directly contact the ceiling of the home. As such, the large capacity whole house fans, necessary to create sufficient negative pressure to draw the cooler air inside in the home, can create undesirable noise and vibrations that penetrate the occupied space of the building. Advantageously, these systems require less energy than air conditioning systems and can reduce the need for air conditioning and therefore reduce home energy consumption while still providing a comfortable space. However, such whole house fans require open windows to serve as intake air vents. Thus, the user is required to manually control the air flow. The opened windows, however, can allow in dust, pollen and other pollutants from the exterior incoming air. Additionally, the cooling capabilities of whole house fans are limited by the ambient outside air. Whole house fans are incapable of lowering the temperature and humidity of the air drawn into the building. Accordingly, whole house fans are not effective at cooling the space when the outside ambient air temperature is higher than the internal air temperature. Thus, a user operating the whole house fan under unsuitable conditions may actually heat the space when they intended to use the fan to cool the space.

[0007] In view of the foregoing, there is a need for an automated fresh air cooling system that determines the temperature of both the interior and exterior of the space as well as the relative humidity value and uses the information to make control decisions about activation of a whole house fan and, if present, existing air conditioning systems. There is also a need for an automated vent system to serve as intake air vents in order to reduce the need for the user to manually operate windows to serve as air intakes. Additionally, there is a need for a whole house fan which is quieter and less intrusive in operation than traditional whole house fans.

SUMMARY

[0008] Disclosed herein is an automated fresh air cooling system for a building structure which can comprise an air intake comprising one or more actuatable vents and a motor, wherein the air intake is in communication with an exterior of the building structure and an interior of the building structure, at least one whole house fan having at least one vent, wherein the at least one whole house fan is in communication with the exterior of the building structure through the at least one vent, at least one external temperature sensor located on the exterior of the building structure and configured to provide a temperature signal, and a programmable controller which can be configured to automatically operate the air intake and the at least one whole house fan based on the temperature signal.

[0009] In some embodiments, the automated fresh air cooling system can comprise at least one air conditioning system, wherein the programmable controller can be configured to automatically operate the at least one air conditioning system based on the temperature signal. In some embodiments, the automated fresh air cooling system can comprise at least one internal temperature sensor located on the interior of the building structure.

[0010] In some embodiments, the motor can open and close the vents in response to a command from the programmable controller. In some embodiments, the programmable controller is a thermostat.

[0011] In some embodiments, upon operation of the whole house fan by the programmable controller, external air can be drawn into the building structure through the air intake and internal air can be forced out of the building structure through the vent. In some embodiments, the programmable controller can be configured to automatically open the air intake and turn on the whole house fan system in response to a first temperature measurement by the external temperature sensor that is less than or equal to a second temperature measurement by the internal temperature sensor. In some embodiments, the programmable controller can be configured to automatically close the air intake and turn off the whole house fan system in response to a first temperature measurement by the external temperature sensor that is less than or equal to a second temperature measurement by the internal temperature sensor. In some embodiments, the programmable controller can be

configured to automatically turn off the air conditioning system in response to a first temperature measurement by the external temperature sensor that is less than or equal to a second temperature measurement by the internal temperature sensor. In some embodiments, the programmable controller can be configured to automatically turn on the air conditioning system in response to a first temperature measurement by the external temperature sensor that is greater than to a second temperature measurement by the internal temperature sensor.

[0012] In some embodiments, the whole house fan can be configured to be operated without any user input. In some embodiments, the air conditioning system can be configured to operate only when the whole house fan is off, and the whole house fan can be configured to operate only when the air conditioning system is off. In some embodiments, the actuatable vents can form an airtight seal against the building structure.

[0013] In some embodiments, the at least one temperature sensor can be configured to provide a humidity signal. In some embodiments, the automated fresh air cooling system can be configured to be retrofitted onto a building structure. In some embodiments, the air intake can comprise a filter.

[0014] Also disclosed herein is method for automatically providing fresh air cooling to a building structure which can comprise determining a temperature on an exterior of the building structure, determining a temperature on an interior of the building structure, automatically turning on a whole house fan system and opening an air intake if the temperature on the exterior of the building structure is less than or equal to the temperature on the interior of the building structure, and automatically turning off the whole house fan system and closing the air intake if the temperature on the exterior of the building structure is greater than the temperature on the interior of the building structure.

[0015] In some embodiments, the method can further comprise automatically turning on an air conditioning system if the temperature on the exterior of the building structure is greater than the temperature on the interior of the building structure, wherein only one of the air conditioning system or the whole house fan system operates at a time

[0016] In some embodiments, determining the temperature can be performed by a thermostat. In some embodiments, the air intake can comprise one or more actuatable vents and a motor, wherein the air intake is in communication with the exterior and interior of the building structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** illustrates a partial sectional view of a building structure showing an embodiment of a fresh air cooling system.

[0018] FIG. **2** illustrates an embodiment of an air intake system.

[0019] FIG. **3** illustrates a partial sectional view of an exterior wall with an installed embodiment of an air intake system.

[0020] FIG. **4** illustrates an embodiment of an air intake system with a decorative grill.

[0021] FIG. **5** depicts an embodiment of an air intake system with a decorative grill.

[0022] FIG. **6** depicts an embodiment of an air intake system with a decorative grill.

[0023] FIG. **7** depicts an embodiment of an integrated thermostat.

DETAILED DESCRIPTION

[0024] Embodiments of the present disclosure provide for an automated fresh air cooling system. The fresh air cooling system can include an air intake system, a whole house fan, a vent system, an air conditioner, an integrated thermostat, and one or more temperature and/or humidity sensors.

[0025] In some embodiments, the air intake system can include a motorized multi-bladed damper to automatically open and close whenever the thermostat detects optimal cooling conditions. The multi-bladed dampers can be fitted with an air filtration system to filter external pollutants. The integrated thermostat can control the fresh air cooling system by measuring internal and external conditions with internal and external temperature and/or humidity sensors. When the external temperature is at or below the internal temperature and the integrated thermostat is active, the thermostat can automatically open the air intake, the vent, and can turn on the whole house fan or fans. When the external temperature is above the internal temperature, the integrated thermostat can automatically close the air intake, the vent, and can turn off the whole house fan or fans. Utilizing an automated air intake system in conjunction with the whole house fan and vent system can enable intelligent air quality and comfort level control. The system can automatically determine when to open and close the intake and vent and turn on the whole house fan when the exterior conditions permit cooling of the internal building structure. The user does not have to manually open windows to serve as air intakes and the building can be more effectively cooled with automated control.

[0026] Further, by not having to open windows in a building while running a whole house fan, security concerns can be alleviated. As windows do not have to be left open while using a whole house fan, a building can remain secure from outside intruders. A significant concern in previous uses of whole house fans is that a window would need to be left open while the whole house fan was running, which presents a target for an intruder to enter a building. However, in embodiments of the disclosed system, the air intake can be opened instead of windows while running the whole house fan and the air intake can be designed so that a person, or animal, cannot enter a building from the outside through it. For example, a grill can be used on embodiments of an air intake to prevent entrance to the building.

[0027] In some embodiments, the fresh air cooling system can be used in conjunction with an air conditioning system. The integrated thermostat can automatically determine optimal utilization of the air conditioning system by preferring the fresh air cooling system over the air conditioning system. When the external temperature is at or below the internal temperature and the integrated thermostat calls for cooling, the thermostat can activate the fresh air cooling system and can turn off the air conditioner. When the external temperature is above the internal temperature and the thermostat calls for cooling, the integrated thermostat can automatically deactivate the fresh air cooling system and can turn on the air conditioner. In some embodiments, the integrated thermostat can include error correction features such that the air conditioning system cannot be turned on when the thermostat detects that the fresh air cooling system is active. Conversely, in some embodiments, the fresh air cooling system will not activate when the thermostat detects that the air conditioning system is activated. In some embodiments, the integrated thermostat also will not allow the whole house fans to activate unless the air intakes and vents are in their open positions.

[0028] The automated fresh air cooling system can have the flexibility to be installed in several different HVAC building environments to provide an energy savings and cost savings. For example, embodiments of the disclosed automated fresh air cooling system can be installed in a building without an air conditioning system, retrofitted to be installed in a building with an existing air conditioning system, or installed as part of an air conditioning system installation.

[0029] Embodiments of the disclosed automated fresh air cooling system may require only a fraction of the energy of the air conditioning system and therefore can result in a significant energy and cost savings compared to traditional air conditioning systems by reducing the demand of the air condition system. Further, a user is not required to open the air intake, and the thermostat can seamlessly switch between the fresh air cooling system and an air conditioning system when present.

[0030] The terms "approximately", "about", and "substantially" as used herein represent an amount close to the stated amount that still performs a desired function or achieves a desired result. For example, the terms "approximately", "about", and "substantially" may refer to an amount that is within less than 10% of, within less than 5% of, within less than 1% of, within less than 0.1% of, and within less than 0.01% of the stated amount.

[0031] Reference will now be made to the drawings wherein like numerals refer to like parts throughout. FIG. **1** illustrates a partial sectional view of a building structure **100** showing an automated fresh air cooling system **102** installed therein to cool the building structure according to one embodiment. The fresh air cooling system can include a whole house fan **104**, an air intake **106**, and an integrated thermostat **108**. It should be appreciated that the fresh air cooling system **102** can include one or more fans, air intakes and thermostats, and the number and location of these components is not limiting. Additionally, the integrated thermostat **108** can be coupled with, for example, temperature and/or humidity sensors both inside and outside of the building structure to make automatic control decisions, as described below in reference to the integrated thermostat.

[0032] In the embodiment shown in FIG. **1**, the building structure **100** is a two-story residential house depicted with two whole house fans **104***a-b* and four air intakes **106***a-d* and a single integrated thermostat **108**. However, the type of building structure is not limiting, and the disclosed system can be used in, for example, one, two, three, four story residential homes, apartment complexes, office buildings, and warehouses. Further, different locations and numbers of components can be used with the automated fresh air cooling system **102**. As described more fully below, the combination of the whole house fan, air intakes, and thermostat with temperature and/or humidity sensors allow a home to be cooled with automatic controls.

[0033] The whole house fan **104** as depicted in the embodiment in FIG. **1** can be mounted in the attic and connected to an air inlet in the ceiling to create a negative pressure in the living area of the home. The air inlet can be a diffuser, a register, or any other similar device as is known in the art. When the air intake is in the open position, the negative pressure can force outside air into the building structure. The stagnant internal air can then be forced out of the building structure through vents to the outside. In one embodiment, the vents to the outside can be actuated to open and close to provide thermal insulation of the attic from the outside elements. In one embodiment, the whole house fan **104** can be mounted in the attic so that it is mechanically isolated from the building structure to dampen vibrations from the fan motor to reduce undesirable noise and vibrations from penetrating the occupied space of the building. In some embodiments, the whole house fan **104** can be mounted in the attic such that it is recessed from the attic ceiling to provide mechanical isolation. In some embodiments, the whole house fan **104** can include shocks, springs, insulation, and/or a dashpot damper to dampen mechanical vibrations from entering the occupied space. In some embodiments, the whole house fan **104** can be mounted between floors. However, the location of the whole house fan is not limiting.

[0034] In some embodiments, the whole house fan **104** can include fan blades actuated by a low rpm motor to expel the internal air out of the building structure. The air inlet, in communication with the inside of the building, and the whole house fan, in communication with the outside, can be connected by a flexible, sound insulating duct, though the type of duct is not limiting. In some embodiments, the low rpm motor can spin at between about 1000-2000 revolutions per minute (rpm) and more preferably between about 1500-1600 rpm and about 1550 rpm. In another implementation the motor is between about 1000-1300 rpm and preferably about 1050 rpm. The air flow capacity of the whole house fan **104** can be between about 500-6500 cubic feet per minute (cfm) and more preferably about 1527 cfm. In some embodiments, the air flow capacity can be about 2465 cfm. In some embodiments, the air flow capacity can be about 3190 cfm. In some embodiments, the air flow capacity can be about 4712 cfm. In some embodiments, the air flow capacity can be about 2457 cfm. In some embodiments, the air flow capacity can be about 1104 cfm. In some embodiments, the air flow capacity can be about 552 cfm.

[0035] In some embodiments, an insulating R value of the duct can be between 4-6, and more preferably about 5 so as to reduce latent heat loss through the duct. The insulating R value through the dampers can be 4-7 with closed dampers and more preferably about 4.2, more preferably about 5 and more preferably about 6.8. The sound level of the fan **104** in the living space can be between about 42-55 decibels (dBA) and more preferably about 43, 45, 47, or 52 dBA.

[0036] In some embodiments, the diameter of the fan blade housing can be between about 14 to 25 inches and the diameter of the duct can be between about 13 to about 19 inches. In some embodiments, the distance between the air intake and the motorized fan can be at least about 4 feet, at least about 5 feet, or at least about 6 feet. In some embodiments, the diameter of the fan blade house can be larger than the duct diameter so as to create a negative venturi effect on the airflow in order to reduce wind noise.

[0037] FIG. **2** depicts an embodiment of air intake **200**. The air intake **200** can be designed to be placed in an exterior wall, or roof, as more fully described in reference to FIG. **3**, below. The air intake **200** can include a housing **202** and a damper with multiple blades **204** that open or closes with one or more electric motors **206**. In some embodiments the blades **204** can open circumferentially, or can part longitudinally. In some embodiments, the air intake **200** can also include an air filter to prevent outdoor dust, pollen and other pollutants from entering the building structure (not illustrated). However, in some embodiments an air filter may not be used. When the multi-bladed damper **204** is in the open configuration, the air intake **200** can allow outside air to enter the interior of the building structure. When the multi-bladed damper **204** is in the closed position, it can prohibit any incoming air or drafts from entering the building structure. In some embodiments, the closed position can result in an air-tight seal, so no air may leak in or out of the building. In some embodiments, the multi-bladed damper **204** can be partially closed to control the rate of air flow into the home. In the embodiment shown in FIG. **2**, the air intake **200** is depicted with a three-blade damper **204***a-c* with a single motor **206**. However, the damper **204** is not limited to a three-blade configuration, and other numbers of blades or damper configurations can be used. The air intake **200** can include a mechanical or electrical switch sensor to indicate blade damper position. The switch sensor can communicate with the integrated thermostat to provide fine tuning of the airflow rate to adjust the atmospheric comfort levels within the building. Further, the switch sensor can provide for a visual or auditory cue to a user to communicate the position of the damper **204**.

[0038] In some embodiments, the blade dampers **204** can be configured to open, close, or partially open together with a common control linkage **208**. The control linkage **208** allows the blade dampers **204** to pivot about a rotation point **210** on each linkage with a single motor **206**. In the embodiment illustrated in FIG. **2**, the rotation points **210** are centrally located on the control linkages **208**. However, it should be appreciated that the rotation point **210** can be located anywhere on the control linkages **208**. In some embodiments, the control linkage **208** can be made from mechanical links, rods, wires, pulleys, poles, dowels, or other mechanical structures as is known in the art. In some embodiments, the blade dampers can be configured to open, close, or partially open with separate motors (not illustrated). In such a configuration, individual blade dampers can be actuated to obtain the desired airflow rate. The control linkage **208** is designed to be placed on one side of the housing **202** such that the control linkage **208** does not obstruct the airflow and helps to reduce wind noise.

[0039] The blade dampers **204** can be configured to close in either an opposed blade direction or a parallel blade direction. In the opposed blade direction, the blade dampers can pivot in opposite directions about their rotation points **210** to form a seal against outside air entering the home. In the parallel blade direction, the blade dampers can pivot in the same direction about their rotation points **210** to form a seal against outside air entering the home. In some embodiments, the blade dampers can include an edge seal to resist opening, provide insulation capabilities by reducing air and thermal leakage and to help reduce wind noise in the closed configuration. In some embodiments, the air intake can allow an air leakage as low as about 6 cubic feet per minute. In some embodiments, the blades can be pivoted up to about 100 degrees of rotation.

[0040] The multi-blade damper **204** can include heavy gauge blade dampers. In some embodiments, the blade dampers can be made out of an extruded metal such as aluminum or painted steel. In some embodiments, the blade dampers can be made out of plastic, such as ABS or acrylic. The blade dampers can be an air foil type blade to increase their torsional stiffness to limit blade torsion and twist. However, the type of material is not limiting. In some embodiments, the air intake can be a boxed out area in an exterior wall of a home that is 24 inches by 48 inches in size with 4 inch wide blade dampers.

[0041] The motor **206** can be, for example, a pneumatic or electric actuator, an AC or DC motor, a servo motor, or any other type of motor as is known in the art, and the type of motor is not limiting. In some embodiments, the motor can be a 24 volt DC motor and includes a transformer to regulate standard US 110 AC wall voltage and provide AC to DC power conversion to operate the motor with household AC current supply. The motor **206** can be connected to the control linkage **208** with a control shaft. In some embodiments, the motor can be an actuator with a minimum torque of about 35 in-lb. The motor can be sized such that it fits onto the control shaft. In some embodiments, the control shaft can be sized from about ⅜" to about 1" in diameter. As described above, the motor **206** can be actuated such that it moves in an on/off configuration to fully open or close the blades. The motor **206** can alternatively be actuated such that it moves in incremental steps to have fine tune control of the blade position. The motor **206** can be coupled with an encoder or angle position sensor to communicate its position with the integrated thermostat.

[0042] The whole house fan and the air intake system can be designed to be activated simultaneously or contemporaneously. When the fresh air cooling system is activated, the air intake system can be opened and the whole house fan or fans can be turned on. When the fresh air cooling system is deactivated, the air intake system can be closed and the whole house fan or fans can be turned off. In some embodiments, building structures fitted with actuated external vents can also be activated simultaneously or contemporaneously with the air intake system and whole house fan. When in the closed position, the system can reduce thermal leakage from interior of the home to the outside. The simultaneous use of the whole house fan and air intake system can allow for a user not to have to open a window, which is a typical requirement of whole house fans. This can allow for the whole house fan to be completely automated without any potential damage to the building. In some embodiments, no user input is required.

[0043] As shown in FIG. **3**, the air intake **300** can be designed to be placed in a cavity in an exterior wall **302** in order to draw cooler air into the home. In some embodiments, a single air intake **300** can be used to cool up to about 2000 square feet of internal building space. The air intake **300** can have a decorative grill **304** on both the interior **306** and exterior faces **308** of the exterior wall as shown in FIGS. **3**, **4**, **5**, and **6**. The air intake **300** can be retrofitted to be installed in existing homes or placed as a part of new home construction.

[0044] FIG. **7** depicts an embodiment of an integrated thermostat. The thermostat can be an electronic control switch that controls the cooling and ventilation systems in a building. The integrated thermostat can be in communication with an air intake system, a whole house fan system, and if present, an air conditioning system to fully optimize air control throughout the building structure, while reducing the overall energy output of the building structure. In some embodiments, the integrated thermostat can be in communication with the motors of the air intake system to activate the multi-blade dampers. Also, as described above, the motors and/or blades can include position information sent to the integrated thermostat. As described in detail below, the integrated thermostat can open and close the air intake, turn on and off the whole house fan system, open and close the external air vent, and turn on and off the air conditioning system without any user input. Therefore, the entire cooling and ventilation system can be completely automated.

[0045] In some embodiments, the integrated thermostat can be coupled with one or more temperature and/or humidity sensors to make fine-tuned control decisions. Temperature and/or humidity sensors can be placed both inside the building structure and outside in the ambient environment to determine optimal conditions for activating the whole house fan system.

[0046] In some embodiments, the integrated thermostat can include a touch-screen interface for programming the device. In some embodiments, the integrated thermostat can also be used to control other secondary automated building functions such as security, lighting, and major appliances. In some embodiments, the integrated thermostat can be used to control heating in a manner similar to the air conditioning system. In some embodiments, the integrated thermostat can be activated remotely via a cellular telephone or by personal computer. In some embodiments, a user can determine the existing indoor temperature, outdoor temperature and humidity, and presently active units from a remote location through remote communication with the integrated thermostat. A user can also use the remote function to make program or control changes in the cooling and ventilation system. In some embodiments, the integrated thermostat can be coupled with energy load sensors to provide an energy management report and energy efficiency recording of the building. In some embodiments, the energy load sensors can be placed on major appliances, the fresh air cooling system, and the air conditioning system to provide instantaneous energy reports.

[0047] As should be appreciated by one skilled in the art, the fresh air cooling system has the flexibility to be installed in several different HVAC building environments to provide an energy savings and cost savings. In some embodiments, the fresh air cooling system can be installed in a building without an existing air conditioning system. In such an installation, the integrated thermostat can make control decisions on whether to activate the fresh air cooling system based on the external and internal building temperature and/or humidity conditions. In some embodiments, the fresh air cooling system can be retrofitted to a building with an existing air conditioning system. In such an installation, the integrated thermostat can use the internal and external temperature and/or humidity sensors to make control decisions about whether to activate either the fresh air cooling system or the existing air conditioning. As described in detail with respect to the control algorithm, the system can activate the fresh air cooling system over the existing air conditioning whenever the ambient temperature and humidity conditions allow in order to realize a cost and energy savings over running the air conditioner. In some embodiments, the fresh air cooling system can be installed in a building as part of a new air conditioning installation. In such an installation, the integrated thermostat functions substantially the same as in installations retrofitted to function with existing air conditioning systems.

[0048] In some embodiments, the fresh air cooling system can be installed in a building without an existing air conditioning system. In such an embodiment, the fresh air cooling system can make control decisions based on interior and exterior atmospheric conditions provided by the internal and external temperature and/or humidity sensors. The typical operation of the system in a home that does not have air conditioning is for the thermostat to turn on or off the whole house fans depending on the desired temperature setting on the integrated thermostat. If the integrated thermostat calls for cooling, the thermostat can determine whether the outside air temperature is cooler than the inside and then opens the damper and turns on the fan or fans. If the outside temperature is warmer than the internal temperature, the thermostat does not activate the system but can continue to monitor the situation periodically until the outside temperature is cool enough to be brought in effectively. In some embodiments, the thermostat can be conditioned to control based on the measured humidity sensors.

[0049] In some embodiments, the system can be installed in a home with an existing air conditioning system. In a home with existing air conditioning, the thermostat can control the air conditioner as well as the fresh air cooling system. If the integrated thermostat calls for cooling, the integrated thermostat first can consider whether the fresh air cooling system has the capacity to efficiently cool the house. The integrated thermostat can be set to default to use the fresh air cooling system whenever possible instead of the air conditioning system to provide a cost savings. If the integrated thermostat determines that the fresh air cooling system can effectively cool the building structure, the thermostat can activate the fresh air cooling system until the desired temperature is reached. If, while the whole house fans are running, the thermostat determines that the fans are providing inadequate cooling and cannot cool the house to the desired temperature, it can turn off the fans, can close the air intake, can close the vents, and can turn on the air conditioner. It then can continue to monitor the situation and can turn off the air conditioner and turn back on the whole house fans when conditions are optimal for the fresh air cooling system.

[0050] In some embodiments, the integrated thermostat can include error correction features such that the air conditioning system cannot be turned on when the thermostat detects that the air intakes are open, the vents are open and the whole house fans are activated. Conversely, in some embodiments, the fresh air cooling system will not activate when the thermostat detects that the air conditioning system is activated. In some embodiments, the integrated thermostat also will not allow the whole house fans to activate unless the air intakes and vents are in their open positions.

[0051] In some embodiments, the recommended usage in the summer season is to turn on the fresh air cooling system when the outside temperature is equal to or below the inside temperature and then keep them on until late in the evening to remove most of the latent heat that can be stored in the structure and mass of the house and the attic. In some embodiments, the system can be kept on until three hours after sunset. This method can prolong the cooling effects of the fresh air cooling system into the subsequent day, thus reducing demand of the air conditioner. By following this procedure, a typical house in a desert climate zone, such as in the inland empire in southern California, may only require that the air conditioner be run for two to three hours per day instead of the normal 8 to 10 hours in the heat of the summer typically required by existing air conditioning systems. The fresh air cooling system can require only a fraction of the energy of the air conditioning system, and therefore results in a significant energy and cost savings compared to traditional air conditioning systems.

[0052] Utilizing multiple air intakes, the system can be constructed with multiple zones whereby each air intake can operate over different rooms or regions of the occupied space. When multiple air intakes are used in conjunction with multiple thermostats, temperature sensors and/or humidity sensors, a user can activate different zones at different times to cool the home. Such a system allows for cooling of only the occupied rooms of the building structure therefore providing for more efficient cooling of the space and less energy consumption. Unoccupied rooms can be turned off or ignored by the control system.

[0053] Utilizing an automated air intake system in conjunction with the whole house fan and vent system can enable for intelligent air quality and comfort level control. The system can automatically determine when to open and close the intake and vent and turn on the whole house fan when the exterior conditions permit cooling of the internal building structure. The user does not have to manually open windows to serve as air intakes and the building can be more effectively cooled with automated control. Additionally, the system can operate when the user is away from the building. The thermostat can open or close the multi-bladed damper and ascertain that the fans do not run until the damper is open. At the same time, the multi-bladed damper's filters can clean all incoming air. Utilizing the fresh air cooling system in conjunction with an air conditioning system can allow for an energy savings and a cost savings by reducing the demand of the air condition system. The integrated thermostat can activate the fresh air cooling system whenever the temperature and/or humidity sensors detect optimal cooling conditions. The user is not required to open the air intake and the thermostat can seamlessly switch between the fresh air cooling system and an air conditioning system when present.

[0054] The foregoing description of the preferred embodiments of the present disclosure has shown, described and pointed out the fundamental novel features of the inventions. The various devices, methods, procedures and techniques described above provide a number of ways to carry out the described embodiments and arrangements. Of course, it is to be understood that not necessarily all features, objectives or advantages described are required and/or achieved in accordance with any particular embodiment described herein. Also, although the invention has been disclosed in the context of certain embodiments, arrangements and examples, it will be understood by those skilled in the art that the invention extends beyond the specifically disclosed embodiments to other alternative embodiments, combinations, sub-combinations and/or uses and obvious modifications and equivalents thereof. Accordingly, the invention is not intended to be limited by the specific disclosures of the embodiments herein.

What is claimed is:

1. A automated fresh air cooling system for a building structure comprising:

an air intake comprising one or more actuatable vents and a motor, wherein the air intake is in communication with an exterior of the building structure and an interior of the building structure;

at least one whole house fan having at least one vent, wherein the at least one whole house fan is in communication with the exterior of the building structure through the at least one vent;

at least one external temperature sensor located on the exterior of the building structure and configured to provide a temperature signal; and

a programmable controller configured to automatically operate the air intake and the at least one whole house fan based on the temperature signal.

2. The automated fresh air cooling system of claim **1**, wherein the motor opens and closes the vents in response to a command from the programmable controller.

3. The automated fresh air cooling system of claim **1**, wherein the programmable controller is a thermostat.

4. The automated fresh air cooling system of claim **1**, further comprising at least one internal temperature sensor located on the interior of the building structure.

5. The automated fresh air cooling system of claim **4**, wherein the programmable controller is configured to automatically open the air intake and turn on the whole house fan system in response to a first temperature measurement by the external temperature sensor that is less than or equal to a second temperature measurement by the internal temperature sensor.

6. The automated fresh air cooling system of claim **4**, wherein the programmable controller is configured to automatically close the air intake and turn off the whole house fan system in response to a first temperature measurement by the external temperature sensor that is less than or equal to a second temperature measurement by the internal temperature sensor.

7. The automated fresh air cooling system of claim **4**, further comprising at least one air conditioning system, wherein the programmable controller is configured to automatically operate the at least one air conditioning system based on the temperature signal.

8. The automated fresh air cooling system of claim **7**, wherein the programmable controller is configured to automatically turn off the air conditioning system in response to a first temperature measurement by the external temperature sensor that is less than or equal to a second temperature measurement by the internal temperature sensor.

9. The automated fresh air cooling system of claim **7**, wherein the programmable controller is configured to automatically turn on the air conditioning system in response to a first temperature measurement by the external temperature sensor that is greater than to a second temperature measurement by the internal temperature sensor.

10. The automated fresh air cooling system of claim **7**, wherein the air conditioning system is configured to operate only when the whole house fan is off, and the whole house fan is configured to operate only when the air conditioning system is off.

11. The automated fresh air cooling system of claim **1**, wherein upon operation of the whole house fan by the programmable controller, external air is drawn into the building structure through the air intake and internal air is forced out of the building structure through the vent.

12. The automated fresh air cooling system of claim **1**, wherein the whole house fan is configured to be operated without any user input.

13. The automated fresh air cooling system of claim **1**, wherein the actuatable vents form an airtight seal against the building structure.

14. The automated fresh air cooling system of claim **1**, wherein the at least one external temperature sensor is configured to provide a humidity signal.

15. The automated fresh air cooling system of claim **1**, wherein the automated fresh air cooling system is configured to be retrofitted onto a building structure.

16. The automated fresh air cooling system of claim **1**, wherein the air intake comprises a filter.

17. A method for automatically providing fresh air cooling to a building structure comprising:

determining a temperature on an exterior of the building structure;

determining a temperature on an interior of the building structure;

automatically turning on a whole house fan system and opening an air intake if the temperature on the exterior of the building structure is less than or equal to the temperature on the interior of the building structure; and

automatically turning off the whole house fan system and closing the air intake if the temperature on the exterior of the building structure is greater than the temperature on the interior of the building structure.

18. The method of claim **17**, wherein the method further comprises:

automatically turning on an air conditioning system if the temperature on the exterior of the building structure is greater than the temperature on the interior of the building structure; and

automatically turning off the air conditioning system if the temperature on the exterior of the building structure is less than or equal to the temperature on the interior of the building structure;

wherein only one of the air conditioning system or the whole house fan system operates at a time.

19. The method of claim **17**, wherein determining the temperature is performed by a thermostat.

20. The method of claim **17**, wherein the air intake comprises one or more actuatable vents and a motor, and wherein the air intake is in communication with the exterior and interior of the building structure.

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