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Vacek

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(45) **Date of Patent: *Feb. 15, 2022**

(54) **SYSTEMS AND METHODS FOR CONTROLLING AIR PROPERTIES IN STRUCTURES AND INHIBITING MOISTURE ACCUMULATION AND MOLD PROPAGATION IN STRUCTURES**

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(73) Assignee: **VACEK LLC**, Porter, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 430 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/273,344**

(22) Filed: **Feb. 12, 2019**

(65) **Prior Publication Data**

US 2020/0256569 A1 Aug. 13, 2020

(51) **Int. Cl.**

F24F 7/10	(2006.01)
F24F 7/02	(2006.01)
F24F 7/08	(2006.01)
E04B 1/72	(2006.01)
E04B 1/70	(2006.01)
F24F 140/30	(2018.01)
F24F 13/22	(2006.01)
F24F 110/20	(2018.01)

(52) **U.S. Cl.**

CPC ***F24F 7/10*** (2013.01); ***E04B 1/7069*** (2013.01); ***E04B 1/72*** (2013.01); ***F24F 7/02*** (2013.01); ***F24F 7/08*** (2013.01); *F24F 2013/221* (2013.01); *F24F 2110/20* (2018.01); *F24F 2140/30* (2018.01)

(58) **Field of Classification Search**

CPC .. E04B 1/7069; E04B 1/72; F24F 7/10; F24F 2013/221

USPC 52/302.1; 454/185, 186; 165/53

See application file for complete search history.

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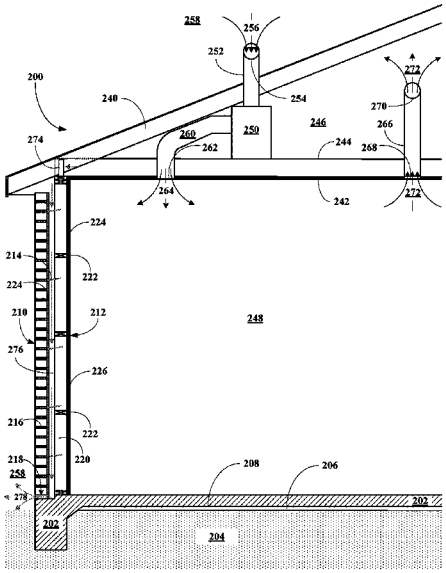
Primary Examiner — Vivek K Shirsat

(74) *Attorney, Agent, or Firm* — Robert W. Strozier

(57) **ABSTRACT**

A structure comprises at least one outer wall having an internal wall section and an outer wall section with an air flow passage therebetween. A circulation system circulates air through the flow passage to inhibit moisture accumulation and mold growth. A sensing system determines the presence of moisture in the flow passage and generates a signal in response thereto. A controller receives the signal from the sensing system and controls the circulation system to maintain a predetermined temperature and relative humidity in the flow passage.

20 Claims, 19 Drawing Sheets



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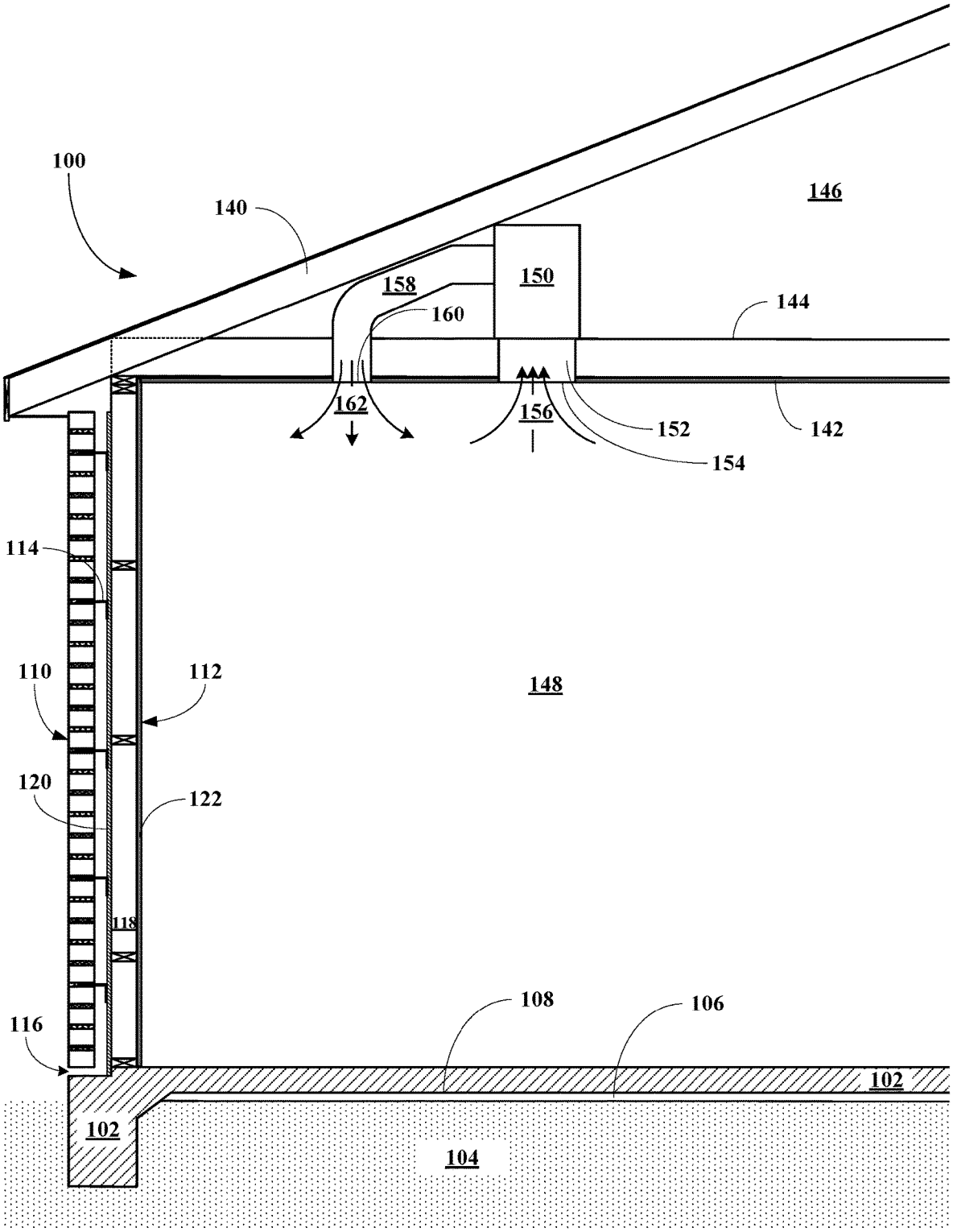

FIG. 1 – Prior Art

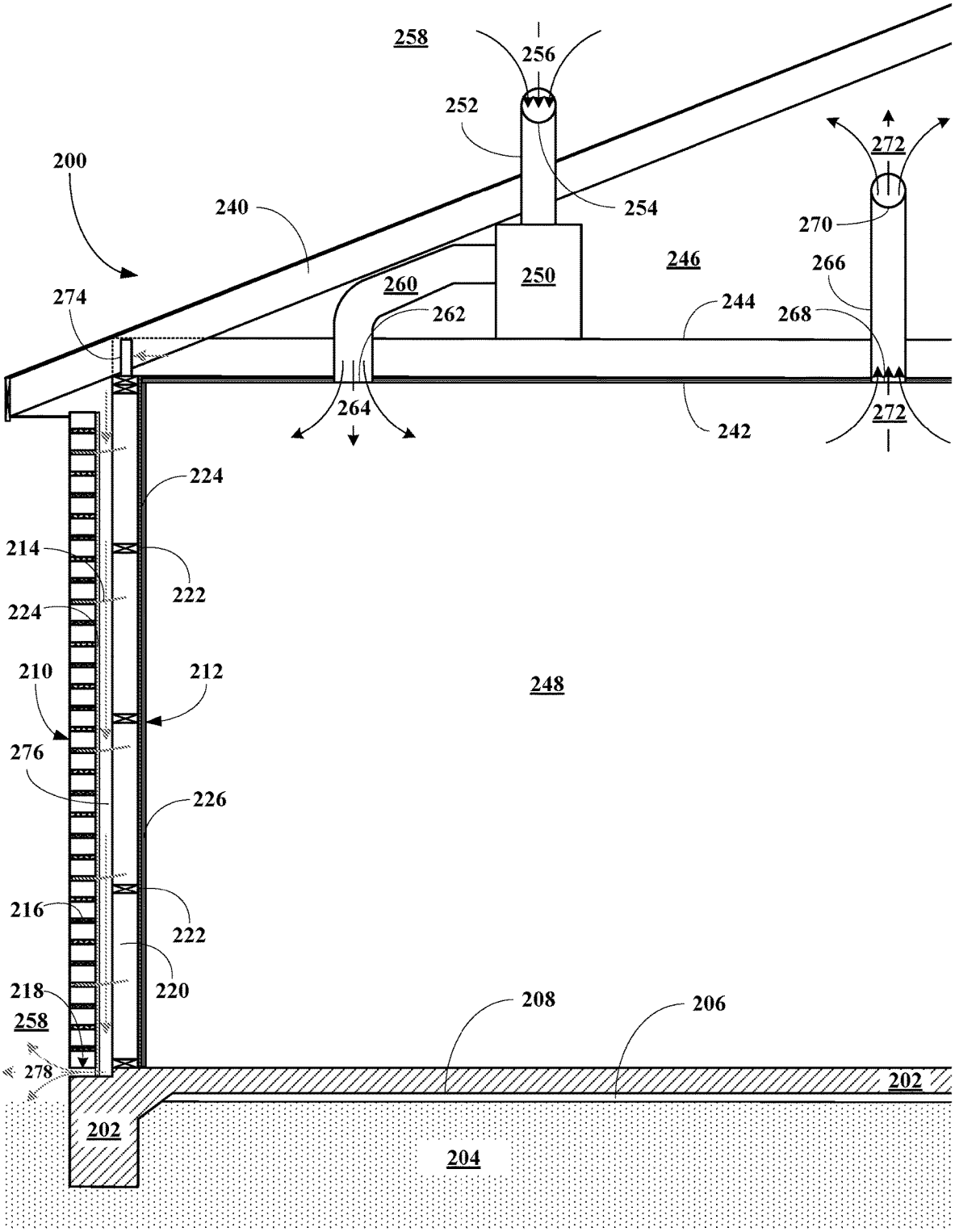
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FIG. 2

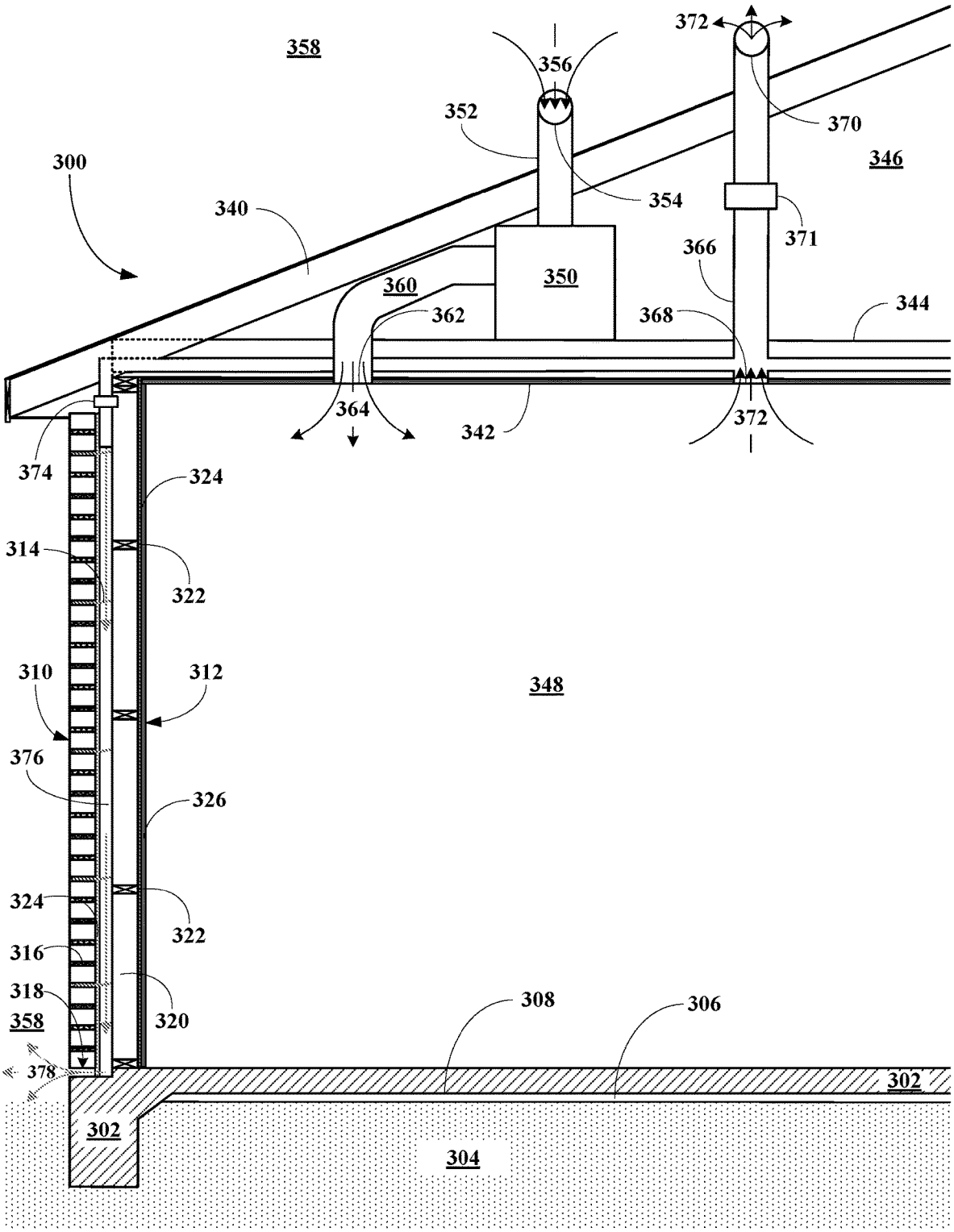
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FIG. 3

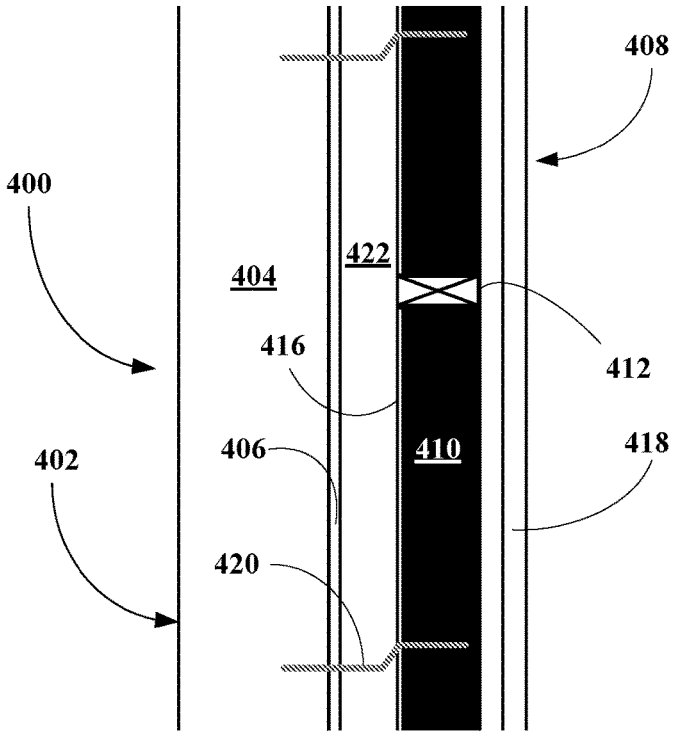
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FIG. 4A

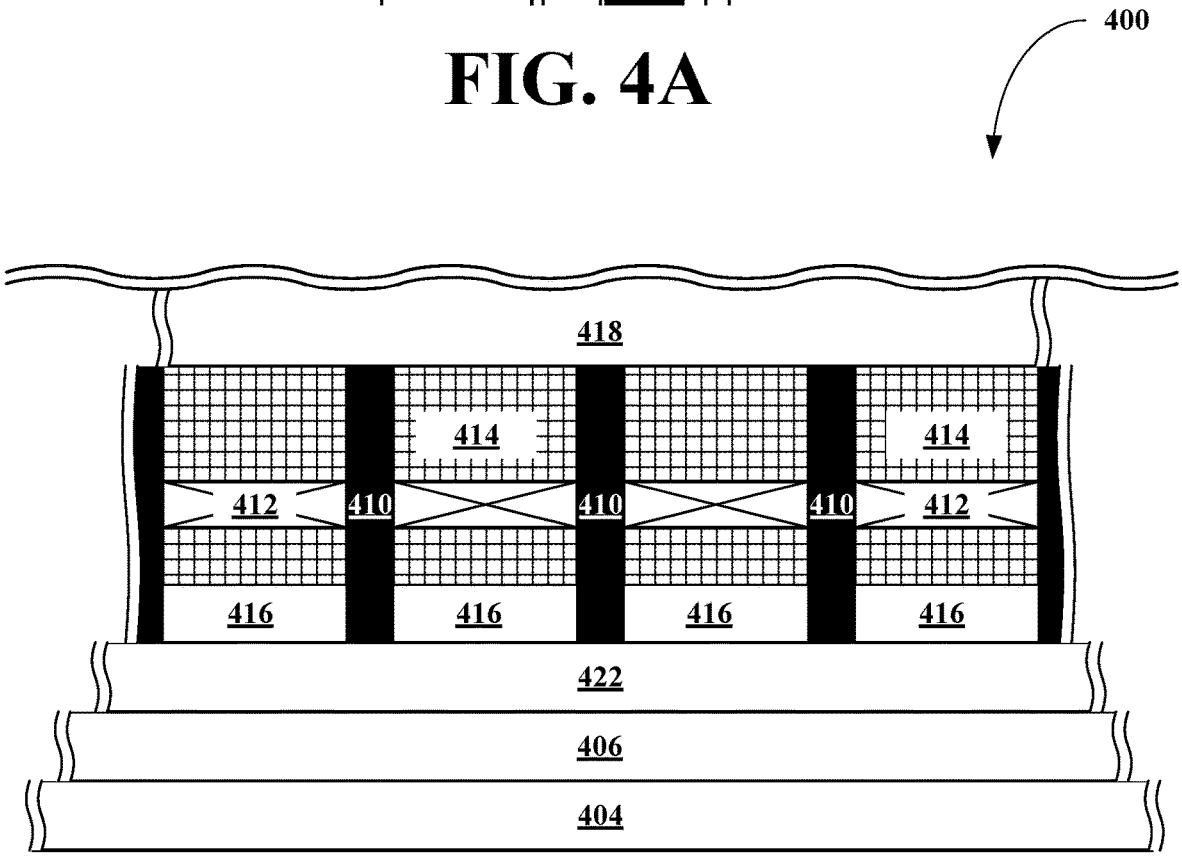
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FIG. 4B

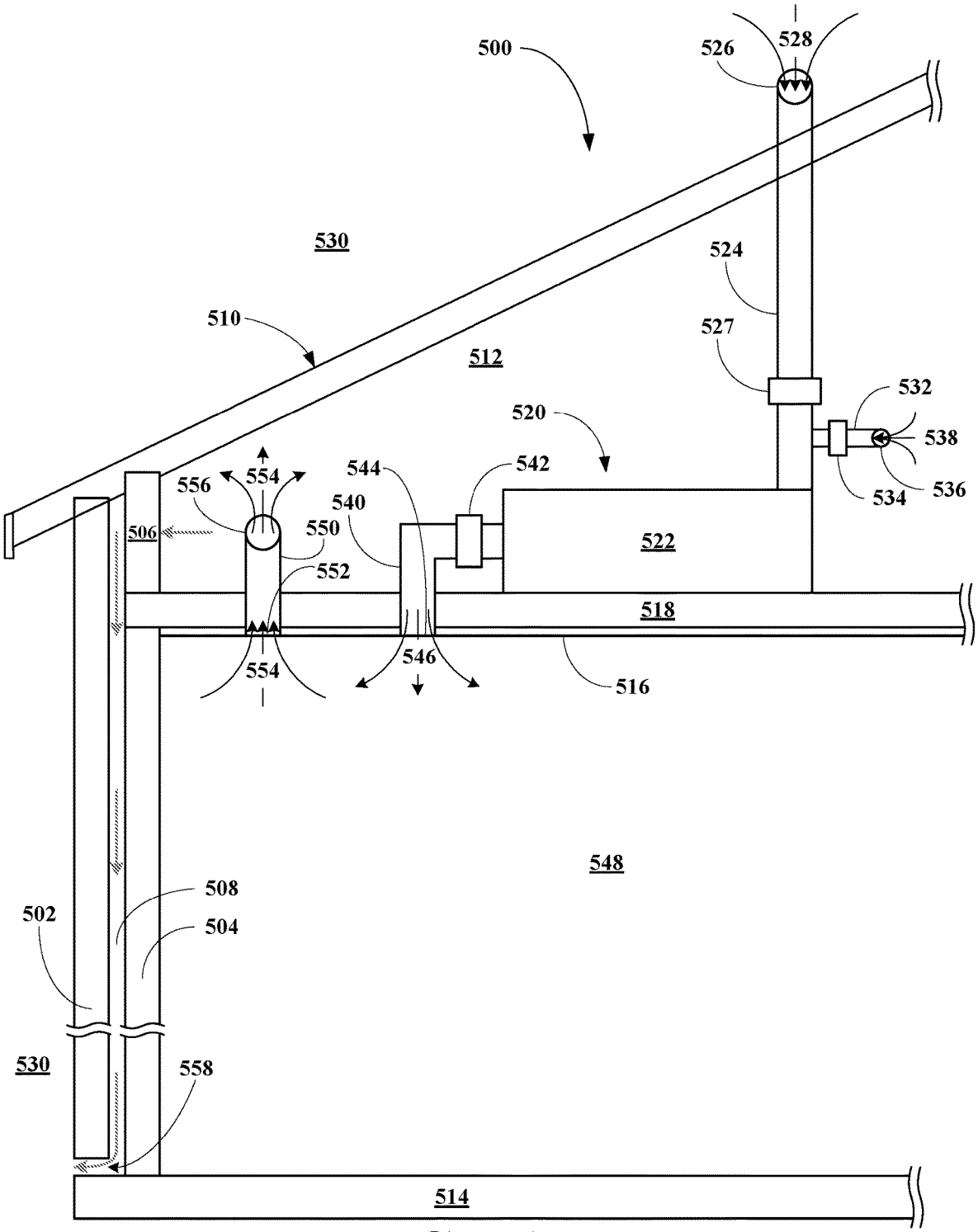
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FIG. 5A

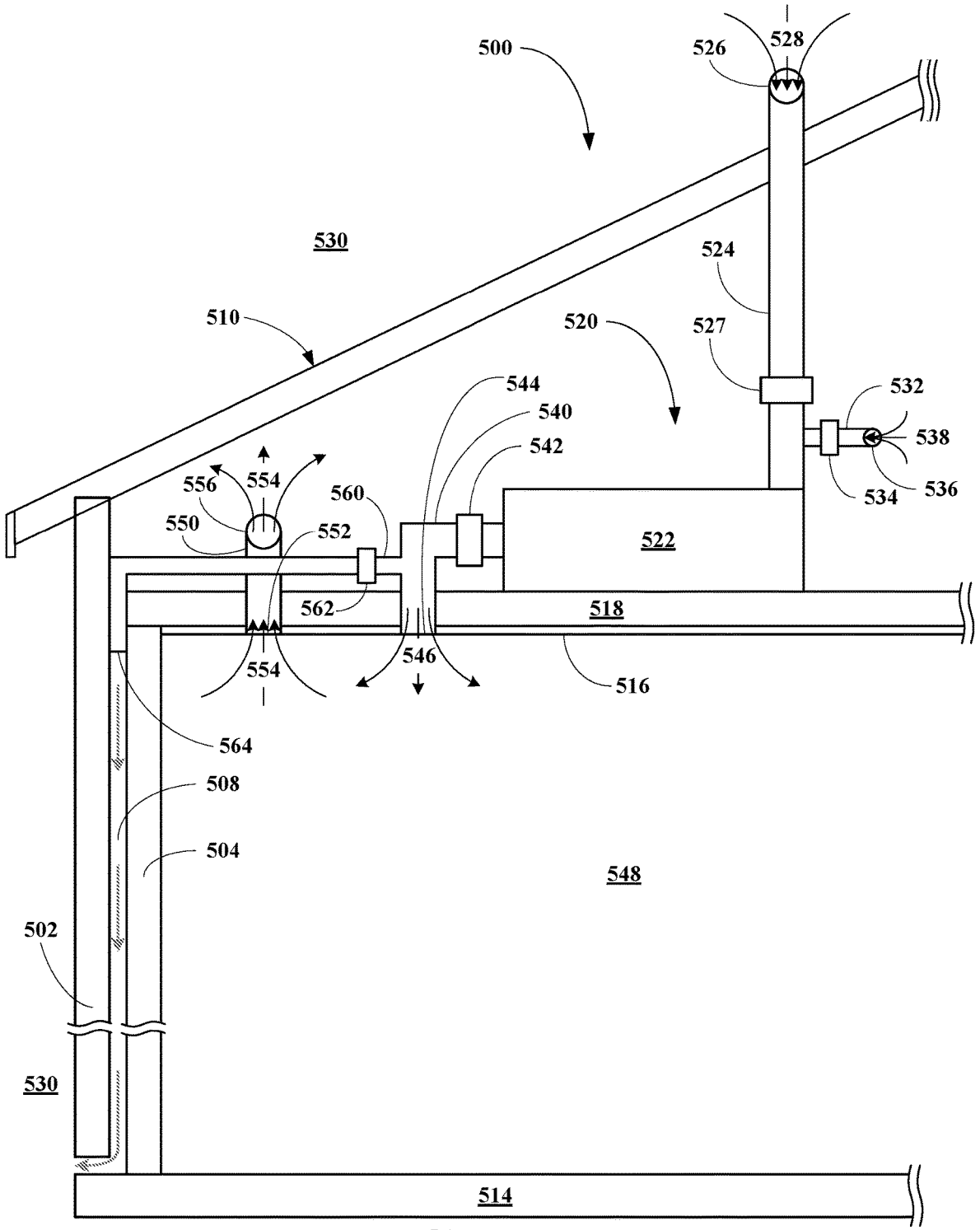
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FIG. 5B

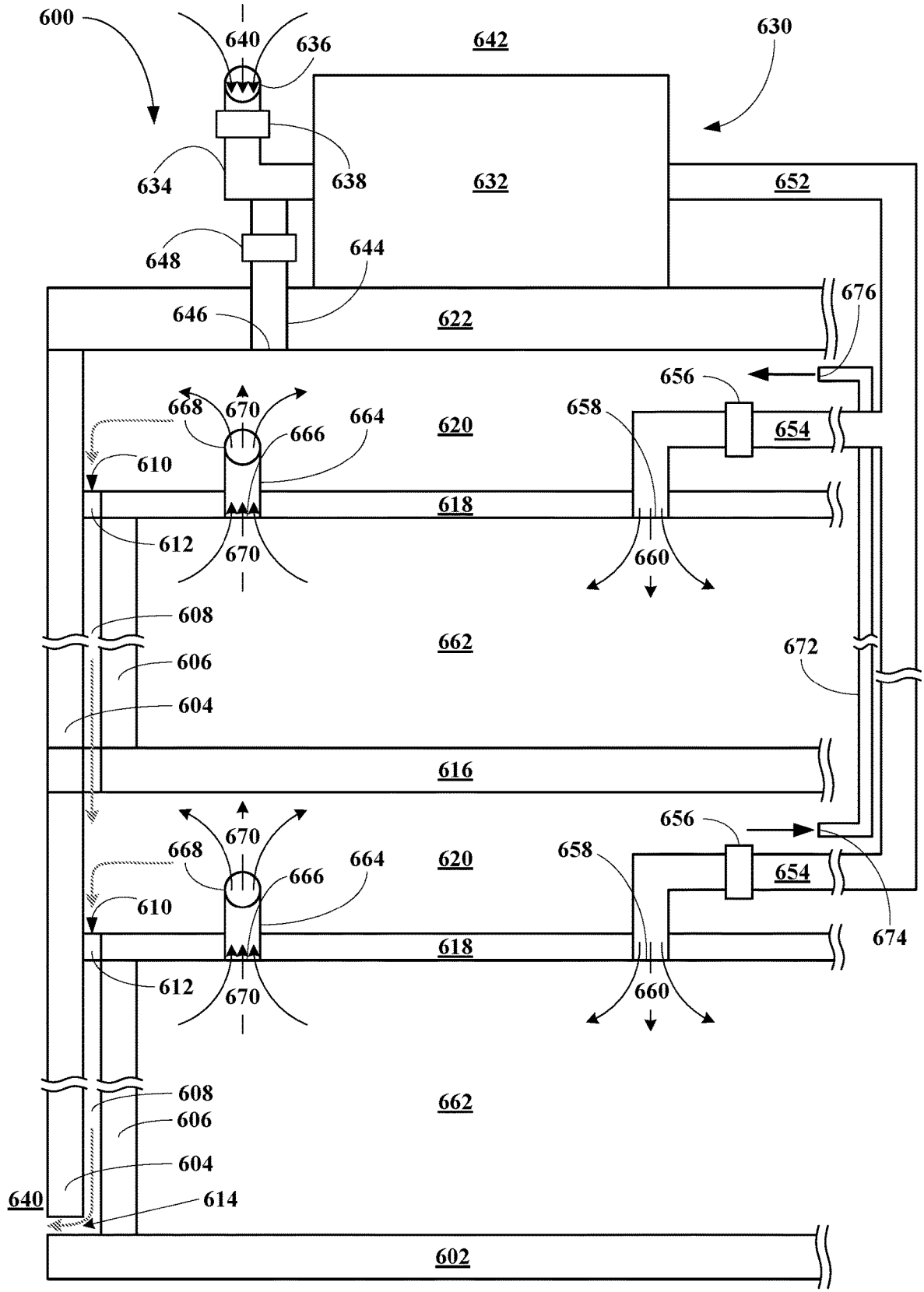
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FIG. 6A

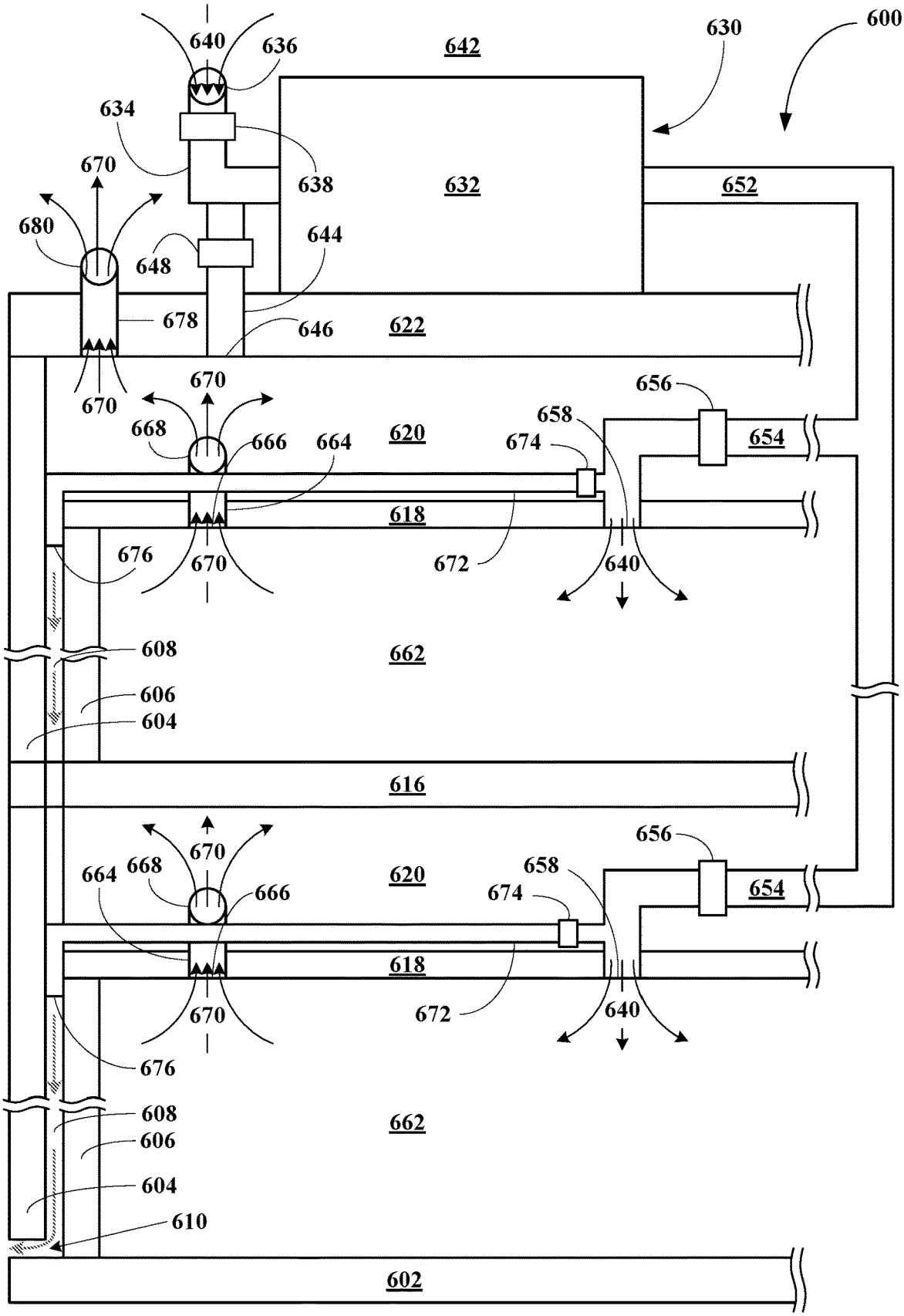
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FIG. 6B

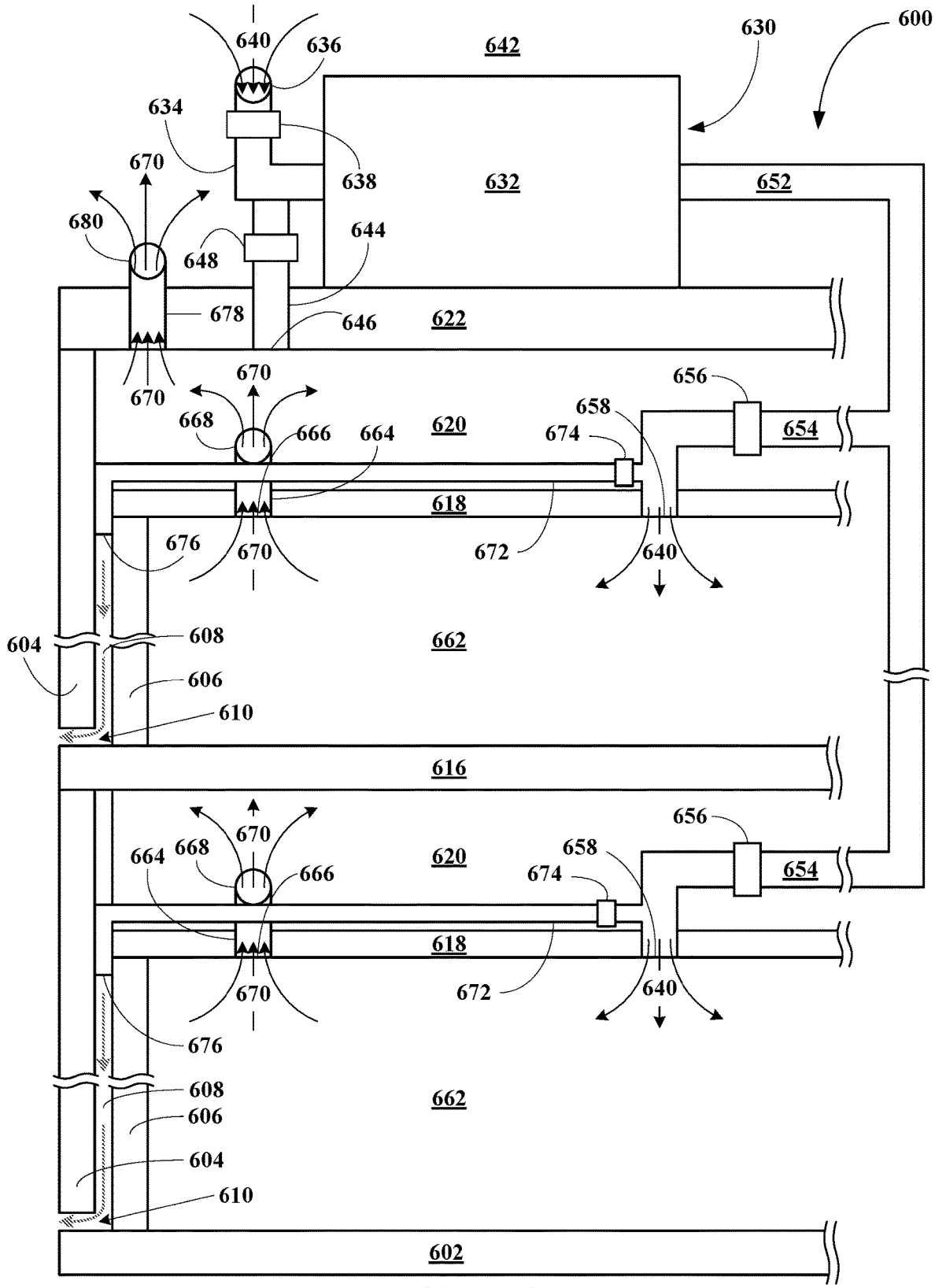
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FIG. 6C

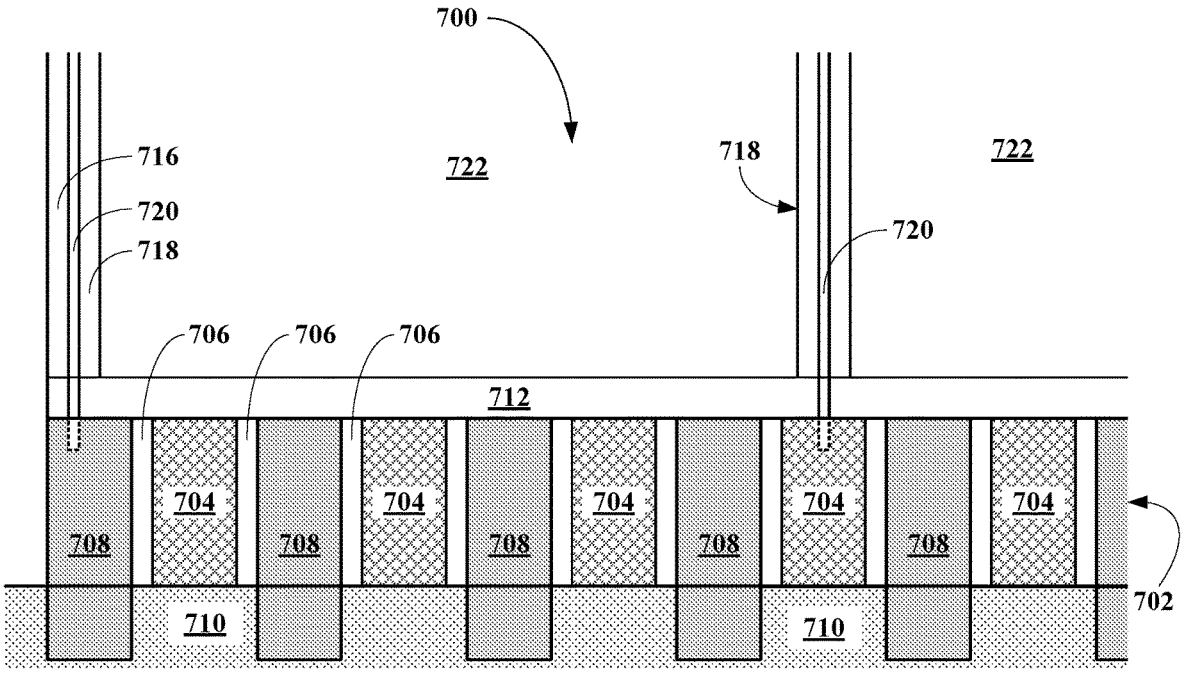
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FIG. 7A

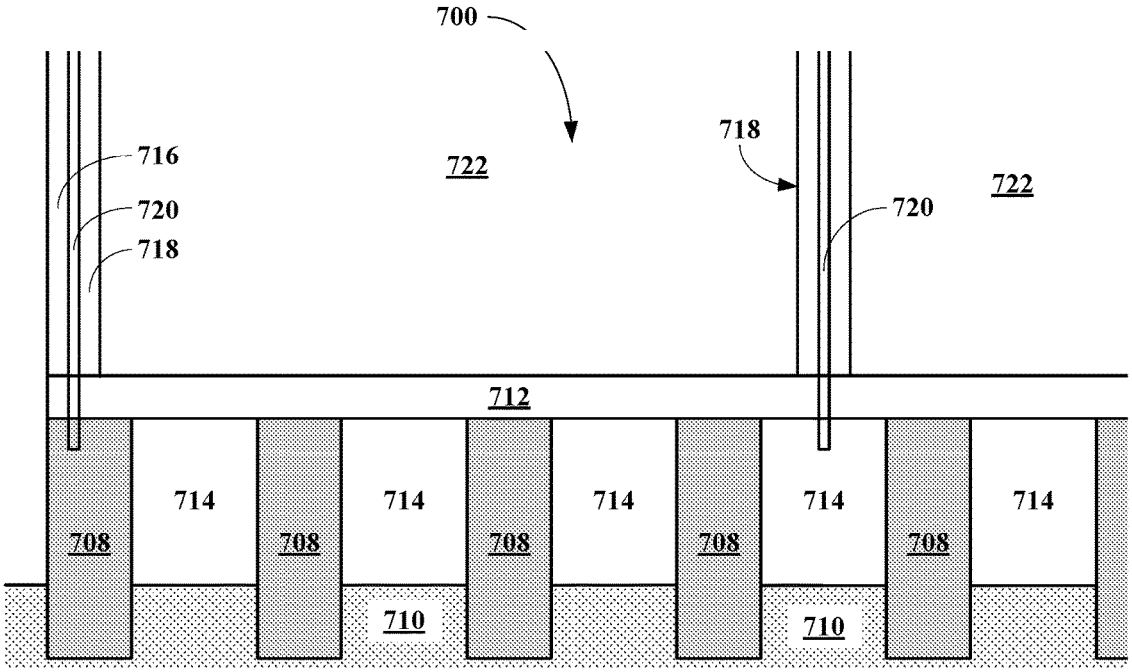
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FIG. 7B

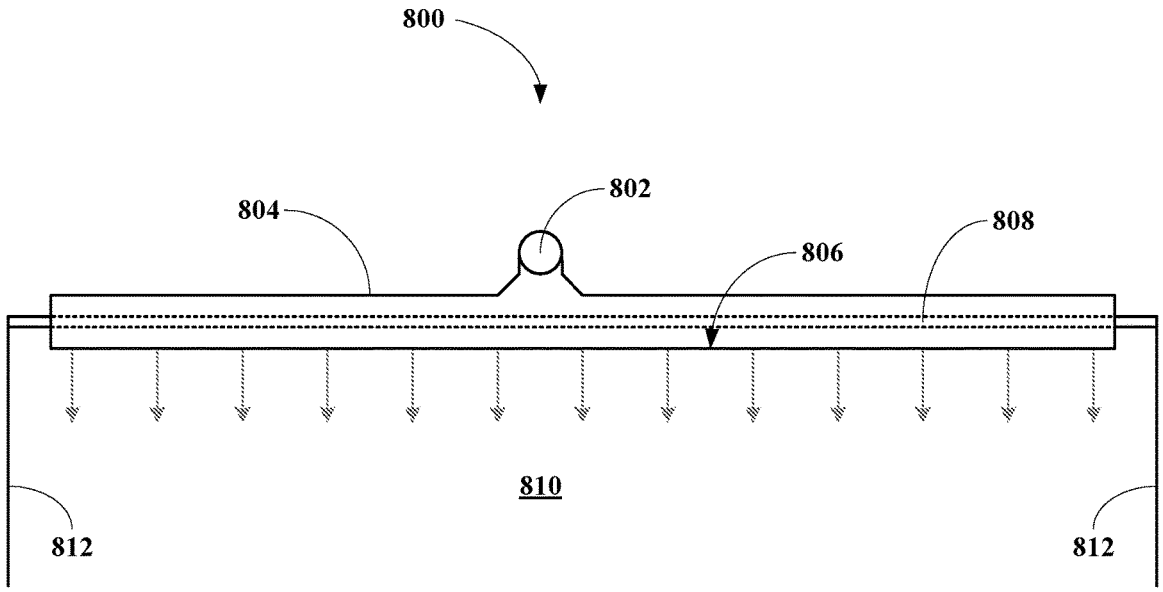
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FIG. 8A

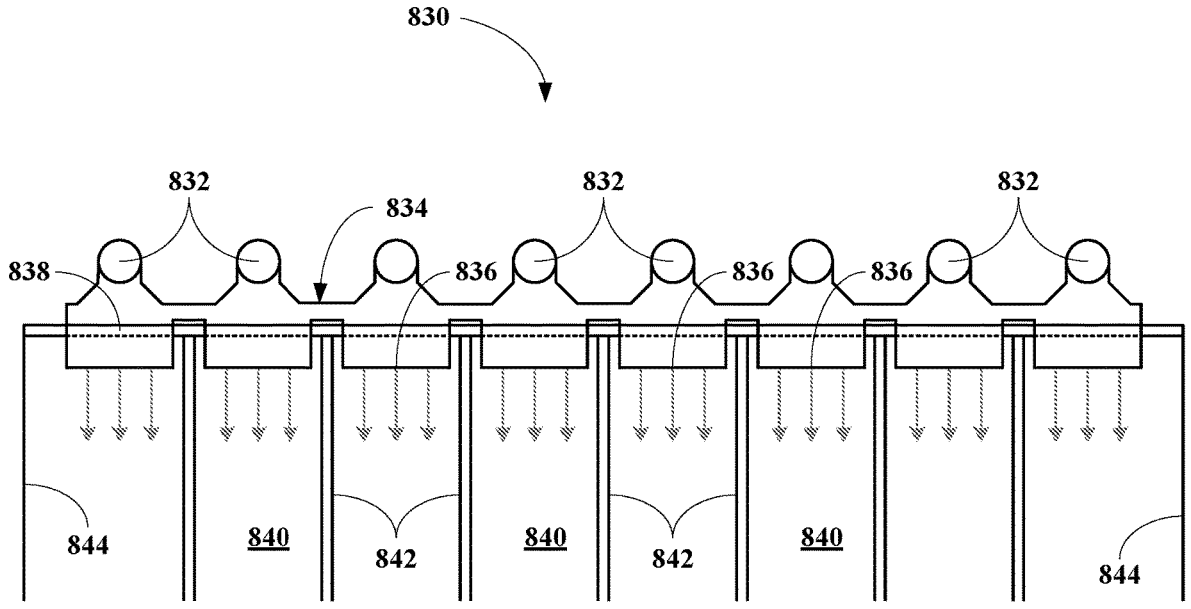
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FIG. 8B

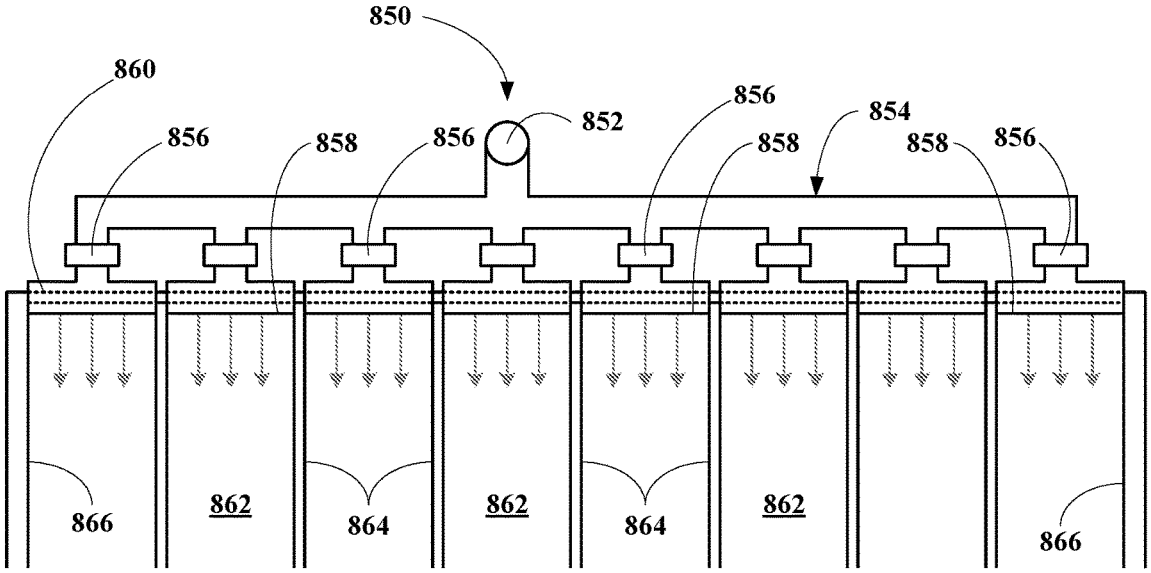
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FIG. 8C

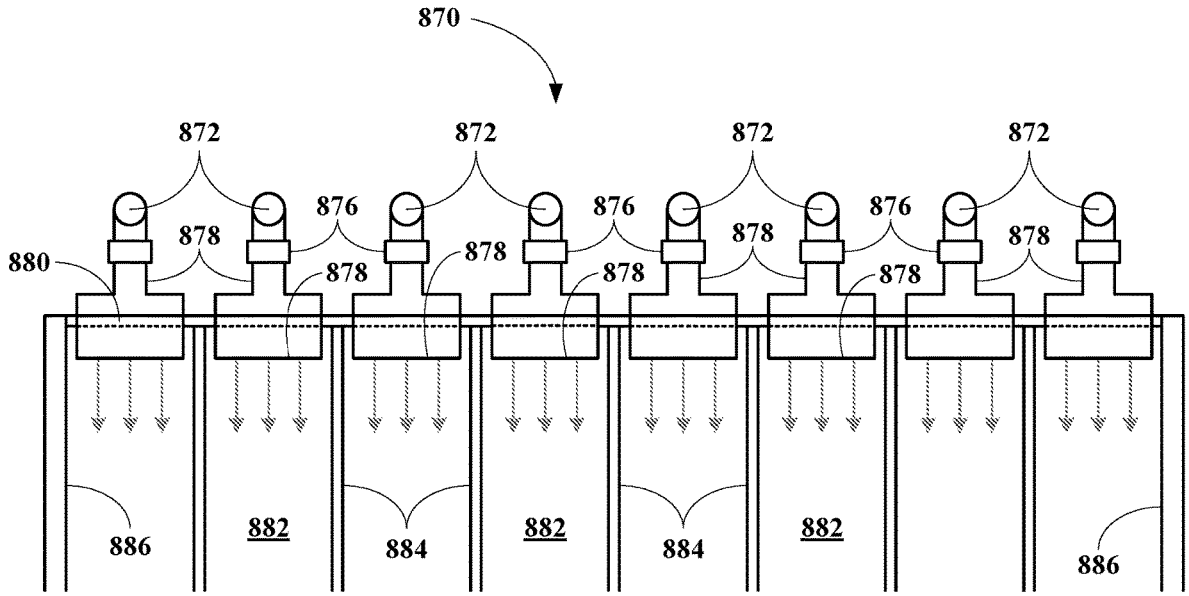
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FIG. 8D

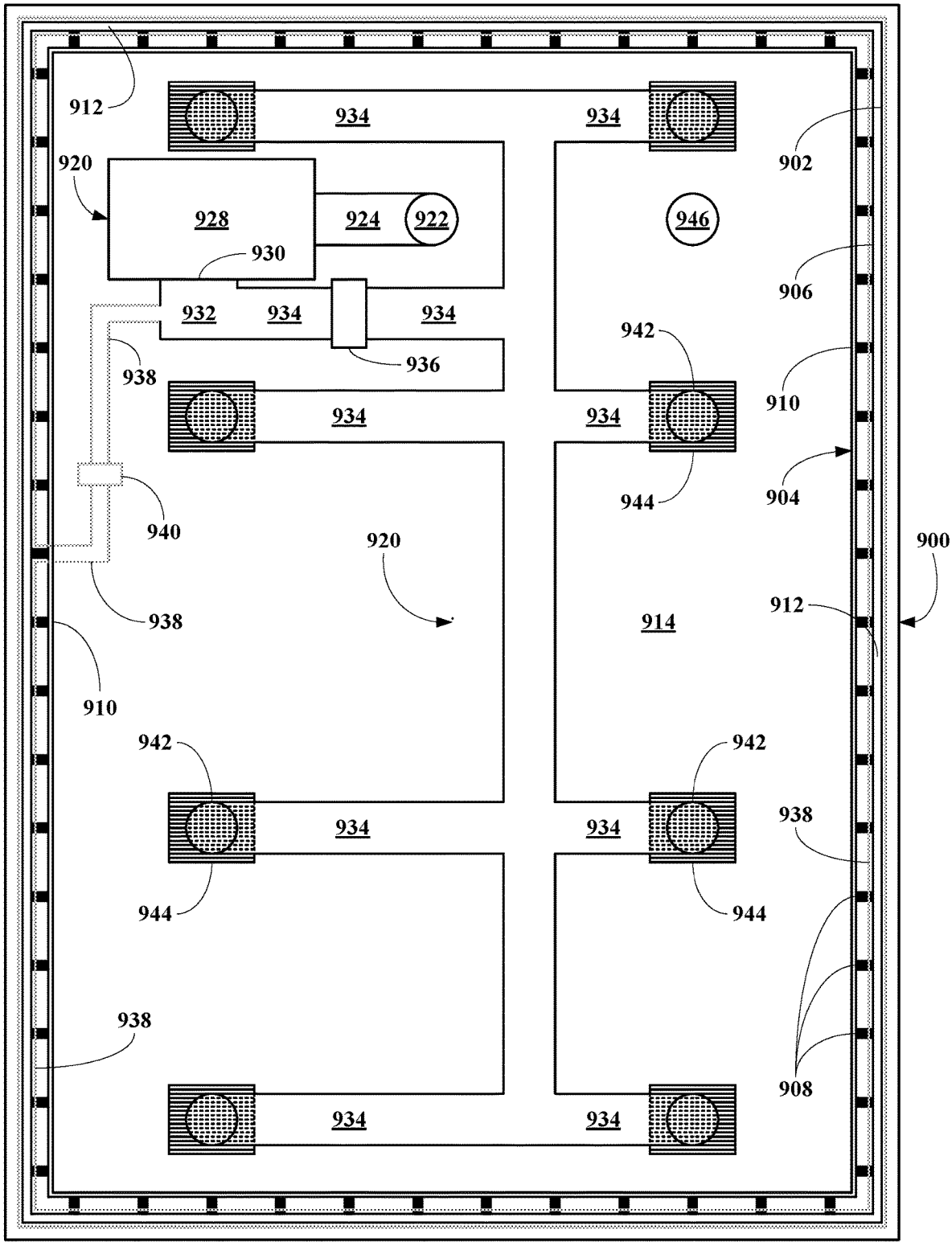
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FIG. 9A

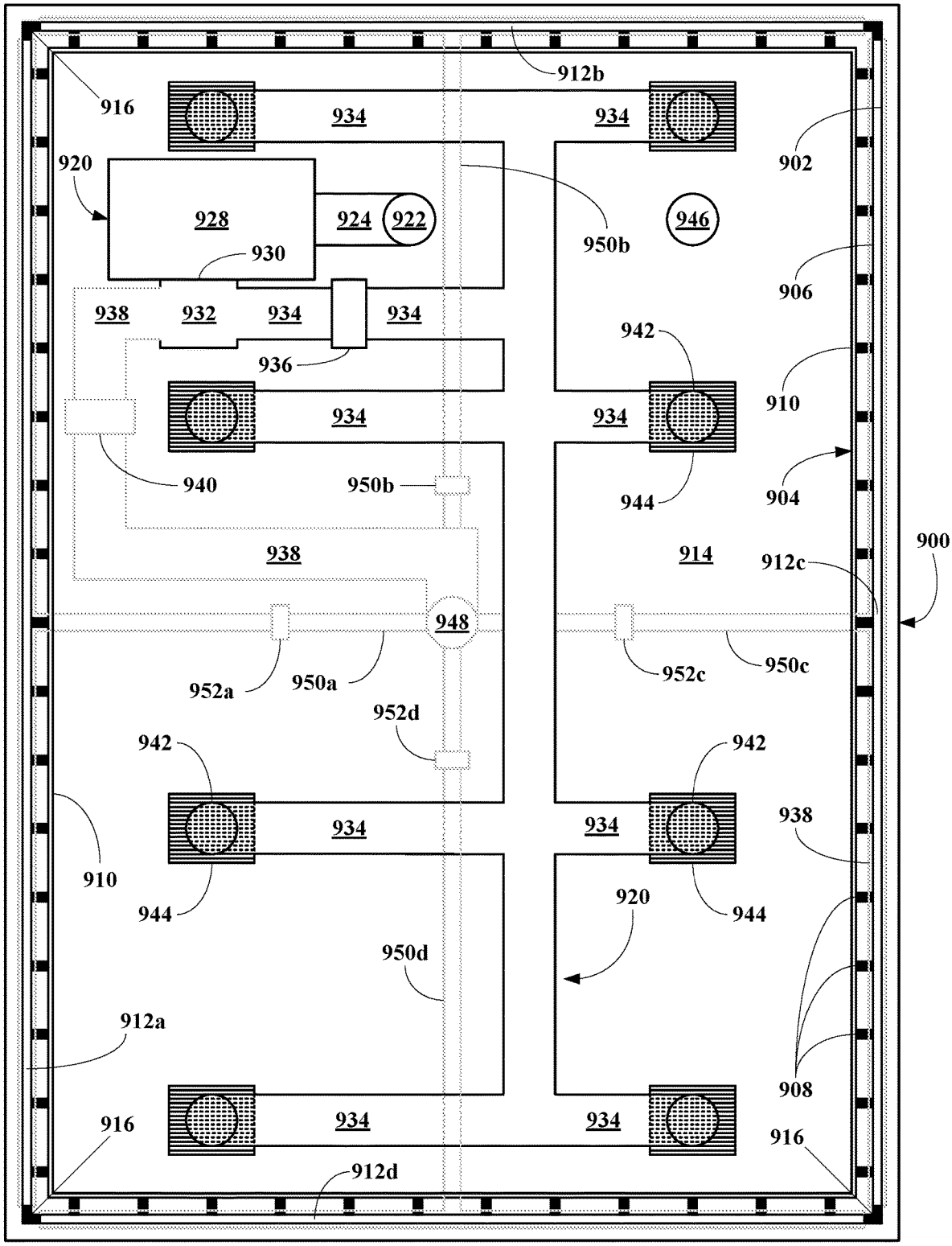
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FIG. 9B

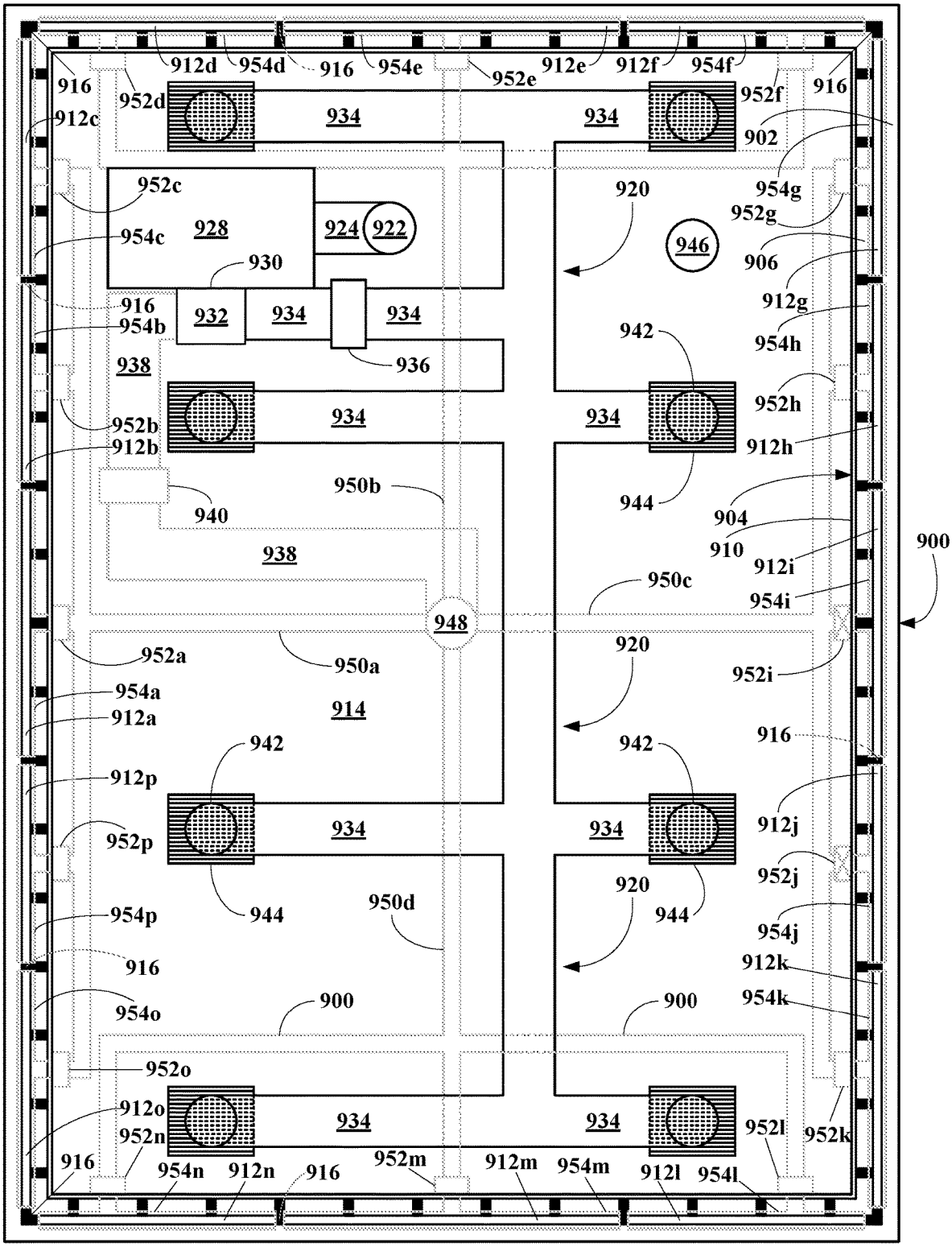
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FIG. 9C

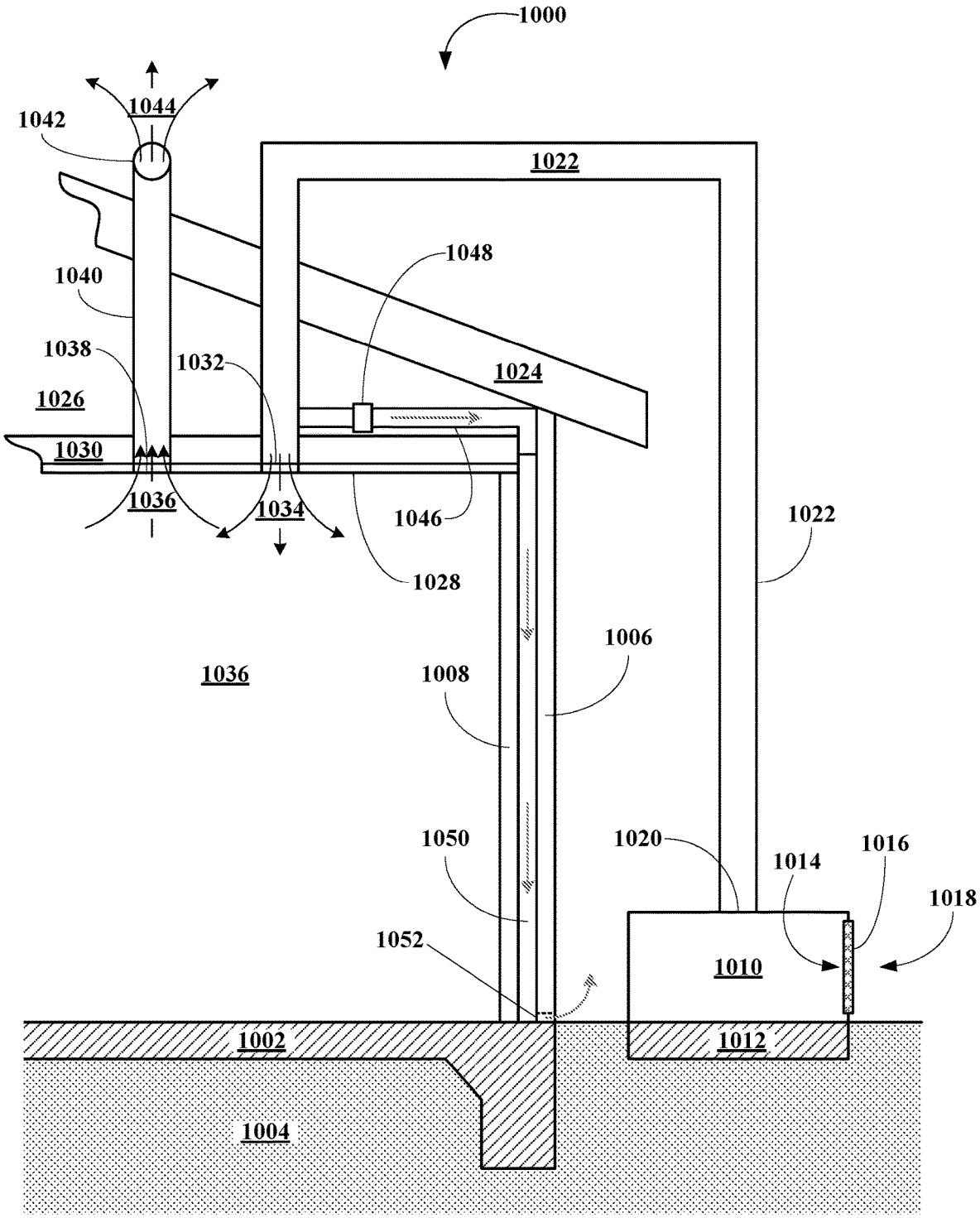
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FIG. 10

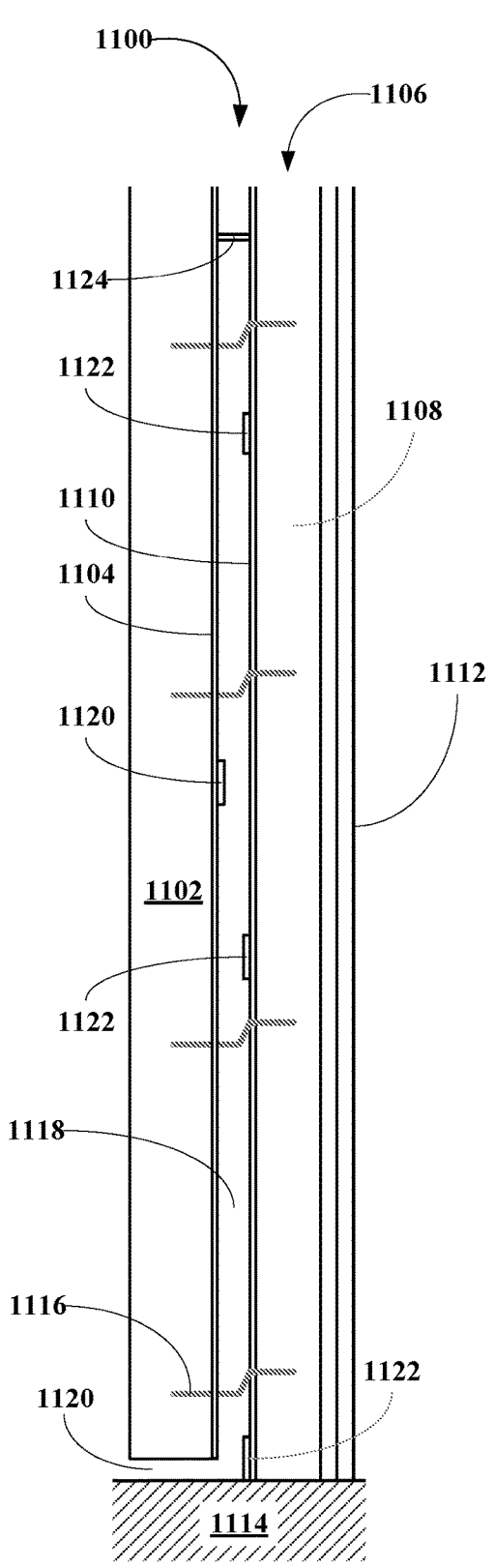

FIG. 11A

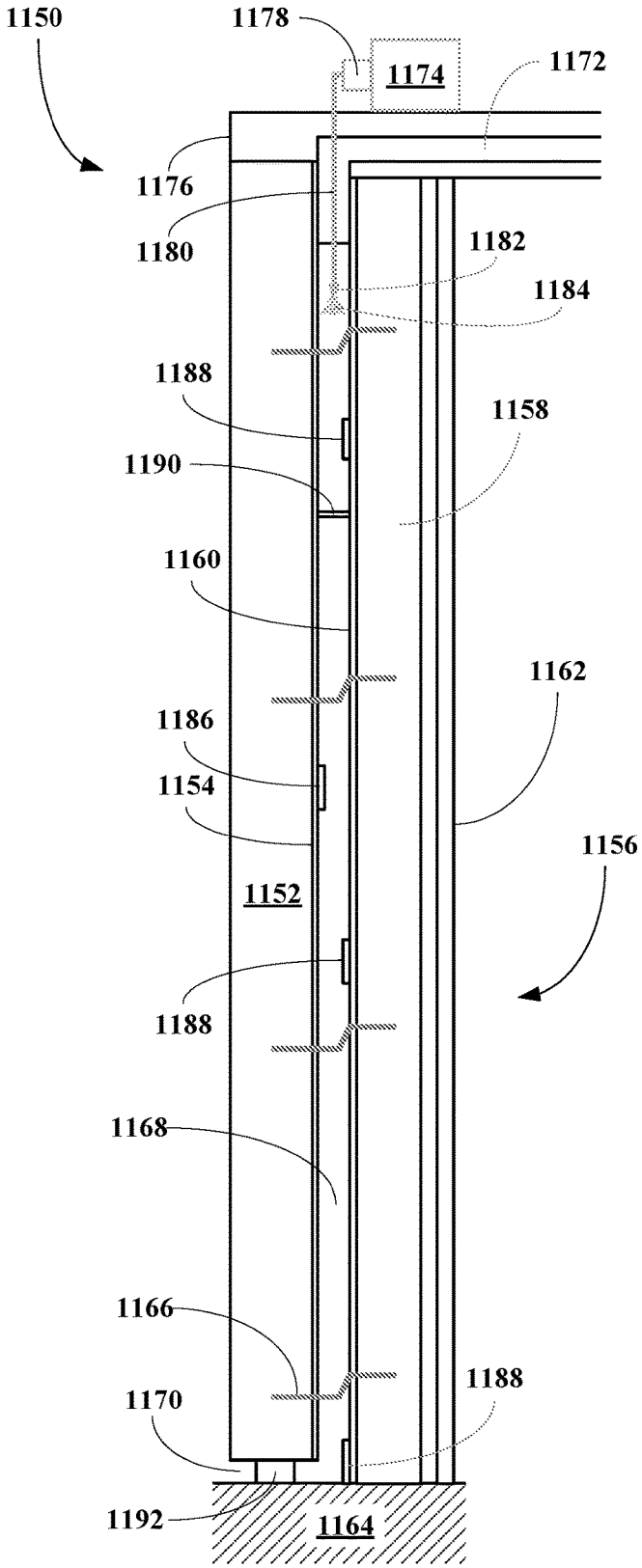

FIG. 11B

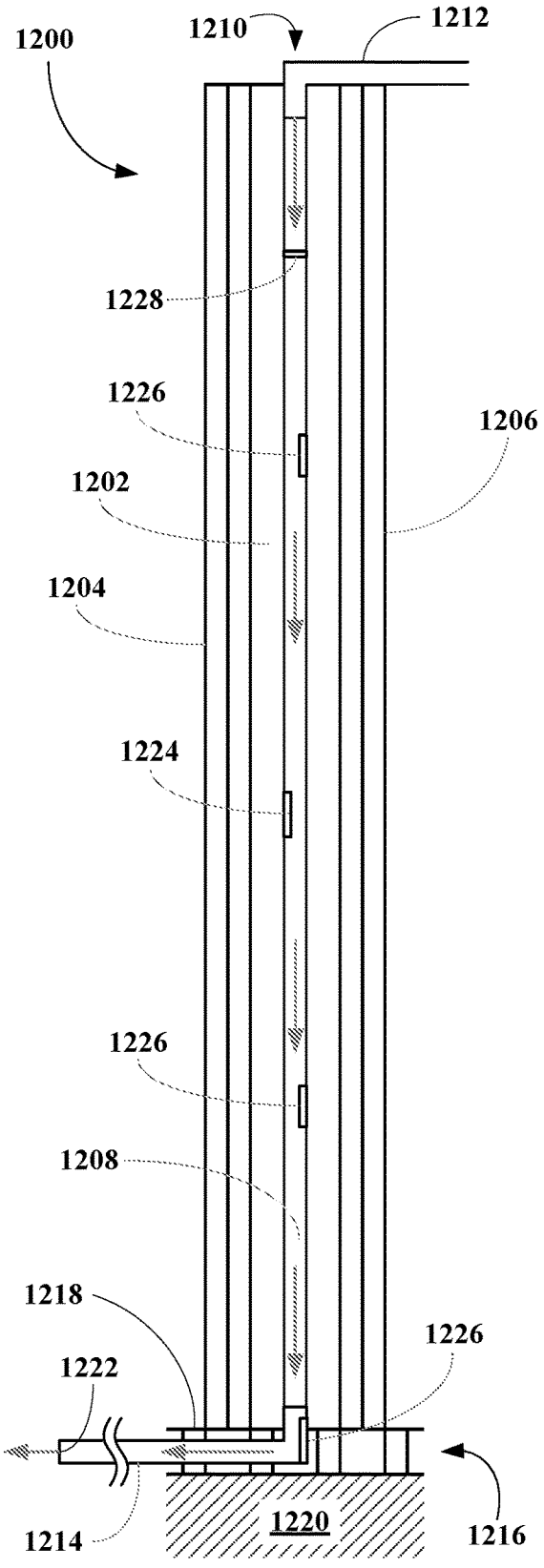

FIG. 12A

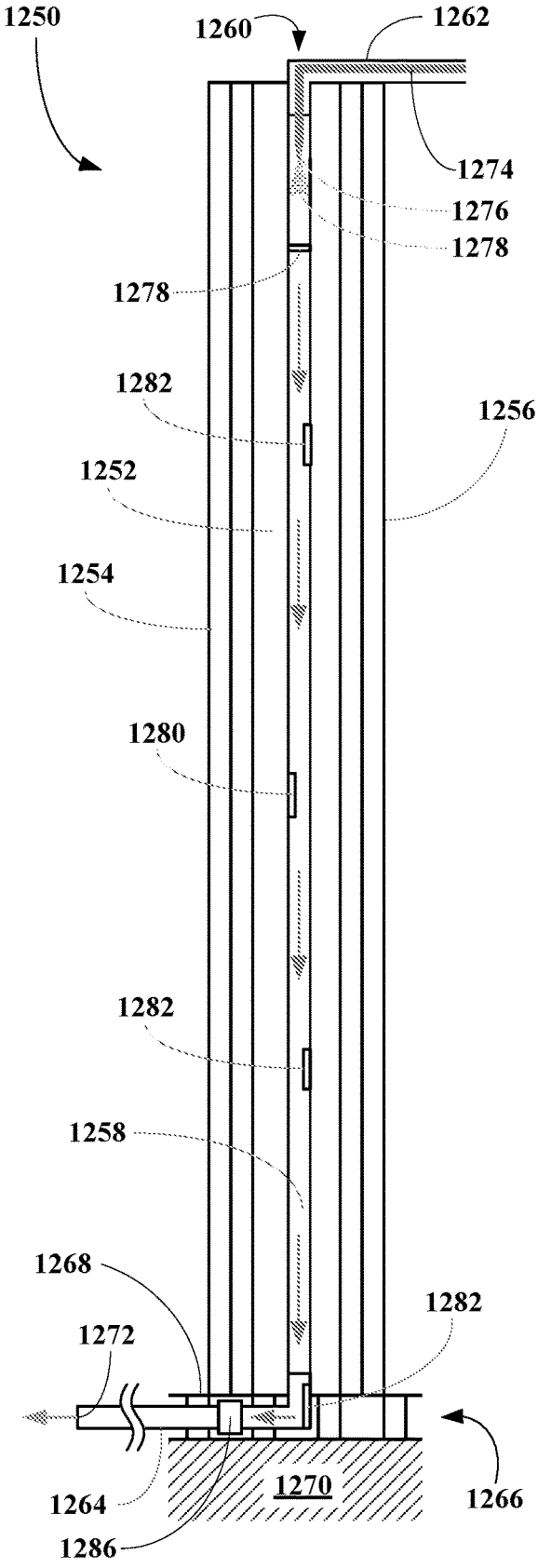

FIG. 12B

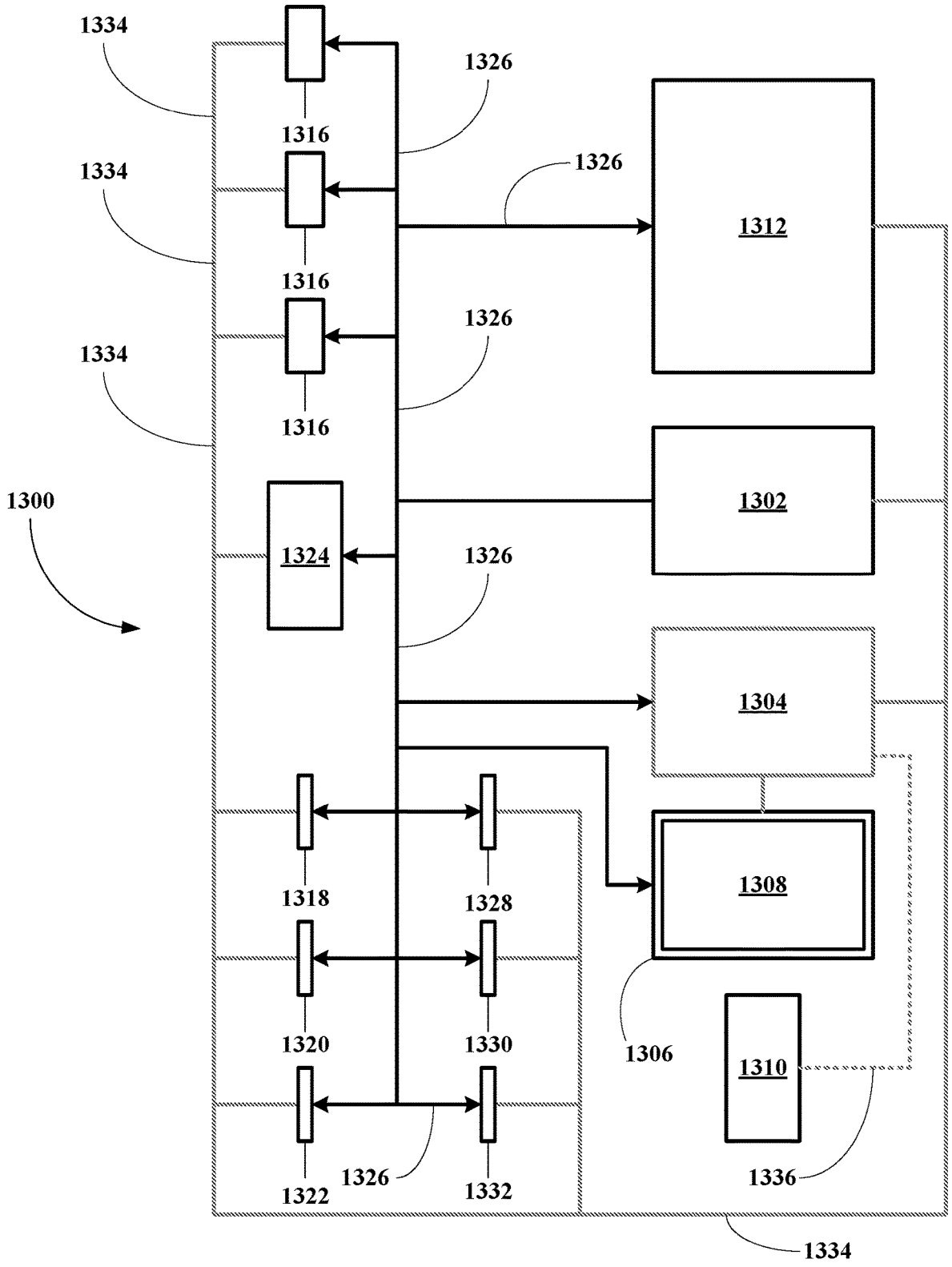
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FIG. 13

SYSTEMS AND METHODS FOR CONTROLLING AIR PROPERTIES IN STRUCTURES AND INHIBITING MOISTURE ACCUMULATION AND MOLD PROPAGATION IN STRUCTURES

RELATED APPLICATIONS

This application claims no benefit a prior application.

BACKGROUND OF THE DISCLOSURE

1. Field of the Disclosure

Embodiments of the present disclosure relate to systems, apparatuses, and methods for reducing, inhibiting, or eliminating water and/or moisture and/or their accumulation and/or mold growth in exterior walls or exterior and interior walls of habitable structures.

In particular, embodiments of the present disclosure relate to systems, apparatuses and methods for reducing, removing, inhibiting, or eliminating water and/or moisture and/or their accumulation and/or mold growth in exterior and interior walls of habitable structures, wherein the systems include air passageways or pathway supporting conditioned air through exterior walls or exterior and interior walls of habitable structures.

2. Description of the Related Art

Previously, I presented a system and method for inhibiting moisture and mold in an outer wall structure, U.S. Pat. No. 7,247,090B2. I now present improved systems, apparatuses, and methods for reducing, inhibiting, or eliminating water and/or moisture penetration and/or accumulation in internal and external walls of buildings and for drying buildings that have been subjected to flooding or other water and/or moisture penetration and/or accumulation events.

SUMMARY OF THE DISCLOSURE

Embodiments of present disclosure provide apparatuses and systems including exterior wall air passageways, optionally interior walls air passageways, and a heating, ventilation, and air conditioning unit (HVAC) that supplies conditioned air to the air passageways, valves, nozzles, and a size and a spacing of weep holes or air outlets associated with the walls and passageways or pathways to control the amount and direction of air flow into and through the passageways, wherein the conditioned air flow is designed to dry, to reduce moisture accumulation, and/or to inhibit mold growth in exterior walls or exterior and interior walls and/or to maintain a substantially uniform temperature in the structure throughout the day.

Embodiments of present disclosure provide methods of drying, inhibiting moisture accumulation, or controlling moisture in exterior and/or interior walls of a structure and/or controlling or maintaining temperature, air flow and air quality within the structure, wherein the methods include providing exterior walls or exterior and interior walls having air flow passageways therein and supplying conditioned air into the flow passageway by the HVAC unit controlled by valves and/or nozzles to dry or reduce or inhibit moisture accumulation in the walls, to maintain a certain moisture content in the walls, and/or to maintain a substantially uniform temperature in interior spaces in the structure as well as maintaining air flow and air quality in the interior

spaces. The term air quality here means maintaining, in all interior spaces, air flow, moisture content, temperature, oxygen content, carbon dioxide content, carbon monooxide contents at desired levels. It should be recognized that the air passageways or pathways may include valves and nozzles for controlling air flow into the passageways or pathways and the sizes, number, and spacing of weep holes or air outlets associated with the passageways and pathways control the flow of air out of the passageways or pathways. It should also be recognized that the valves may be "active" or "passive", wherein the term passive means that the valves are one-way valves allowing flow into the passageways and pathways, but not out of the passageways or pathways, and wherein the term active means that the valves actively control the flow of air into the passageways or pathways. Again, the size, number and spacing of the passageway or pathway outlets along with valves ultimately control the air flow rate through the passageways or pathways.

BRIEF DESCRIPTION OF THE DRAWINGS OF THE DISCLOSURE

The disclosure may be better understood with reference to the following detailed description together with the appended illustrative drawings in which like elements are numbered the same:

FIG. **1** depicts a prior art wall or building structure.

FIG. **2** depicts a first embodiment of a wall or building structure of this disclosure.

FIG. **3** depicts a second embodiment of a wall or building structure of this disclosure.

FIGS. **4**A&B depict expanded views of wall embodiments of this disclosure.

FIG. **5**A depicts a third embodiment of a wall or building structure of this disclosure.

FIG. **5**B depicts a fourth embodiment of a wall or building structure of this disclosure.

FIG. **6**A depicts a first embodiment of a multistory building structure of this disclosure.

FIG. **6**B depicts a second embodiment of a multistory building structure of this disclosure.

FIG. **6**C depicts a third embodiment of a multistory building structure of this disclosure.

FIGS. **7**A&B depict an embodiment of a peer and beam structure of this disclosure.

FIGS. **8**A-D depict four embodiments of wall air distribution systems of this disclosure.

FIGS. **9**A-C depict three other embodiments of wall air distribution systems of this disclosure.

FIG. **10** depicts a fifth embodiment of a wall or building structure of this disclosure.

FIGS. **11**A&B depict expanded views of embodiments of outer wall assemblies of this disclosure, with sensors and a sprayer.

FIGS. **12**A&B depict expanded views of embodiments of outer wall assemblies of this disclosure, with sensors and a sprayer.

FIG. **13** depicts a control system of this disclosure.

DEFINITIONS USED IN THE DISCLOSURE

The term "at least one" means one or more or one or a plurality, additionally, these three terms may be used interchangeably within this application. For example, at least one device means one or more devices or one device and a plurality of devices.

The term "one or a plurality" means one item or a plurality of items.

The term "about" means that a value of a given quantity is within ±20% of the stated value. In other embodiments, the value is within ±15% of the stated value. In other embodiments, the value is within ±10% of the stated value. In other embodiments, the value is within ±5% of the stated value. In other embodiments, the value is within ±2.5% of the stated value. In other embodiments, the value is within ±1% of the stated value.

The term "substantially" means that a value of a given quantity is within ±5% of the stated value. In other embodiments, the value is within ±2.5% of the stated value. In other embodiments, the value is within ±2% of the stated value. In other embodiments, the value is within ±1% of the stated value. In other embodiments, the value is within ±0.1% of the stated value.

The term "HVAC" means a heating, ventilation, and air conditioning unit, which generally includes a furnace, cooling coils, and blower along with the electronic and electrical components that control the unit.

DETAILED DESCRIPTION OF THE DISCLOSURE

The inventor has found that new systems, apparatuses, and methods may be constructed and implemented for reducing, inhibiting, or eliminating water and/or moisture and/or their accumulation and/or mold growth in exterior and interior walls of habitable structures by providing conditioned air pathways in the walls of the structures that are externally vented to force the removal or water and/or moisture from the walls and reduce, remove, inhibit or eliminate water and/or moisture and/or their accumulation and/or mold growth in exterior and interior walls.

Embodiments of present disclosure broadly related to apparatuses and systems including: exterior wall air passageways; optionally interior walls air passageways; a heating, ventilation, air conditioning unit (HVAC) to supply conditioned air, and valves to control an amount and/or direction of air flowing into and through the passageways, wherein the conditioned air flow may dry the walls, reduce moisture content in the walls, inhibit or control mold growth in the walls, and/or maintain a substantially uniform temperature in the structure throughout the day and night.

In certain embodiments, each exterior wall includes an internal wall section and an external wall section with the passageway disposed therebetween, wherein each passageway includes an inlet having a control valve or a unidirectional valve and an outlet, wherein the control valves or the unidirectional valves insure either a desired amount of air flow into the passageways or the air flow proceeds from the inlets to the outlets.

In other embodiments, each exterior wall includes an internal wall section and an external wall section with the passageway disposed therebetween, wherein each passageway includes an inlet having a control valve or a unidirectional valve and an outlet, and each interior wall includes a first wall section and a second wall section with the passageway disposed therebetween, wherein each passageway includes an inlet having a control valve or a unidirectional valve and an outlet, wherein the control valves or the unidirectional valves insure either a desired amount of air flow into the passageways or the air flow proceeds from the inlets to the outlets.

In other embodiments, the apparatuses and systems also include at least one sensor configured to sense moisture and generate a signal corresponding to the sensed moisture and a control unit configured to receive the signal from the at least one sensor and to control the HVAC and the valves to provide a conditioned air having properties to dry or reduce the sensed moisture or to maintain a certain moisture content in the walls due to the air flow into, through, and out of the passageways.

In other embodiments, the apparatuses and systems also include at least one sensor disposed in one, some, or all of the passageways and configured to sense moisture in the passageways and to generate a signal corresponding to the sensed moisture and a control unit configured to receive the signal from the at least one moisture sensor and to control the HVAC and optionally the valves to provide conditioned air and control an amount of the conditioned air into the air flow passageways, wherein the conditioned air has properties to dry the walls or to reduce the sensed moisture in the walls or to maintain a certain moisture content in the walls as the conditioned air flows into, through, and out of the passageways.

In other embodiments, the apparatuses and systems also include at least one sensor disposed in one, some, or all of the passageways and configured to sense temperature in the passageways and to generate a signal corresponding to the sensed temperature, and a control unit configured to receive the signals from the temperature sensors and to control the HVAC and optionally the valves to variably supply controlled amounts of conditioned air into the air flow passageways to maintain a constant and/or uniform temperature in the structure and/or to dry or reduce the moisture or to maintain a certain moisture content in the walls.

In other embodiments, the apparatuses and systems also include a supply unit for supplying mold control compositions or other compositions into the walls, wherein the supply unit is under the control of the control unit. In other embodiments, the apparatuses and systems also include fire suppressant units that may feed carbon dioxide or carbon dioxide foam or other fire retardant or suppression compositions.

In other embodiments, the apparatuses and systems are designed to permit conditioned air to be flow through the exterior and interior walls so that a uniform temperature and moisture content in the wall interiors may be maintained. During the day and night, the apparatuses and systems may continuously adjust rate and amount of conditioned air flowing into each passageway so that the temperature and moisture content within the interior of each wall is maintained at substantially uniform values that may be preset set or set as desired by the user. As the sun rises, one side of a structure will begin to heat differently than the non-illuminated side, the apparatuses and systems adjust the distribution of air flow so that the temperature and/or moisture content in the interior the walls and therefore throughout the entire structure may be more uniformly controlled.

Embodiments of present disclosure broadly relates to methods of drying water or moisture in exterior walls or exterior and interior walls of a structure, inhibiting moisture accumulation in the walls, or maintaining a substantially uniform temperature and/or moisture content in the wall, where the methods include providing exterior walls or exterior and interior walls having air flow passageways and supplying conditioned air into the flow passageway by an HVAC unit and valves to dry or reduce or inhibit moisture accumulation in the walls, to maintain a certain moisture content in the walls, and/or to maintain a substantially uniform temperature in the structure.

In certain embodiments, the methods further include receiving output from at least one sensor and controlling properties of the conditioned air in response thereto.

In other embodiments, the methods further include receiving output from at least one sensor, controlling properties of the conditioned air in response thereto and controlling an air flow rate into the passageways in response thereto.

In other embodiments, the methods further include supplying a treating composition into the passageways, wherein the treating composition is a mold control composition, a pesticide, an insecticide, a fungicide, a bactericide, a poison for rodents, other control compositions, or mixtures and combinations thereof.

In other embodiments, the methods also include collecting temperature data, moisture data, air flow data, pressure data, air component data, and/or other data and adjusting the air flow rate and/or amount into each passageway so that the values of each measure property may be maintained at some desired level or some pre-set level. In other embodiments, the adjusting may be in conjunction with data indicating a fire or other emergency situation in which case the air flow and fire suppressants and/or retardants flow rate into the passageways my be used to impede progression of the fire or to produce fire breaks, wall as that do not support fire due to air flow and flame retardant flow rate into each passageway.

Again, it should be recognized that the air passageways or pathways may include valves and nozzles for controlling air flow into the passageways or pathways and the sizes, number, and spacing of weep holes or air outlets associated with the passageways and pathways control the flow of air out of the passageways or pathways. It should also be recognized that the valves may be "active" or "passive", wherein the term passive means that the valves are one way valves allowing flow into the passageways and pathways, but not out of the passageways or pathways, and wherein the term active means that the valves actively control the flow of air into the passageways or pathways. Again, the size, number and spacing of the passageway or pathway outlets along with valves ultimately control the air flow rate through the passageways or pathways.

Embodiments of this disclosure broadly relate to structures including a floor or slab, a ceiling, an insulated roof, and an attic interposed between the ceiling and the roof. The structures further include one or a plurality of exterior walls, each of the exterior walls includes: an exterior wall outer portion, an exterior wall inner portion including a wall framing system, an exterior wall air flow passageway interposed therebetween, and at least one exterior wall exhaust conduit having: a passageway inlet, and a passage way outlet. The structures further include a plurality of interior walls and a plurality of interior spaces defined by the exterior and interior walls. The structures further include an HVAC unit, disposed in the attic, including: an HVAC air inlet conduit having: an HVAC inlet, and an HVAC inlet control valve configured to control a supply of unconditioned air or a mixture of unconditioned air and exhaust conditioned air to the HVAC unit; an HVAC air outlet conduit having: an HVAC outlet, and an HVAC outlet control valve configured to control a supply of conditioned air to the interior spaces; and at least one HVAC exhaust conduit having: an HVAC exhaust inlet, and an HVAC exhaust outlet configured to support an air flow of exhaust conditioned air into the attic. The structures further include at least one passageway control valve associated with the passageway inlets and configured to support passageway air flow into the passageway(s) and out of the exhaust conduit(s) into the surroundings and to stop air flow from the surroundings into the passageways, whereby the passageway air flow reduces, removes, and/or eliminates moisture in the exterior walls.

In certain embodiments, the at least one passageway control valve is a passive one-way or unidirectional valve, and the passageway air flow comprises attic exhaust conditioned air. In other embodiments, the at least one passageway control valve is part of the HVAC unit and is associated with a HVAC passageway outlet conduit connected to the HVAC outlet conduit and having a passageway outlet associated with the passageway inlets, the at least one passageway control valve is a passive one-way or unidirectional valve or an active control valve, and the passageway air flow comprises conditioned air from the HVAC unit. In other embodiments, each of the interior walls includes: two interior wall outer portions, an interior wall inner portion having: an interior wall air flow passageway having: a passageway inlet and a passageway outlet; at least one interior wall exhaust conduit. In other embodiments, the exterior wall inner portion includes: an insulating layer, a weather-resistant layer disposed on an outer surface of the insulating layer; and/or a sheathing disposed on an inner surface of the insulating layer. In other embodiments, the exterior wall inner portion further includes: a liquid barrier and/or a first sheathing between the liquid barrier and the wall framing system. In other embodiments, the at least one HVAC exhaust conduit further includes: a second HVAC exhaust outlet configure to support an air flow of exhaust conditioned air into the surrounding and having: an HVAC exhaust control valve configured to control amounts of exhaust conditioned air exhausted into the attic and into the surrounds.

In other embodiments, the structure further comprising: an air flow control system including: a processing unit; and plurality of sensors; wherein one, some, or all of the control valves are active control valves, wherein the processing unit is in communication with the active control valves, and wherein the processing unit is configured to: receive input from the sensors, and control the HVAC unit and the active control valves thereby controlling air flow rates into the interior spaces and into the passageways. In other embodiments, the sensors are selected from the group consisting of temperature sensors, water/moisture sensors, air flow sensors, chemical sensors, other physical sensors, and combinations thereof. In other embodiments, at least one of the sensors is disposed in: the air flow passageways or the air flow passageways and the attic and/or the interior spaces. In other embodiments, all of the control valves are active control valves, and during a 24 hour period of time, the processing unit is further configured: to adjust the air flow into each of the interior spaces and into each passageway so that one or more interior space properties and/or one or more passageway properties are maintained at desired values. In other embodiments, the one or more properties include moisture concentrations in the interior spaces and/or passageways, temperature in the interior spaces and/or passageways, or mixtures and combinations thereof. In other embodiments, the one or more properties further include pressures in the interior spaces and/or passageways, air flow rates in the interior spaces and/or passageways, sensed chemical concentrations in the interior spaces and/or passageways, and/or microbial concentrations in the interior spaces and/or passageways.

In other embodiments, the structures further comprises: a dispensing assembly associated with one, some, or all of the passageways and including: a reservoir containing a treating composition; a dispensing supply conduit having: a dispens-

ing assembly control value, a dispensing head at its distal end, wherein the dispensing assembly control value is configured to control an amount of treating solution or gas introduced into one, some, or all of the passageways. In other embodiments, the treating composition is selected from the group consisting of a mold control composition, a pesticide, an insecticide, a fungicide, a bactericide, a rodent poison, other control compositions, a gas, a fire retardant compositions, a foam, and mixtures or combinations thereof, and the gas is selected from the group consisting of nitrogen, nitrogen enriched air, argon, haloalkanes and mixtures thereof, the haloalkanes are selected from the group consisting of iodomethane (Halon 10001); bromomethane (Halon 1001), bromochloromethane, CH_2BrCl (Halon 1011), carbon tetrachloride (Halon 104), tribromofluoromethane (Halon 1103), dichlorofluoromethane (Halon 112), bromodifluoromethane (Halon 1201), dibromodifluoromethane (Halon 1202), bromochlorodifluoromethane, CF_2ClBr (Halon 1211), dichlorodifluoromethane (Halon 122), bromotrifluoromethane, $CBrF_3$ (Halon 1301), tetrafluoromethane (Halon 14), 1,2-dichlorotetrafluoroethane (Halon 242), dibromotetrafluoroethane, $C_2Br_2F_4$ (Halon 2402), hexafluoroethane (Halon 2600), and mixtures thereof.

Embodiments of this disclosure multistory structures comprising: a plurality of stories, each of the stories including: a floor, a ceiling, and a dead spaces interposed therebetween. The multi-story structures further include: a plurality of exterior walls, each of the exterior walls includes: an exterior wall outer portion; an exterior wall inner portion; an exterior wall framing system; an exterior wall air flow passageway interposed between the exterior wall outer portion and the exterior wall inner portion; and at least one exterior wall exhaust conduit. The multi-story further include: a plurality of interior walls; a plurality of interior spaces defined by the exterior walls and interior walls; and an air flow control system including: a processing unit; plurality of sensors. The multi-story structures further include: an air handling system comprising: an HVAC unit; an HVAC inlet conduit including: an HVAC surroundings inlet conduit having: a surrounding inlet; and a surrounding inlet control valve configured to supply unconditioned air to the HVAC unit; a return conditioned air conduit having: a return conduit control valve configured to control an amount of exhausted conditioned air to the HVAC unit; a plurality of floor return conduits, each of the floor return conduits includes: an inlet disposed in the each of the floor dead spaces; a floor return conduit control valve configured to control an amount of exhaust conditioned air supplied to the return conduit from each of the floor dead spaces; and a main HVAC outlet conduit including; a plurality of floor outlet conduits, each of the floor outlet conduits includes: a floor outlet conduit control valve configured to control an amount of conditioned air supplied to each of the floors; a plurality of interior space outlet conduits, each of the interior space outlet conduits having: a plurality of interior space outlets, each of the interior space outlets; and an interior space outlet conduit control valve configured to control an amount of conditioned air supplied to each of the interior space outlets, wherein one, some, or all of the control valves are active control valves, wherein at one or more of the sensors is disposed in each of the interior spaces and one or more of the sensors is disposed in the passageways, wherein the processing unit is in communication with the active control valves, the HVAC unit, and the sensors, and wherein the processing unit is configured to: receive input from the sensors, and control the HVAC unit and the active control valves based on the sensor inputs, thereby controlling unconditioned air flow rates into the HVAC, interior space air flow rates from the HVAC, return air flow rates into the HVAC, exhaust air flow rate to the surroundings, and passageway air flow rates through the passageways and into the surroundings.

In certain embodiments, each of the floor return conduits further includes: at least one return air control valve configured to control an amount of the return conditioned air to the return conduit.

Embodiments of the disclosure broadly relates to methods for controlling air flow in a single story structures, wherein the method comprises: receiving, via the processing unit, output from the sensors, and adjusting unconditioned air flow rates into the HVAC, interior space air flow rates from the HVAC, return air flow rates into the HVAC, exhaust air flow rate to the surroundings, and passageway air flow rates through the passageways and into the surroundings to maintain properties within the interior spaces and/or passageways at desired values.

In certain embodiments, in the adjusting steps, the properties include temperature and relative humidity in each of the interior spaces and moisture concentration in the passageways.

Embodiments of the disclosure broadly relates to methods for controlling air flow in a multis-story structures, wherein the method comprises: receiving, via the processing unit, output from the sensors, and adjusting unconditioned air flow rates into the HVAC, interior space air flow rates from the HVAC, return air flow rates into the HVAC, exhaust air flow rate to the surroundings, and passageway air flow rates through the passageways and into the surroundings to maintain properties within the interior spaces and/or passageways at desired values.

In certain embodiments, in the adjusting steps, the properties include temperature and relative humidity in each of the interior spaces and moisture concentration in the passageways.

Suitable Components for Use in the Disclosure

Suitable treating compositions include, without limitation, mold control compositions, pesticides, insecticides, fungicides, bactericides, rodent poisons, other control compositions, gases, fire retardant compositions, foams, and mixtures or combinations thereof.

Suitable gases include, without limitation, air, nitrogen enriched air, nitrogen (all grades), argon, carbon dioxide, haloalkanes and mixtures thereof.

Suitable haloalkanes include, without limitation, iodomethane (Halon 10001); bromomethane (Halon 1001), bromochloromethane, CH_2BrCl (Halon 1011), carbon tetrachloride (Halon 104), tribromofluoromethane (Halon 1103), dichlorofluoromethane (Halon 112), bromodifluoromethane (Halon 1201), dibromodifluoromethane (Halon 1202), bromochlorodifluoromethane, CF_2ClBr (Halon 1211), dichlorodifluoromethane (Halon 122), bromotrifluoromethane, $CBrF_3$ (Halon 1301), tetrafluoromethane (Halon 14), 1,2-dichlorotetrafluoroethane (Halon 242), dibromotetrafluoroethane, $C_2Br_2F_4$ (Halon 2402), hexafluoroethane (Halon 2600), and mixtures thereof.

Suitable foams include, without limitation, any of the gases and compositions introduced as a foam using a foaming agent or the co-introduction of a foaming agent and a gas or treating compositions. Suitable foaming agents include all surfactants and any other material the forms a foam when combined with a gas.

Suitable flow control valves or dampers for use herein include, without limitation, control valves or dampers manufactured by Johnson Controls, Belimo, Honeywell, Siemens, Greenheck, KMC Controls, or other similar manufacturers.

Suitable sensor for use in the disclosure include, without limitation, relative humidity sensors, moisture sensors, water sensors, physical sensors such as temperature sensors, pressure sensors, air flow sensors, etc., chemical sensors such as carbon dioxide sensors, carbon monooxide sensors, oxygen sensors, etc., microbial sensors such as mold sensors, fungus sensors, bacterial sensors, viral sensors, etc., other sensors, and combinations thereof.

Suitable air flow sensors for use herein include, without limitation, E+E Elektronik, Honeywell, Siemens, IFM Electronics, Air Logic, SDT, EGE, Delta OHM, Weber, EC, or other similar manufacturers.

Suitable temperature sensors for use herein include, without limitation, Analog Devices, Mitsumi, Melexis, Environdata, Geokon, IST, SBE, Andigilog, AquiStar, Envco, STMicroelectronics, ZMD, Measurement Specialties, Microship, MicroDAQ, Smartec, Dallas Semiconductor, Slop Indicator, Honsberg, Maxim, ReGMet, GF Signet, Philips, Texas Instruments, FTDI Chip, Thermometrics, Spica Technology, or other similar manufacturers.

Suitable water/moisture sensors for use herein include, without limitation, Converge, Edyn, Oval Digital, Sengenia, Galltec, E+E Elektronik, TE Connectivity, Kurabe Industrial Co, Ltd., Scale-Tron, Measurement Specialties, Michell Instruments, EMS Brno, Hoperf Electronics, GE Sensing, Hygrosens Instruments, Sensirion, Gefran, U.P.S.I., Precon, EME Systems, FTDI Chip, IST, Blue Earth, Vishay, or other similar manufacturers.

Suitable chemical sensors for use herein include, without limitation, carbon dioxide sensors, carbon monoxide sensors, mold sensors, or other similar chemical and microbial sensors.

Suitable physical sensors for use herein include, without limitation, pressure sensors, air compositional sensors, partial pressure sensors, or other physical sensors.

Suitable processors or processing units for use herein include, without limitation, without limitation, digital processing units (DPUs), analog processing units (APUs), any other technology that can receive motion sensor output and generate command and/or control functions for objects under the control of the processing unit, or mixtures and combinations thereof.

Suitable digital processing units (DPUs) include, without limitation, any digital processing unit capable of accepting input from a plurality of devices and converting at least some of the input into output designed to select and/or control attributes of one or more of the devices. Exemplary examples of such DPUs include, without limitation, microprocessor, microcontrollers, or the like manufactured by Intel, Motorola, Ericsson, HP, Samsung, Hitachi, NRC, Applied Materials, AMD, Cyrix, Sun Microsystem, Philips, National Semiconductor, Qualcomm, or any other manufacture of microprocessors or microcontrollers.

Suitable analog processing units (APUs) include, without limitation, any analog processing unit capable of accepting input from a plurality of devices and converting at least some of the input into output designed to control attributes of one or more of the devices. Such analog devices are available from manufacturers such as Analog Devices Inc.

Suitable interfaces and interface components for use herein include, without limitation, manufactured by Microsoft, Samsung, Apple, Linex, or other similar GUI or user interfaces.

Suitable HVAC unit and associated components for use herein include, without limitation, AAON, Airedale International Air Conditioning, Amana Corporation, American Standard Companies, ASI Controls, Baxi, BDR Thermea, BELIMO Holding AG, Buffalo Forge Company, CaptiveAire Systems, Carrier Corporation, Chunlan Group, CIAT Group, Climaveneta, Coleman Heating & Air Conditioning, Comfort Systems USA, Cylon Controls Ltd., Daewoo Electronics, Daikin, Daikin Applied Americas, De Dietrich Remeha, De'Longhi, DeLclima, Electronic Temperature Instruments, Embraco, Fegyver-es Gepgyar, Fuji Electric, Fujitsu, Galanz, General Airconditioners, GlenDimplex, Goodman Global, Gree Electric, Haier, Hart & Cooley, Help-Link, Hisense, Hisense Kelon, Hitachi, J & E Hall, Jasun Filtration, Johnson Controls, Jotul, Kenstar, KMC Controls, Lennox International, LG Electronics, MarinAire, Mirgor, Mitsubishi Electric, MPF Industry Group, Panasonic, PEC Power Electric Cooperation, Petra Engineering Industries Company, Rettig ICC, Rheem, Robert Bosch GmbH, Roberts-Gordon LLC, Sampo Corporation, Sanden Corporation, Sanhua, Sanyo, Shinco, Siragon, Stelrad, Taikisha, Tatung Company, Temperzone, Thermax, Thermo King, Toshiba, Trane, Vaillant Group, Viega, Viessmann, Voltas, Walton Group, Wellman Group, Westaflex, Whirlpool Corporation, Worcester, Bosch Group, Wrightsoft, Yilida, York International, or other similar manufacturers.

DETAILED DESCRIPTION OF THE DRAWINGS OF THE DISCLOSURE

Prior Art

Referring now to FIG. **1**, a prior art structure, generally **100**, is shown to include a slab **102** situated on the ground **104** with a water resistant layer **106** on a bottom surface **108** of the slab **102**. The structure **100** also includes an outer wall **110** (shown here as a masonry and mortar wall) anchored to an inner wall **112** via ties **114**. The outer wall **110** includes weep holes **116**. The inner wall **112** includes studs **118**, a sheathing layer **120**, and a drywall layer **122** (e.g., gypsum board or plywood) and insulation.

The structure **100** also includes a roof **140**, a ceiling **142** supported by framing **144**, an attic **146**, and an interior **148**. The structure **100** also includes an HVAC unit **150** situated in the attic **146**. The HVAC unit **150** includes an inlet conduit **152** having an inlet **154** for pulling air **156** from the interior **148** into the HVAC unit **150**. The HVAC unit **150** also includes an outlet conduit **158** having an outlet **160** adapted to push conditioned air **162** into the interior **148**.

The structure **100** is ill equip to reduce, prevent, inhibit, or eliminate water, moisture and/or mold intrusion into exterior walls and as shown later herein, interior walls.

In U.S. Pat. No. 7,247,090B2, the inventor disclosed systems and methods for reducing water and moisture accumulation in external walls by providing a path way for conditioned air pass through the external walls and exhaust out through weep holes in the external walls. The present invention describes improved systems, apparatuses, and methods for reducing, removing, inhibiting, or eliminating water and/or moisture and/or their accumulation and/or mold growth in exterior and interior wall of habitable structures.

First Embodiment

Referring now to FIG. **2**, an embodiment of a structure of this disclosure, generally **200**, is shown to include a slab **202**

situated on the ground **204** with a water resistant layer **206** on a bottom surface **208** of the slab **202**. It should be noted that the water resistant layer **206** may be disposed on the top surface of the slab **202** or both surfaces may include a water resistant layer **206**. The structure **200** also includes an outer wall **210** (shown here as a masonry and mortar wall) anchored to an inner wall **212** via ties **214**. The outer wall **210** includes a masonry sealer layer **216** and weep holes **218**. The inner wall **212** includes studs **220**, bracings between studs **222**, a sheathing and/or drywall layer **224**, and an optional drywall layer **226**, which may be insulating or non-insulating. The ties **214** are angled up and affixed to the studs **220**.

The structure **200** also includes an insulated roof **240**, a ceiling **242** supported by framing **244**, an attic **246**, and an interior **248**. The structure **200** also include an HVAC unit **250** situated in the attic **246**. The HVAC unit **250** includes an inlet conduit **252** having an inlet **254**, wherein the inlet **254** pulls unconditioned air **256** from the surrounding **258** into the HVAC unit **250**. The HVAC unit **250** also includes an outlet conduit **260** having an outlet **262** adapted to push conditioned air **264** into the interior **248**. The structure **200** also includes an outlet conduit **266** having an inlet **268** and an outlet **270**, wherein the inlet **268** receives interior exhaust conditioned air **272** and the outlet **268** exhausts the interior exhaust conditioned air **272** into the attic **246**. The structure **200** also includes a unidirectional valve **274** so that the exhausted conditioned air **272** flows (indicated by arrows) from the attic **246** into an air flow path **276** between the outer wall **210** and the inner wall **212** and out the weep holes **218** exhausting spent conditioned air **278** into the surrounding **258**. The flow of the conditioned air from the attic through the pathways and out of the weep holes may be used to push water and/or moisture out of the walls to facilitate wall drying or to decrease/reduce or inhibit water/moisture accumulation or to decrease/reduce or inhibit mold growth in the outer wall and/or to control the moisture content in the walls.

Second Embodiment

Referring now to FIG. **3**, another embodiment of a structure of this disclosure, generally **300**, is shown to include a slab **302** situated on the ground **304** with a water resistant layer **306** on a bottom surface **308** of the slab **302**. Again it should be noted that the water resistant layer **306** may be disposed on the top surface of the slab **302** or both surfaces may include a water resistant layer **306**. The structure **300** also includes an outer wall **310** (shown here as a masonry and mortar wall) anchored to an inner wall **312** via ties **314**. The outer wall **310** includes a masonry sealer layer **316** and weep holes **318**. The inner wall **312** includes studs **320**, bracings between studs **322**, a sheathing and/or drywall layer **324**, and an optional drywall layer **326**, which may be insulating or non-insulating. The ties **314** are angled up and affixed to the studs **320**.

The structure **300** also includes an insulated roof **340**, a ceiling **342** supported by framing **344**, an attic **346**, and an interior **348**. The structure **300** also includes an HVAC unit **350** situated in the attic **346**. The HVAC unit **350** includes an inlet conduit **352** having an inlet **354**, wherein the inlet **354** pulls unconditioned air **356** from the surrounding **358** into the HVAC unit **350**. The HVAC unit **350** also includes an outlet conduit **360** having an outlet **362** adapted to push conditioned air **364** into the interior **348**. The structure **300** also includes an outlet conduit **366** having an inlet **368**, an outlet **370**, and a control value **371**, wherein the inlet **368** receives interior exhaust conditioned air **372** and the outlet **370** exhausts the interior exhaust conditioned air **372** into the surrounding **358** and wherein the control value **371** controls the amount of air being exhausted through the outlet **370**. The structure **300** may also includes a control valve **374** so that the exhausted conditioned air **370** flows (indicated by arrows) from the attic **346** into an air flow path or passageway **376** between the outer wall **310** and the inner wall **312** and out the weep holes **318** exhausting spent conditioned air **378** into the surrounding **358**. However, in certain embodiments, the control valve **371** will be sufficient to direct the desired amount of conditioned air to the passageways, unless there are more than one passageways, then each passageway would include a control valve **371** that would control the air flow into each of the passageways/pathways. The flow of the conditioned air from the attic through the pathways or passageways and out of the weep holes may be used to push water and/or moisture out of the walls to facilitate wall drying or to decrease/reduce or inhibit water/moisture accumulation or to decrease/reduce or inhibit mold growth in the outer wall and/or to control the moisture content in the walls.

Expanded Views of Walls

Referring now to FIGS. **4**A&B, expanded views of embodiments of an exterior wall of a structure of this disclosure, generally **400**, are shown. FIG. **4**A depicts an expanded cross-sectional view of the walls, while FIG. **4**B depicts successive cut away elevation view of the exterior wall.

Looking at FIG. **4**A, the exterior wall **400** includes an outer wall assembly **402** comprising an outer wall **404** and a sealer layer **406** and an inner wall assembly **408** comprising studs **410**, bracings between studs **412**, and insulation **414** (shown only in FIG. **4**B), an thermal and/or moisture barrier layer **416**, and sheathing and/or drywall layer **418**, which may be insulating or non-insulating. The exterior wall **400** also includes ties **420** anchoring the outer wall **404** to the studs **410** or the bracings between studs **412** of the inner wall assembly **408** and an air pathway or passageway **422** disposed between the outer wall assembly **402** and the inner wall assembly **408**.

Looking at FIG. **4**B, the wall **400** depicts successive cutaways showing each layer of the wall **400**. The wall **400** includes the outer wall **404**, then the sealer layer **406**, then the air pathway **422**, and then the studs **410**, the bracings between studs **412**, and the insulation **414**. The wall **400** then include the barrier layer **416**, and then the layer **418**.

Third Embodiment

Referring now to FIG. **5**A, another embodiment of a structure of this disclosure, generally **500**, is shown to include an outer wall **502**, an inner wall **504**, an air flow control valve **506**, an air flow pathway **508** interposed between the outer wall **502** and the inner wall **504**, a roof **510**, an attic **512**, and a slab **514**. The structure **500** includes a ceiling **516** and support framing **518**.

The structure **500** also includes an air circulation assembly **520** including an HVAC unit **522** including an air intake conduit **524** having an inlet **526** and a control valve **527** for supplying unconditioned air **528** from an outside **530** to the HVAC unit **522** and an attic air conduit **532** having an air control valve **534** and an inlet **536** for supplying exhaust conditioned air **538** to the HVAC unit **522** from the attic **512**. The circulation assembly **520** also includes an outlet conduit **540** having a control valve **542** and an outlet **544** for sending conditioned air **546** into an interior **548** of the structure **500**. It should be recognized that the structure **500** may include a

plurality of outlets **544** associated with the outlet conduit **540** for sending the conditioned air **546** into the interior **548**. The circulation assembly **520** also includes an exhaust conduit **550** having an inlet **552** that withdraws exhaust conditioned air **554** from the interior **548** and an outlet **556** through which the exhaust conditioned air **554** is discharged into the attic **512**. Some of the attic air **554** then exits through the control valve **506** and through the air flow pathway **508** shown by the dark grey arrows and out through weep holes or channels **558** into the outside **530**.

Fourth Embodiment

Referring now to FIG. **5**B, another embodiment of a structure of this disclosure, generally **500**, is shown to include an outer wall **502**, an inner wall **504**, an air flow control valve **506**, an air flow pathway **508** interposed between the outer wall **502** and the inner wall **504**, a roof **510**, an attic **512**, and a floor **514**. The structure **500** includes a ceiling **516** and support framing **518**.

The structure **500** also includes an air circulation assembly **520** including an HVAC unit **522** including an air intake conduit **524** having an inlet **526** and a control valve **527** for supplying unconditioned air **528** from an outside **530** to the HVAC unit **522** and an attic air conduit **532** having an air control valve **534** and an inlet **536** for supplying exhaust conditioned air **538** to the HVAC unit **522** from the attic **512**. The circulation assembly **520** also includes an outlet conduit **540** having a control valve **542** and an outlet **544** for sending conditioned air **546** into an interior **548** of the structure **500**. It should be recognized that the structure **500** may include a plurality of conduits **540**, control valves **542**, and outlets **544** for sending the conditioned air **546** into the interior **548**. The circulation assembly **520** also includes an exhaust conduit **550** having an inlet **552** that withdraws exhaust conditioned air **554** from the interior **548** and an outlet **556** through which the exhaust conditioned air **554** is discharged into the attic **512**. In should be recognized that the structure **500** may also include a plurality of conduits **550**, inlets **552**, and outlets **556** for withdrawing exhaust error **554** from the interior **548**. The system **520** also includes a wall conditioned air conduit **560** having a control valve **562** through which conditioned air shown by the dark grey arrows is discharged into the air flow pathway **508** via an outlet **564** into the pathway **508**, through the pathway **508**, and out through weep holes or channels **558** into the outside **530**. Again, it should be recognized that the structure **500** may also include a plurality of conduits **560**, valves **562**, and outlets **564** associated with a plurality of pathways **508** associated with exterior or interior walls.

First Multistory Building Embodiment

Referring now to FIG. **6**A, an embodiment of a multistory structure of this disclosure, generally **600**, is shown to include a lower floor **602**, outer/exterior wall or walls **604**, inner walls **606**, and air flow pathways **608** interposed between the outer wall or walls **604** and the inner walls **606**, wherein the pathways or passageways **608** include inlets **610** having control valves **612** and outlet channels **614**. The structure **600** also includes floors **616**, ceilings **618**, dead spaces **620** interposed between the intermediate floors **616** and the ceiling **618**, and a roof **622**. It should be recognized that the outer walls **604** may be transparent (made of glass) and the air flow passageways **608** comprise a gap between two transparent layer or panes of glass through with air may flow.

The structure **600** also includes an air circulation assembly or system **630** including an HVAC unit **632** including an unconditioned air intake conduit **634** having an inlet **636** and a control valve **638** for supplying unconditioned air **640** from an outside **642** to the HVAC unit **632** and optionally an exhaust conditioned air intake conduit **644** having an inlet **646** and a control valve **648** for supplying exhaust conditioned air **670** from the dead spaces **620** to the HVAC unit **632** via the conduits **644** and **634**.

The system **630** also includes a main conditioned air conduit **652** from which floor conditioned air conduits **654** branch. Each of the floor conduits **654** include a flow control valve **656** and terminate in an outlet **658** passing through their respective ceilings **618** (only one per floor shown here, but of course, each floor will generally have a plurality of outlets **658**). The floor conduits **654** discharge conditioned air **660** into interiors **662** between the floors **602** and **616** and the ceilings **618**.

The system **630** also includes floor outlet conduits **664** having inlets **666** and outlets **668** for discharging exhaust conditioned air **670** into the dead spaces **620**, which then progresses through the control valves **612** through the pathways **608** and out of the channels **614** into the outside **642** or through the conduits **644** and **634** to the HVAC unit **632**.

The system **630** also includes a dead space return conduit **672** configured to allow exhaust conditioned air to flow from each dead space **620** with inlets **674** and an outlet **676** in the last floor dead space, wherein the return conduit **672** is configured to supply return exhausted conditioned air to the HVAC unit via the conduit **644**. The return conduit **672** may include a control valve at each floor (not shown) to control the amount of air introduced into the return conduit **672** from each of the dead spaces **620**.

Second Multistory Building Embodiment

Referring now to FIG. **6**B, another embodiment of a multistory structure of this disclosure, generally **600**, is shown to include a lower floor **602**, outer/exterior wall or walls **604**, inner walls **606** and air flow pathways **608** interposed between the outer wall or walls **604** and the inner walls **606** and exiting through exit channels **610**. The structure **600** also includes floors **616**, ceilings **618**, dead spaces **620** interposed between the intermediate floors **610** and the ceiling **612**, and a roof **622**. Again, it should be recognized that the outer walls **604** may be transparent (made of glass) and the air flow passageways **608** comprise a gap between two transparent layer or panes of glass through with air may flow.

The structure **600** also includes an air circulation assembly **630** including an HVAC unit **632** including an unconditioned air intake conduit **634** having an inlet **636** and a control valve **638** for supplying unconditioned air **640** from an outside **642** to the HVAC unit **632** and optionally an exhaust conditioned air intake conduit **644** having an inlet **646** and a control valve **648** for supplying exhaust conditioned air **670** from the dead spaces **620** to the HVAC unit **632** via the conduit **634**.

The system **630** also include a main conditioned air conduit **652** from which floor conditioned air conduits **654** branch. Each of the floor conduits **654** include flow controllers **656** and terminate in outlets **658** passing through their respective ceilings **618** (only one per floor shown here, but of course, each floor will generally have a plurality of outlets **658**). The floor conduits **654** discharge conditioned air **660** into interiors **662** between the floors **616** and the ceilings **618**. The system **630** also includes pathway floor outlet conduits **664** having inlets **666** and outlets **668** for discharging exhaust conditioned air **670** into the dead spaces **620**.

The system **630** also includes conditioned air pathway conduits **672** including a control valves **674** and outlets **676**

through which conditioned air shown in the dark gray arrows flows into the pathways **608** and then out through the channels **610**.

The system **630** may also include an exhaust conduit **678** having an outlet **680** and a control valve **682** for exhausting air **670** from the dead spaces **620** to the outside **642**.

Third Multistory Building Embodiment

Referring now to FIG. **6**C, another embodiment of a multistory structure of this disclosure, generally **600**, is shown to include in addition to the other features disclosed above, exhaust channels **610** at each floor. Of course, the exhaust channels may be also include control valves to control the rate of air being exhausted from the passageways. Additionally, the passageways may extend between floors so that the flow rate of exhausted air may be controlled floor by floor. It should be recognized that all of the multi-story structures will include a return system for returning exhaust conditioned air to the HVAC unit. Additionally, all structures may include an air circulation systems that monitors carbon dioxide, carbon monoxide, oxygen levels, humidity, and temperature, and to control the air flow into and out of the interior spaces and into and out of the passageways to maintain these properties at desirable levels.

Pier and Beam Building Embodiment

Referring now to FIGS. **7**A&B, embodiment of a pier and beam structure of this disclosure, generally **700**, is shown to include a pier and beam facade **702** having air vents **704** and solid portions **706** and piers **708** extending from the ground or below the ground **710** to a floor **712** and a dead space **714** between the floor **712** and the ground **710**. The structure **700** also includes outer walls **716**, inner walls **718**, and air flow pathways or passageways **720**. The structure **700** also includes interiors **722**. It should be recognized that the pier and beam structure **700** may include any or all of the circulation systems, control systems, and sensor systems set forth herein. It should be recognized that there does not have to be an air vent **704** between every pair of piers **708** and the number of air vents **704** are generally a matter of design.

Embodiments Wall Air Distribution Systems

Referring now to FIGS. **8**A-D, four embodiments of wall air distribution systems of this disclosure, generally **800**, **830**, **850**, and **870**, respectfully, are shown.

Looking at FIG. **8**A, the wall air distribution system **800** includes an inlet **802**, an air distribution conduit **804** having an outlet **806** that passes through a ceiling **808** and ends within an air pathway **810** disposed between an outer wall section and an inner wall section (not shown) of an interior or exterior wall **812**. Conditioned air proceeds from an HVAC unit (not shown) and flows into the inlet **802** through the distribution conduit **804** and out the outlet **806** depicted by the dark gray arrows and then through the pathway **810** and out through weep holes or outlet channels (not shown), but fully described herein.

Looking at FIG. **8**B, the wall air distribution system **830** includes a plurality of inlets **832**, a distribution conduit **834**, and a plurality of outlets **836**. Each of the outlets **836** passes through a ceiling **838** and ends within one of a plurality of air pathways **840** formed by a plurality of pathway dividers **842** within an interior or exterior wall **844**. The pathways **840** are disposed between an outer wall section and an inner wall section (not shown). Conditioned air proceeds from an HVAC unit (not shown) and flows into the inlets **832** through the distribution conduit **834** and out the outlets **836** and then through the pathways **840** as depicted by the dark gray arrows and out through weep holes or outlet channels (not shown).

Looking at FIG. **8**C, the wall air distribution system **850** includes an inlet **852**, an air distribution conduit **854** having a plurality of flow control valves **856** and a plurality of outlets **858**. Each of the outlets **858** passes through a ceiling **860** and ends within a plurality of air pathways **862** formed by a plurality of pathway dividers **864** within an interior or exterior wall **866**. The pathways **862** are disposed between an outer wall section and an inner wall section (not shown). Conditioned air proceeds from an HVAC unit (not shown) and flows into the inlet **852** through the distribution conduit **854** and out the outlets **886** as depicted by the dark gray arrows and then through the pathways **862** and out through weep holes (not shown), where the air flow through each of the pathways **862** is controlled by the control valves **856**.

Looking at FIG. **8**D, the wall air distribution system **870** includes a plurality of inlets **872**, a plurality of distribution conduits **874**, a plurality of flow control valves **876**, and a plurality of outlets **878**. Each of the outlets **878** passes through a ceiling **880** and ends within one of a plurality of air pathways **882** formed by a plurality of pathway dividers **884** within an interior or exterior wall **886**. The pathways **882** are disposed between an outer wall and an inner wall of an interior or exterior wall (not shown). Conditioned air proceeds from an HVAC unit (not shown) and flows into the inlets **872** through the distribution conduits **874** and out the outlets **878** depicted by the dark gray arrows and then through the pathways **882** and out through weep holes (not shown), where the air flow through each of the pathways **882** is controlled by the control valves **876**.

Embodiment Wall Air Distribution Systems

Referring now to FIG. **9**A, a structure, generally **900**, is shown to include an outer wall **902** and an inner wall **904** having a thermal and/or moisture barrier layer **906**, studs **908**, a sheathing and/or drywall layer **910**, which may be insulating or non-insulating, and an air flow pathway **912** between an inner surface of the outer wall **902** and the barrier layer **906**. The structure **900** also includes a ceiling **914** upon which is disposed an air conditioning and distribution assembly **920**.

The assembly **920** includes an air inlet **922**, an air inlet conduit **924** connected to an HVAC unit **928**. The HVAC unit **928** includes an outlet **930** and an outlet conduit **932**. The outlet conduit **932** splits into a main conduit **934** having a main control valve **936** and a secondary conduit **938** having a secondary control valve **940**. The main conduit **934** supplies conditioned air to outlets **942** associated with registers **944** for heating or cooling an interior (not shown) of the structure **900**, while the secondary conduit **938** supplies conditioned air to the air flow pathway **912** so that conditioned air may flow down the pathway **912** pushing out water and/or moisture through weep holes or drainage channels and drying the outer wall **902** and/or the inner wall **904**. Of course, the same wall assembly may be used to dry out interior walls, but with different drainage and exhaust channels as described herein. The assembly **920** also includes an outlet **946** associated with an outlet conduit (not shown) for exhausting air from the interior of the structure **900** to the surroundings or to an attic or similar space associated with the structure **900**.

Looking at FIG. **9**B, generally **900**, is shown to include an outer wall **902** and an inner wall **904** having a thermal and/or moisture barrier layer **906**, studs **908**, a sheathing and/or drywall layer **910**, which may be insulating or non-insulating, and air flow pathways **912***a-d* between an inner surface of the outer wall **902** and the barrier layer **906**. The structure **900** also includes a ceiling **914** upon which is disposed an air conditioning and distribution assembly **920**. The pathways

912 are isolated by corner dividers 916 that prevent air exchange between the pathways 912*a-d*.

The assembly 920 includes an air inlet 922, an air inlet conduit 924 connected to an HVAC unit 928. The HVAC unit 928 includes an outlet 930 and an outlet conduit 932. The outlet conduit 932 splits into a main conduit 934 having a main control valve 936 and a secondary conduit 938 having a secondary control valve 940. The main conduit 934 supplies conditioned air to outlets 942 associated with registers 944 for heating or cooling an interior of the structure 900 (not shown). The assembly 920 also includes an outlet 946 associated with an outlet conduit (not shown) for withdrawing air from the interior of the structure and exhausting either to the surroundings or to an attic or similar space associated with the structure 900.

The secondary conduit 938 terminated in a distribution unit 948 that supplies conditioned air to four wall conduits 950*a-d*, where the conduits 950*a-d* include flow control valves 952*a-d*. The four conduits 950*a-d* supply conditioned air to the four pathways 912*a-d* so that the conditioned air may flow down the pathway 912*a-d* pushing out water and moisture through weep holes or drainage channels and drying the outer wall 902 and the inner wall 904. The control valve 952*a-d* controls the amount of conditioned air that flows into each pathway 912*a-d* so that each wall section may be dehydrated at different rates depending on water, moisture and/or mold content.

Of course, the same wall assembly may be used to dry out interior walls, but with different drainage and exhaust channels as described herein.

Looking at FIG. 9C, generally 900, is shown to include an outer wall 902 and an inner wall 904 having a thermal and/or moisture barrier layer 906, studs 908, a sheathing and/or drywall layer 910, which may be insulating or non-insulating, and sixteen air flow pathways 912*a-p* between an inner surface of the outer wall 902 and the barrier layer 906. The structure 900 also includes a ceiling 914 upon which is disposed an air conditioning and distribution assembly 920. The pathways 912*a-p* are isolated by dividers 916 that prevent air exchange between the pathways 912*a-p*.

The assembly 920 includes an air inlet 922, an air inlet conduit 924 connected to an HVAC unit 928. The HVAC unit 928 includes an outlet 930 and an outlet conduit 932. The outlet conduit 932 splits into a main conduit 934 having a main control valve 936 and a secondary conduit 938 having a secondary control valve 940. The main conduit 934 supplies conditioned air to outlets 942 associated with registers 944 for heating or cooling an interior of the structure 900 (not shown). The assembly 920 also includes an outlet 946 associated with an outlet conduit (not shown) for withdrawing air from the interior of the structure and exhausting either to the surroundings or to an attic or similar space associated with the structure 900.

The secondary conduit 938 terminated in a distribution unit 948 that supplies conditioned air to four main wall conduits 950*a-d*. The four main wall conduits 950*a-d* end in sixteen flow control valves 952*a-p* and feed conditioned air to sixteen air distribution conduits 954*a-p* that in turn supply conditioned air to the sixteen pathways 912*a-p* so that the conditioned air may flow down the pathway 912*a-d* pushing out water and moisture through weep holes or drainage channels and drying the outer wall 902 and the inner wall 904. The control valve 952*a-p* controls the amount of conditioned air that flows into each pathway 912*a-p* so that each wall section may be dehydrated at different rates depending on water, moisture and/or mold content.

Of course, the same wall assembly may be used to dry out interior walls, but with different drainage and exhaust channels as described herein.

Fifth Embodiment

Referring now to FIG. 10, an embodiment of a structure of this disclosure, generally 1000, is shown to include a slab 1002 situated on the ground 1004. The structure 1000 also includes an outer wall 1006 and an inner wall 1008. The outer wall 1006 and the inner wall 1008 may be of any type or construction. The structure 1000 also includes an outside HVAC unit 1010 disposed on an HVAC slab 1012 and including an air intake 1014 having a screen 1016 for pulling air 1018 from the surroundings into the HVAC unit 1010. The structure 1000 also includes an outlet 1020 and an outlet conduit 1022 leading through a roof 1024, through an attic space 1026, and through a ceiling 1028 supported by framing 1030 to an interior inlet 1032 from which conditioned air 1034 is discharged into an interior 1036 of the structure 1000. The structure 1000 also includes an interior outlet 1038 associated with an outlet conduit 1040 having an exhaust outlet 1042 for withdrawing air from the interior 1036 and discharging exhaust air 1044 into the attic 1026 or surrounding. The HVAC unit 1010 also includes a conditioned air wall discharge conduit 1046 including a control valve 1048 for controlling a rate and amount of conditioned air discharged into a wall pathway 1050 flows through the pathway 1048 and out exhaust holes 1052, which may be weep holes if the outer wall is masonry and mortar or just discharge channels if the outer wall is of some other construction. It should be recognized that in multistory building, the space into which the air is exhausted and that may be used to dry out walls may be any dead space including the space between floors or any other dead space that would allow air to flow through the walls and out the outlet channels. Of course, it should also be recognized that some structures the air flow may be from the bottom of the wall up especially in multistory buildings.

Expanded Views of Exterior Walls with Sensors

Referring now to FIG. 11A, an expanded view of an embodiment of an outer wall assembly of a structure of this disclosure, generally 1100, is shown to an outer wall 1102 and a sealer layer 1104 and an inner wall assembly 1106 including studs 1108, an moisture and/or vapor barrier layer 1110, an insulating sheathing and/or drywall layer 1112 situated on a slab 1114. The wall assembly 1100 also includes ties 1116 anchoring the outer wall 1102 to the studs 1108 of the inner wall assembly 1106. The wall assembly 1100 also includes an air pathway 1118 disposed between the outer wall 1102 and the barrier layer 1110. The wall assembly 1100 also includes exhaust ports, holes, or channels 1120 through which conditioned air is exits the pathway 1118.

The wall assembly 1100 also includes wall temperature sensors 1122, moisture/water sensors 1124 and an air flow rate sensor 1126. The sensors and control valves are all controlled by a controller describe more fully in FIG. 13.

Looking at FIG. 11B, an expanded view of another embodiment of an outer wall assembly of a structure of this disclosure, generally 1150, is shown to an outer wall 1152 and a sealer layer 1154 and an inner wall assembly 1156 including studs 1158, an moisture and/or vapor barrier layer 1160, an insulating sheathing and/or drywall layer 1162 situated on a slab 1164. The wall assembly 1150 also includes ties 1166 anchoring the outer wall 1152 to the studs 1158 of the inner wall assembly 1156. The wall assembly

1150 also includes an air pathway 1168 disposed between the outer wall 1152 and the barrier layer 1160. The wall assembly 1150 also includes exhaust ports, holes, or channels 1170 through which conditioned air is exits the pathway 1168. The wall assembly 1156 also includes an wall air conduit 1172 for supplying conditioned air to the pathway 1168 and a treating solution reservoir 1174 disposed on a beam 1176, a treating solution treating dispensing unit 1178, a dispensing conduit 1180 ending in a nozzle 1182 for spraying the treating solution 1184 into the pathway 1168.

The wall assembly 1100 also includes wall temperature sensors 1186, moisture/water sensors 1188 and an air flow rate sensor 1190. The sensors and control valves are all controlled by a controller describe more fully in FIG. 13.

The wall assembly 1100 may also include a control valve 1192 associated with the channels 1170 so that the passageways or pathways 1168 may be pressurized or cut off from air flow. Thus, the passageways or pathways 1168 may be flooded with a fire retardant gas or foam and pressurized to help impede the spread of a fire.

Expanded Views of Interior Walls with Sensors and Dispensing Assemblies

Referring now to FIG. 12A, an expanded view of an embodiment of an inner wall assembly of a structure of this disclosure, generally 1200, is shown to include studs 1202, a first insulating sheathing and/or drywall layer 1204 and a second insulating sheathing and/or drywall layer 1206. The inner wall assembly 1200 also includes an air pathway 1208 disposed in a center 1210 of the assembly 1200. The assembly 1200 also includes a conditioner air conduit 1212 that supplies conditioned air into the pathway 1208 and an exhaust conduit 1214 that exhaust air, water, and/or moisture from the interior of the wall assembly 1200 disposed in a sub floor 1216 supported by support members 1218 on a slab 1220 and is vented out of the structure 1200 via an outlet 1222, where conditioned air flow is shown by the dark gray arrows. Of course, the pathway 1208 may require holes or other opening to be provided through the inner wall cross members (not shown) so that the conditioned is capable of reducing, decreasing, and/or eliminating water, moisture or mold accumulation in the wall assembly 1200 or facilitate drying the wall assembly 1200 after a water, moisture or mold event.

The wall assembly 1200 also includes wall temperature sensors 1224, moisture/water sensors 1226, and an air flow rate sensor 1228. The sensors and control valves are all controlled by a controller describe more fully in FIG. 13.

Looking at FIG. 12B, an expanded view of another embodiment of an inner wall assembly of a structure of this disclosure, generally 1250, is shown to include studs 1252, a first insulating sheathing and/or drywall layer 1254 and a second insulating sheathing and/or drywall layer 1256. The inner wall assembly 1250 also includes an air pathway 1258 disposed in a center 1260 of the assembly 1250. The assembly 1250 also includes a conditioner air conduit 1262 that supplies conditioned air into the pathway 1258 and an exhaust conduit 1264 that exhaust air, water, and/or moisture from the interior of the wall assembly 1250 disposed in a sub floor 1266 supported by support members 1268 on a slab 1270 and is vented out of the structure 1250 via an outlet 1272, where conditioned air flow is shown by the dark gray arrows. The assembly 1250 also includes a treating solution dispensing conduit 1274 ending in a nozzle 1276 for spraying a treating solution 1278 into the pathway 1258. The treating solution reservoir and dispensing mechanism are not shown, but may be as shown in FIG. 11B or of any other form used in the art to dispense a liquid, gas, or foam treating composition.

Of course, the pathway 1258 may require holes or other opening to be provided through the inner wall cross members (not shown) so that the conditioned air is capable ofreducing, decreasing, and/or eliminating water, moisture or mold accumulation in the wall assembly 1250 or facilitate drying the wall assembly 1250 after a water, moisture or mold event.

The wall assembly 1250 also includes wall temperature sensors 1280, moisture/water sensors 1282, and an air flow rate sensor 1284. The sensors and control valves are all controlled by a controller describe more fully in FIG. 13.

The wall assembly 1200 may also include a control valve 1286 associated with the exhaust conduit 1264 so that the passageways or pathways 1258 may be pressurized or cut off from air flow. Thus, the passageways or pathways 1258 may be flooded with a fire retardant gas and pressurized to help impede the fire.

While FIGS. 11B and 12B demonstrate that introduction of compositions into the passageways to control pests, insects, molds, fungii, bacteria, and/or other pests, the compositions being dispensed may be fire suppressants and/or retardants that may be used to retard or impede the progression of fire through a structure.

Control System Embodiment

Referring now to FIG. 13, an embodiment of a control system, generally 1300, of a structure of this disclosure is shown to include a power supply 1302 (which may of course be the a power outlet in the structure or a dedicated power supply or power conditioning unit), a processor or processing unit 1304, one or a plurality of user interface or panel units 1306 including touch screen 1308 (or other interactive user interface), and optionally one or a plurality of remote control units 1310 (which may be a cell phone, a lap top, or desk top computer). The interface or panel units 1306 may be associated with each interior space or a plurality of interior spaces in communication with the processor 1304. By setting air properties in each of the interior spaces via the panels 1306, the air properties in each of the interior spaces or coupled interior spaces may be separately and independently controlled by the processor 1304. Additionally, air properties in each of the passageways may be entered into the panels 1306 communicated to the processor 1304 so that the air properties in each passageway may be independently and separately controlled. Of course, the processor 1304 may be programmed so that air properties in each of the interior spaces may be collectively controlled based on the number of people and heat generating equipment in each of the interior spaces. The processor 1304 include memory, communication hardware and software, and firmware or other software for controlling HVAC units, sensors, control valves, and dispensing units that dispense treating solutions. It should be recognized that passive air control valves are not be controlled by the processing unit 1304, but may be controlled by the air flow.

The power supply 1302 supplies power to the processor 1304, the interface 1306, an HVAC unit 1312, control values 1316, temperature sensors 1318, water/moisture sensors 1320, air flow sensors 1322, and treating units 1324 via power supply wires 1326. While I have disclosed using temperature sensors, water/moisture sensors, and air flow sensors, the systems of this invention may also include other sensors such as chemical sensors 1328 (e.g., carbon dioxide, carbon monoxide, mold, smoke, etc.) or other physical sensors 1330 (e.g., pressure, etc.) and any other sensors 1332

that may assist in reducing, removing, inhibiting and/or eliminating water, moisture, and/or mold or drying walls exposed to a water, moisture, and/or mold event.

The processor **1304** is in two way communication with the interface **1306**, the remote control **1310**, the HVAC unit **1312**, the sensors **1318**, **1320**, **1322**, **1328**, **1330**, and **1332**, and the treating units **1324** via communication pathways **1334** (shown here as wires for the interface **1306**, the HVAC unit **1312**, the blower **1314**, the sensors **1318**, **1320**, **1322**, **1328**, **1330**, and **1332**, and the treating units **1320** or a communication pathway **1336** (shown here as wireless for the remote control **1310**). Of course, all of the communication pathways **1324** may also be wireless or a combination of wired and wireless communication pathways. Additionally, the interface **1306**, the remote control **1310**, the HVAC unit **1312**, the blower **1314**, the sensors **1316** and **1318** all include communication hardware and software for communication with the processor **1304**, whether via wired or wireless communication pathways. Additionally, the remote control unit **1310** includes its own power supply, memory, processor, interface, touch screen or the like and human cognizable output devices such as speakers.

CLOSING PARAGRAPH OF THE DISCLOSURE

All references cited herein are incorporated by reference. Although the disclosure has been disclosed with reference to its preferred embodiments, from reading this description those of skill in the art may appreciate changes and modification that may be made which do not depart from the scope and spirit of the disclosure as described above and claimed hereafter.

I claim:

1. A structure comprising:
- a floor or slab;
- a ceiling;
- an insulated roof;
- an attic interposed between the ceiling and the roof;
- one or a plurality of exterior walls, each of the exterior walls includes:
  - an exterior wall outer portion,
  - an exterior wall inner portion including a wall framing system,
  - an exterior wall air flow passageway interposed therebetween, and
  - at least one exterior wall exhaust conduit having:
    - a passageway inlet, and
    - a passage way outlet;
- a plurality of interior walls;
- a plurality of interior spaces defined by the exterior and interior walls;
- an HVAC unit, disposed in the attic, including:
  - an HVAC air inlet conduit having:
    - an HVAC inlet, and
    - an HVAC inlet control valve configured to control a supply of unconditioned air or a mixture of unconditioned air and exhaust conditioned air to the HVAC unit;
  - an HVAC air outlet conduit having:
    - an HVAC outlet, and
    - an HVAC outlet control valve configured to control a supply of conditioned air to the interior spaces;
  - at least one HVAC exhaust conduit having:
    - an HVAC exhaust inlet, and
    - an HVAC exhaust outlet configured to support an air flow of exhaust conditioned air into the attic; and
  - at least one passageway control valve associated with the passageway inlets and configured to support passageway air flow into the passageway(s) and out of the exhaust conduit(s) into the surroundings and to stop air flow from the surroundings into the passageways, wherein the at least one passageway control valve is: (a) part of the HVAC unit and is associated with a HVAC passageway outlet conduit connected to the HVAC outlet conduit and having a passageway outlet associated with the passageway inlets, and (b) a passive one-way or unidirectional valve or an active control valve, and wherein the passageway air flow comprises conditioned air from the HVAC unit,
- whereby the passageway air flow reduces, removes, and/or eliminates moisture in the exterior walls.

2. The structure of claim **1**, wherein:
- the at least one passageway control valve is a passive one-way or unidirectional valve, and
- the passageway air flow comprises attic exhaust conditioned air.

3. The structure of claim **1**, wherein each of the interior walls includes:
- two interior wall outer portions,
- an interior wall inner portion having:
  - an interior wall air flow passageway having:
    - a passageway inlet and a passageway outlet;
- at least one interior wall exhaust conduit.

4. The structure of claim **1** wherein the exterior wall inner portion includes:
- an insulating layer, a weather-resistant layer disposed on an outer surface of the insulating layer; and/or a sheathing disposed on an inner surface of the insulating layer.

5. The structure of claim **1**, wherein the exterior wall inner portion further includes:
- a liquid barrier and/or a first sheathing between the liquid barrier and the wall framing system.

6. The structure of claim **1**, wherein:
- the at least one HVAC exhaust conduit further includes:
  - a second HVAC exhaust outlet configure to support an air flow of exhaust conditioned air into the surrounding and having:
    - an HVAC exhaust control valve configured to control amounts of exhaust conditioned air exhausted into the attic and into the surrounds.

7. The structure of claim **1**, further comprising:
- an air flow control system including:
  - a processing unit; and
  - plurality of sensors;
- wherein one, some, or all of the control valves are active control valves,
- wherein the processing unit is in communication with the active control valves, and
- wherein the processing unit is configured to:
  - receive input from the sensors, and
  - control the HVAC unit and the active control valves thereby controlling air flow rates into the interior spaces and into the passageways.

8. The structure of claim **7**, wherein the sensors are selected from the group consisting of temperature sensors, water/moisture sensors, air flow sensors, chemical sensors, other physical sensors, and combinations thereof.

9. The structure of claim **7**, wherein at least one of the sensors is disposed in: the air flow passageways or the air flow passageways and the attic and/or the interior spaces.

10. The structure of claim 7, wherein:
all of the control valves are active control valves, and
during a 24 hour period of time, the processing unit is further configured:
to adjust the air flow into each of the interior spaces and into each passageway so that one or more interior space properties and/or one or more passageway properties are maintained at desired values.

11. The structure of claim 10, wherein the one or more properties include moisture concentrations in the interior spaces and/or passageways, temperature in the interior spaces and/or passageways, or mixtures and combinations thereof.

12. The structure of claim 11, wherein the one or more properties further include pressures in the interior spaces and/or passageways, air flow rates in the interior spaces and/or passageways, sensed chemical concentrations in the interior spaces and/or passageways, and/or microbial concentrations in the interior spaces and/or passageways.

13. The structure of claim 1, further comprising:
a dispensing assembly associated with one, some, or all of the passageways and including:
a reservoir containing a treating composition;
a dispensing supply conduit having:
a dispensing assembly control value,
a dispensing head at its distal end,
wherein the dispensing assembly control value is configured to control an amount of treating solution or gas introduced into one, some, or all of the passageways.

14. The structure of claim 13, wherein:
the treating composition is selected from the group consisting of a mold control composition, a pesticide, an insecticide, a fungicide, a bactericide, a rodent poison, other control compositions, a gas, a fire retardant compositions, a foam, and mixtures or combinations thereof, and
the gas is selected from the group consisting of nitrogen, nitrogen enriched air, argon, haloalkanes and mixtures thereof,
the haloalkanes are selected from the group consisting of iodomethane (Halon 10001); bromomethane (Halon 1001), bromochloromethane, CH_2BrCl (Halon 1011), carbon tetrachloride (Halon 104), tribromofluoromethane (Halon 1103), dichlorofluoromethane (Halon 112), bromodifluoromethane (Halon 1201), dibromodifluoromethane (Halon 1202), bromochlorodifluoromethane, CF_2ClBr (Halon 1211), dichlorodifluoromethane (Halon 122), bromotrifluoromethane, $CBrF_3$ (Halon 1301), tetrafluoromethane (Halon 14), 1,2-dichlorotetrafluoroethane (Halon 242), dibromotetrafluoroethane, $C_2Br_2F_4$ (Halon 2402), hexafluoroethane (Halon 2600), and mixtures thereof.

15. A multistory structure comprising:
a plurality of stories, each of the stories including:
a floor,
a ceiling, and
a dead spaces interposed therebetween;
a plurality of exterior walls, each of the exterior walls includes:
an exterior wall outer portion;
an exterior wall inner portion;
an exterior wall framing system;
an exterior wall air flow passageway interposed between the exterior wall outer portion and the exterior wall inner portion; and
at least one exterior wall exhaust conduit;
a plurality of interior walls;
a plurality of interior spaces defined by the exterior walls and interior walls;
an air flow control system including:
a processing unit;
plurality of sensors; and
an air handling system comprising:
an HVAC unit;
an HVAC inlet conduit including:
an HVAC surroundings inlet conduit having:
a surrounding inlet; and
a surrounding inlet control valve configured to supply unconditioned air to the HVAC unit;
a return conditioned air conduit having:
a return conduit control valve configured to control an amount of exhausted conditioned air to the HVAC unit;
a plurality of floor return conduits, each of the floor return conduits includes:
an inlet disposed in the each of the floor dead spaces;
a floor return conduit control valve configured to control an amount of exhaust conditioned air supplied to the return conduit from each of the floor dead spaces; and
a main HVAC outlet conduit including;
a plurality of floor outlet conduits, each of the floor outlet conduits includes:
a floor outlet conduit control valve configured to control an amount of conditioned air supplied to each of the floors;
a plurality of interior space outlet conduits, each of the interior space outlet conduits having:
a plurality of interior space outlets, each of the interior space outlets having an interior space outlet conduit control valve configured to control an amount of conditioned air supplied to each of the interior space outlets,
wherein one, some, or all of the control valves are active control valves,
wherein at one or more of the sensors is disposed in each of the interior spaces and one or more of the sensors is disposed in the passageways,
wherein the processing unit is in communication with the active control valves, the HVAC unit, and the sensors, and
wherein the processing unit is configured to:
receive input from the sensors, and
control the HVAC unit and the active control valves based on the sensor inputs,
thereby controlling unconditioned air flow rates into the HVAC, interior space air flow rates from the HVAC, return air flow rates into the HVAC, exhaust air flow rate to the surroundings, and passageway air flow rates through the passageways and into the surroundings.

16. The structure of claim 15, wherein each of the floor return conduits further includes:
at least one return air control valve configured to control an amount of the return conditioned air to the return conduit.

17. A method for controlling air flow in a structure of claim 7, wherein the method comprises:
receiving, via the processing unit, output from the sensors, and
adjusting unconditioned air flow rates into the HVAC, interior space air flow rates from the HVAC, return air

flow rates into the HVAC, exhaust air flow rate to the surroundings, and passageway air flow rates through the passageways and into the surroundings to maintain properties within the interior spaces and/or passageways at desired values.

18. The method of claim **17**, wherein, in the adjusting steps, the properties include temperature and relative humidity in each of the interior spaces and moisture concentration in the passageways.

19. A method for controlling air flow in a structure of claim **15**, wherein the method comprises:

receiving, via the processing unit, output from the sensors, and

adjusting unconditioned air flow rates into the HVAC, interior space air flow rates from the HVAC, return air flow rates into the HVAC, exhaust air flow rate to the surroundings, and passageway air flow rates through the passageways and into the surroundings to maintain properties within the interior spaces and/or passageways at desired values.

20. The method of claim **19**, wherein, in the adjusting steps, the properties include temperature and relative humidity in each of the interior spaces and moisture concentration in the passageways.

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