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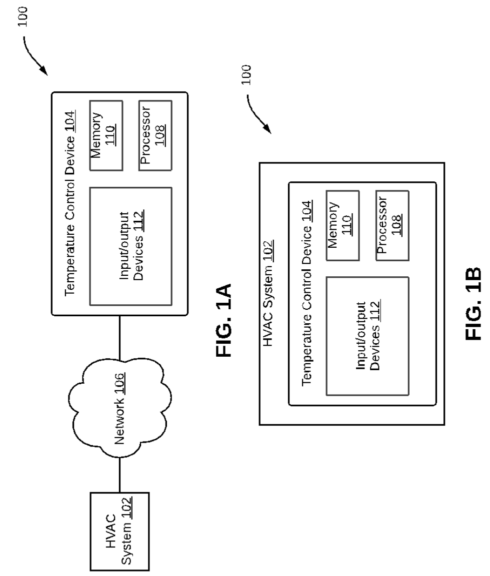
(54) Title: SMART INDOOR AIR HANDLER FOR MULTIZONE APPLICATION

(57) Abstract: Temperature control system for Heating, Ventilation, and Air Conditioning (HVAC) systems and method thereof is disclosed. The temperature control system includes at least two inlet openings for receiving ambient air, wherein the received ambient air is fed in the HVAC system. The temperature control system further includes one or more inlet gates engaging with the at least two inlet openings for controlling an amount of ambient air being received from the at least two inlet openings and at least two outlet vents for releasing conditioned air generated by the HVAC system, wherein the conditioned air is generated using the received ambient air. The temperature control system includes a vane valve configured to move for adjusting an amount of conditioned air being released from each of the at least two outlet vents.



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FORM 2

THE PATENTS ACT 1970

(39 Of 1970)

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The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

Smart Indoor Air Handler for Multizone Application

2. APPLICANT(S)

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification particularly describes the invention and the manner in which it is performed.

DESCRIPTION

Technical Field

[001] This disclosure relates generally to a Heating, Ventilation, and Air Conditioning (HVAC) systems and, more particularly relates to temperature control system for HVAC systems and method thereof.

Background

[002] Split and multi-split air conditioning systems are conventional systems for controlling temperature in residential and commercial areas. The split air conditioning is a one-to-one system that includes one indoor heat exchanger unit connected to an external refrigeration unit. The indoor heat exchanger unit absorbs heat from the surrounding air, while the external refrigeration unit transfers the heat to the environment. A multi-type air conditioning system operates on the same principles as the split type air conditioning system, however in the former case, there are multiple indoor heat exchanger unit that are connected to a single external refrigeration unit. This is also applicable for the reverse flow, i.e., indoor heat exchanger units acting as heat pumps.

[003] A Variable Refrigerant Flow (VRF) is a large-scale version of ductless mini-split air conditioning system. A conventional VRF system includes a single external refrigeration unit and multiple indoor heat exchanger units. The external refrigeration unit typically includes a compressor and a condenser, while the indoor heat exchanger units includes an expansion valve and a fan. The VRF system controls the amount of refrigerant fluid flowing to the multiple indoor heat exchanger units, enabling the use of many indoor heat exchanger units of differing capacities and configurations connected to a single external refrigeration unit. Such arrangement provides an individualized comfort control, and simultaneous heating and cooling in different zones.

[004] However, as indoor heat exchanger units are fixed at dedicated locations, the above-mentioned systems result in uneven temperature within a confined region as well as limited and inefficient usage of indoor heat exchanger units.

SUMMARY

[005] In one embodiment, a temperature control system for a Heating, Ventilation, and Air Conditioning (HVAC) system is disclosed. The temperature control system includes at least two inlet openings for receiving ambient air, wherein the received ambient air is fed in the HVAC system; one or more inlet gates engaging with the at least two inlet openings for controlling an amount of ambient air being received from the at least two inlet openings; at least two outlet vents for releasing conditioned air generated by the HVAC system, wherein the conditioned air is generated using the received ambient air; and a vane valve configured to move for adjusting an amount of conditioned air being released from each of the at least two outlet vents.

[006] In another embodiment, a temperature control device for an HVAC system is disclosed. The temperature control device includes at least one processor; a memory coupled with the at least one processor, wherein the memory comprises computer executable instructions, wherein the computer executable instructions on execution, cause the least one processor to: receive at least two temperature requests associated with at least two spatial zones for controlling ambient temperature in the at least two spatial zones; trigger displacement of one or more inlet gates with respect to at least two inlet openings to modify effective opening area of each of the at least two inlet openings, wherein modifying the effective opening area controls the amount of ambient air being received from the at least two inlet openings; and trigger a movement of a vane valve for adjusting an amount of conditioned air to be released from each of at least two outlet vents, based on the at least two temperature requests, wherein the at least two outlet vents are configured to release the conditioned air in at least two spatial zones, respectively, and wherein displacement of the one or more inlet gates is synchronized with the movement of the vane valve.

[007] In yet another embodiment, an HVAC system is disclosed. The HVAC system includes at least two inlet openings for receiving ambient air, wherein the received ambient air is fed in the HVAC system; one or more inlet gates engaging with the at least two inlet openings for controlling an amount of ambient air being received from the at least two inlet openings; at least two outlet vents for releasing conditioned air generated by the HVAC system in at least two spatial zones, respectively, wherein the conditioned air is generated using the received ambient air; a vane valve configured to move for adjusting an amount of conditioned air being released from each of the at least two outlet vents; and a temperature control device, wherein the temperature control device comprises at least one processor and computer executable instructions, wherein the computer executable instructions on execution cause the least one processor to: receive at least two temperature requests associated with the at least two spatial zones for controlling the ambient temperature in at least two spatial zones; and trigger a movement of the vane valve for adjusting the amount of conditioned air being released from each of the at least two outlet vents, based on the at least two temperature requests.

[008] In another embodiment, a method of controlling ambient temperature in at least two spatial zones, using an HVAC system is disclosed. The method includes receiving at least two temperature requests associated with at least two spatial zones for controlling the ambient temperature in the at least two spatial zones; triggering displacement of one or more inlet gates with respect to at least two inlet openings to modify effective opening area of each of the at least two inlet openings, wherein modifying the effective opening area controls the amount of ambient air being received from the at least two inlet openings; and triggering a movement of a vane valve for adjusting an amount of conditioned air to be released from each of at least two outlet vents, based on the at least two temperature requests, wherein the at least two outlet vents are configured to release conditioned air in the at least two spatial zones, respectively.

[009] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[010] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles.

[011] **FIG. 1A and 1B** illustrate functional block diagrams of a temperature control system for a Heating, Ventilation, and Air Conditioning (HVAC) system, in accordance with an embodiment.

[012] **FIG. 2** illustrates a cross sectional view of a temperature control system operating simultaneously for two spatial zones, in accordance with an embodiment.

[013] **FIG. 3** illustrates a cross sectional view of a temperature control system operating for a first spatial zone from two spatial zones, in accordance with an embodiment.

[014] **FIG. 4** illustrates a cross sectional view of a temperature control system operating for a second spatial zone from two spatial zones, in accordance with an embodiment.

[015] **FIG. 5** illustrates a front view and a top view of a temperature control system operating for two spatial zones, in accordance with another embodiment.

[016] **FIG. 6** illustrates a flowchart of a method controlling ambient temperature in at least two spatial zones, using an HVAC system, in accordance with an embodiment.

DETAILED DESCRIPTION

[017] Exemplary embodiments are described with reference to the accompanying drawings. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from the spirit and scope of the disclosed embodiments. It is intended that the following detailed description be considered as exemplary only, with the true scope and spirit being indicated by the following claims.

[018] Referring now to FIG. 1A and 1B, a function block diagram of a temperature control system 100 for a Heating, Ventilation, and Air Conditioning (HVAC) system 102 is illustrated, in accordance with an embodiment. The temperature control system 100 may further include a temperature control device 104. FIG. 1A depicts an implementation, where the temperature control device 104 is located externally to the HVAC system 102. In this case, the temperature control device 104 may be communicatively coupled to the HVAC system 102 via a network 106. The network 106 may be a wired or a wireless network and the examples may include, but are not limited to the Internet, Wireless Local Area Network (WLAN), Wi-Fi, Long Term Evolution (LTE), Worldwide Interoperability for Microwave Access (WiMAX), and General Packet Radio Service (GPRS). In contrast, FIG. 1B depicts an implementation, where the temperature control device 104 is located inside the HVAC system 102. In both the implementations, functionality performed by the temperature control device 104 is the same.

[019] The HVAC system 102 may be employed or installed to serve two or more spatial zones (not shown in FIG. 1A and 1B). The current temperature may be different within each of two or more spatial zones, owing to different dimensions and occupancy level. The two or more spatial zones may be separated by partitions that may be temporary or permanent walls. Examples of a spatial zone may thus include, but are not limited to a room, a container, a chamber, a hall, or an auditorium.

[020] Each of the two or more spatial zones may have different temperature requirements or requests. The temperature control device 104 may be configured to control the HVAC system

102, such that, the HVAC system 102 is able to provide for and manage the different temperature requirements in each of the two or more spatial zones. This is further explained in detail in conjunction with FIG. 2 to FIG. 6. To this end, the temperature control device 104 may include a processor 108 that is communicatively coupled to a memory 110. The memory 110 includes computer executable instructions, such that, the computer executable instructions on execution, cause the processor 108 to control operation of the HVAC system 102. The memory 110 may be a non-volatile memory or a volatile memory. Examples of the non-volatile memory, may include, but are not limited to a flash memory, a Read Only Memory (ROM), a Programmable ROM (PROM), Erasable PROM (EPROM), and Electrically EPROM (EEPROM) memory. Examples of the volatile memory may include, but are not limited Dynamic Random-Access Memory (DRAM), and Static Random-Access memory (SRAM)**.**

[021] The temperature control device 104 may further include input/output devices 112, which may be used by a user or an administrator to provide inputs to the temperature control device 104. Additionally, the input/output devices 112 may be used to view various parameters for each of the two or more spatial zones. The parameters, for example, may include, but are not limited to current temperature readings, humidity level, fan speeds, or occupancy level. Examples of the input/output devices 112 may include one or more of, but are not limited to a display, a touchscreen, a keypad, a microphone, various sensors, or a speaker. Examples of various sensors may include, but are not limited to a temperature sensor, a humidity sensor, an occupancy sensor, or a presence sensor.

[022] Referring now to FIG. 2, a cross sectional view of the temperature control system 100 operating simultaneously for a spatial zone 202 and a spatial zone 204 is illustrated, in accordance with an embodiment. The temperature control system 100 includes an inlet opening 206 and an inlet opening 208. The inlet opening 206 is configured to receive ambient air from the spatial zone 202, while the inlet opening 208 is configured to receive ambient air from the spatial zone 204. The spatial zones 202 and 204 may be separated by a partition 210. The partition 210, for example, may be a wall. The received ambient air is fed in the HVAC system 102 (not shown separately in FIG. 2). The HVAC system 102 may be the temperature control system 100 or may be integrated within the temperature control system 100.

[023] The temperature control system 100 may further include an intel gate 212 that may engage with the inlet openings 206 and 208 in order to control an amount of ambient air that is received from each of the inlet openings 206 and 208. The current position of the inlet gate 212 as depicted in FIG. 2 is such that equal amount of ambient air is received from each of the inlet openings 206 and 208. It will be apparent to a person skilled in the art that the structure and functionality of the inlet gate 212 is not limited to the current depiction of FIG. 2. It will be further apparent to a person skilled in the art that the temperature control system 100 may include two or more inlet gates. For example, in the current depiction of FIG. 2, the temperature control system 100 may include two inlet gates, one each for the inlet openings 206 and 208.

[024] In an embodiment, the inlet gate 212 may engage with the inlet opening 208, thereby completely blocking receival of ambient air from the spatial zone 204. This has been depicted in conjunction with FIG. 3. In a similar manner, in another embodiment, the inlet gate 212 may engage with the inlet opening 206, thereby completely blocking receival of ambient air from the spatial zone 202. This has been depicted in conjunction with FIG. 4.

[025] The temperature control system 100 may further include an outlet vent 214 and an outlet vent 216 for releasing conditioned air generated by the HVAC system 102 into the respective spatial zones. Thus, the outlet vent 214 may release conditioned air into the spatial zone 202, while the outlet vent 216 may release conditioned air into the spatial zone 204. The HVAC system 102 may generate the conditioned air using the received ambient air.

[026] In order to adjust the amount of conditioned air that is released from each of the outlet vent 214 and the outlet vent 216, the temperature control system 100 may include a vane valve 218. The vane valve 218 is configured to move in order to control the amount of conditioned air that is released into the spatial zones 202 and 204. In the current depiction of FIG. 2, since the temperature control system 100 is simultaneously operating for the spatial zones 202 and 204, the vane valve 218 is in a neutral position, such that, the vane valve 218 allows same amount of conditioned air to be released from the outlet vents 214 and 216.

[027] The temperature control system 100 further includes the processor 108 and the memory 110. In other words, the temperature control system 100 may act as the temperature control device 104. The processor 108, via the input/output devices 112 may receive separate temperature requests associated with the spatial zone 202 and the spatial zone 204 for controlling the ambient temperature in these spatial zones. Based on the received temperature requests, the processor 108 may displace the inlet gate 212 with respect to the inlet openings 206 and 208 in order to modify effective opening area of each of the inlet openings 206 and 208. Modifying the effective opening area of the inlet openings 206 and 208 controls the amount of ambient air being received from the inlet openings 206 and 208. In the current depiction of FIG. 2, the processor 108 may receive same temperature requests from the spatial zones 202 and 204, thus, the processor 108 may keep the inlet gate 212 in a neutral position, as depicted.

[028] In a similar manner, based on the two temperature requests, the processor 108 may trigger a movement of the vane valve 218 in order to adjust the amount of conditioned air being released from each of the outlet vents 214 and 216 into the spatial zones 202 and 204 respectively. In an embodiment, the vane valve 218 may be mechanically coupled to the inlet gate 212, such that, movement of the vane valve 218 is synchronized with displacement of the inlet gate 212. The movement of the vane valve 218 may be caused using an electric motor. Alternatively, movement of the vane valve 218 may be caused by way of manual intervention. It will be apparent to a person skilled in the art that the temperature control system 100 may include multiple vane valves. For example, in the current depiction of FIG. 2, the temperature control system 100 may include two vane valves, one each for the outlet vents 214 and 216.

[029] The temperature control system 100 further includes an evaporator coil 220, a cross flow blower 222, and an air filter 224 that perform functionalities that are already known in the art.

[030] Referring now to FIG. 3, a cross sectional view of the temperature control system 100 operating for the spatial zone 202 is illustrated, in accordance with an embodiment. In FIG. 3, the processor 108 may receive a temperature request for controlling the ambient temperature in the spatial zone 202. Based on the received temperature request, the processor 108 may displace the inlet gate 212 with respect to inlet openings 206 and 208, such that, the inlet gate 212 completely blocks the inlet opening 208 and completely opens the inlet opening 206. Simultaneously, in a synchronized movement, the processor 108 triggers a movement of the vane valve 218, such that, the vane valve 218 completely blocks air being released from the outlet vent 216. As a result, the ambient air is only taken in from the spatial zone 202 and conditioned air is subsequently released only into the spatial zone 202. Thus, in this embodiment, the spatial zone 204 is not provided with any conditioned air at all.

[031] Referring now to FIG. 4, a cross sectional view of the temperature control system 100 operating for the spatial zone 204 is illustrated, in accordance with an embodiment. In FIG. 4, the processor 108 may receive a temperature request for controlling the ambient temperature in the spatial zone 204. Based on the received temperature request, the processor 108 may displace the inlet gate 212 with respect to the inlet openings 206 and 208, such that, the inlet gate 212 completely blocks the inlet opening 206 and completely opens the inlet opening 208. Simultaneously, in a synchronized movement, the processor 108 triggers a movement of the vane valve 218, such that, the vane valve 218 completely blocks air being released from the outlet vent 214. As a result, the ambient air is only taken in from the spatial zone 204 and conditioned air is subsequently released only into the spatial zone 204. Thus, in this embodiment, the spatial zone 202 is not provided with any conditioned air at all.

[032] Referring now to FIG. 5, a front view 502 and a top view 504 of the temperature control system 100 operating for the spatial zone 202 and the spatial zone 204 is illustrated, in accordance with another embodiment. The temperature control system 100 operates in a similar manner as that depicted in FIG. 2 to FIG. 4. However, the inlet gate 212 is replaced with an inlet damper 506 for the inlet opening 206 and an inlet damper 508 for the inlet opening 208. Thus, the inlet damper 506 may control receival of ambient air from the spatial zone 202 via the inlet opening 206, while the inlet damper 508 may control receival of ambient air from the spatial zone 204 via the inlet opening 208. Similarly, the vane valve 218 is replaced with an outlet damper 510 for the outlet vent 214 and an outlet damper 512 for the outlet vent 216. Thus, the outlet damper 510 may control release of conditioned air to the spatial zone 202 via the outlet vent 214, while the outlet damper 512 may control release of conditioned air into the spatial zone 204 via the outlet vent 216.

[033] Thus, each of the dampers 506, 508, 510, and 512 may act as an airflow control component may include of two or more blades in order to control cross-sectional area of an air flow path. Each of the dampers 506, 508, 510, and 512 may be made using metal sheets. Also, the movement or displacement of the inlet damper 506 may be synchronized with that of the outlet damper 510, while the movement or displacement of the inlet damper 508 may be synchronized with that of the outlet damper 512. In the top view 504, a blower 514 is also depicted that performs functionality already known in the art.

[034] Referring now to FIG. 6, a flowchart of a method for controlling ambient temperature in at least two spatial zones, using the HVAC system 102 is illustrated, in accordance with an embodiment. At step 602, at least two temperature requests associated with at least two spatial zones for controlling the ambient temperature in the at least two spatial zones is received. At step 604, displacement of one or more inlet gates is triggered with respect to at least two inlet openings to modify effective opening area of each of the at least two inlet openings. Modifying the effective opening area controls the amount of ambient air being received from the at least two inlet openings. At step 606, a movement of a vane valve is triggered for adjusting an amount of conditioned air to be released from each of at least two outlet vents, based on the at least two temperature requests, wherein the at least two outlet vents are configured to release conditioned air in the at least two spatial zones, respectively. This has already been explained in detail in conjunction with FIG. 1 to 5.

[035] Various embodiments provide a temperature control system for HVAC systems and method thereof. The proposed system leads to substantial reduction in initial investment by reducing number of equipment required. Moreover, there are additional advantages that may include but are not limited to maintenance cost nearly half of conventional systems, increased cooling capacity during single spatial zone operation, reduced commissioning time and cost, elimination of unnecessary redundancy, effective space management by reducing physical foot print, and optimal utilization of resources leading to reduced idle time.

[036] The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[037] It is intended that the disclosure and examples be considered as exemplary only, with a true scope and spirit of disclosed embodiments being indicated by the following claims.

CLAIMS

We Claim:

1. A temperature control system for a Heating, Ventilation, and Air Conditioning (HVAC) system, the temperature control system comprising:

at least two inlet openings for receiving ambient air, wherein the received ambient air is fed in the HVAC system;

one or more inlet gates engaging with the at least two inlet openings for controlling an amount of ambient air being received from the at least two inlet openings;

at least two outlet vents for releasing conditioned air generated by the HVAC system, wherein the conditioned air is generated using the received ambient air; and

a vane valve configured to move for adjusting an amount of conditioned air being released from each of the at least two outlet vents.

2. The temperature control system of claim 1, wherein the at least two outlet vents are configured to release the conditioned air in at least two spatial zones, respectively.

3. The temperature control system of claim 2, further comprising:

at least one processor; and

a memory coupled with the at least one processor, wherein the memory comprises computer executable instructions, wherein the computer executable instructions on execution, cause the least one processor to:

receive at least two temperature requests associated with the at least two spatial zones for controlling the ambient temperature in the at least two spatial zones; and

trigger a movement of the vane valve for adjusting the amount of conditioned air being released from each of the at least two outlet vents in the at least two spatial zones, respectively, based on the at least two temperature requests.

4. The temperature control system of claim 3, wherein the computer executable instructions on execution, further cause the least one processor to displace the one or more inlet gates with respect to the at least two inlet openings to modify effective opening area of each of the at least two inlet openings, wherein modifying the effective opening area controls the amount of ambient air being received from the at least two inlet openings.

5. The temperature control system of claim 1, wherein the vane valve is mechanically coupled to the one or more inlet gates, and wherein movement of the vane valve is synchronized with the displacement of the one or more inlet gates.

6. The temperature control system of claim 3, wherein the movement of the vane valve is caused using one or more of an electric motor and a manual intervention.

7. A temperature control device for a Heating, ventilation, and Air Conditioning (HVAC) system, the temperature control device comprising:

at least one processor;

a memory coupled with the at least one processor, wherein the memory comprises computer executable instructions, wherein the computer executable instructions on execution, cause the least one processor to:

receive at least two temperature requests associated with at least two spatial zones for controlling ambient temperature in the at least two spatial zones;

trigger displacement of one or more inlet gates with respect to at least two inlet openings to modify effective opening area of each of the at least two inlet openings, wherein modifying the effective opening area controls the amount of ambient air being received from the at least two inlet openings; and

trigger a movement of a vane valve for adjusting an amount of conditioned air to be released from each of at least two outlet vents, based on the at least two temperature requests, wherein the at least two outlet vents are configured to release the conditioned air in at least two spatial zones, respectively, and wherein displacement of the one or more inlet gates is synchronized with the movement of the vane valve.

8. The temperature control device as claimed in claim 7, wherein the received ambient air is fed in the HVAC system, and wherein the conditioned air is generated using the received ambient air.

9. A Heating, ventilation, and Air Conditioning (HVAC) system comprising:

at least two inlet openings for receiving ambient air, wherein the received ambient air is fed in the HVAC system;

one or more inlet gates engaging with the at least two inlet openings for controlling an amount of ambient air being received from the at least two inlet openings;

at least two outlet vents for releasing conditioned air generated by the HVAC system in at least two spatial zones, respectively, wherein the conditioned air is generated using the received ambient air;

a vane valve configured to move for adjusting an amount of conditioned air being released from each of the at least two outlet vents; and

a temperature control device, wherein the temperature control device comprises at least one processor and computer executable instructions, wherein the computer executable instructions on execution cause the least one processor to:

receive at least two temperature requests associated with the at least two spatial zones for controlling the ambient temperature in at least two spatial zones; and

trigger a movement of the vane valve for adjusting the amount of conditioned air being released from each of the at least two outlet vents, based on the at least two temperature requests.

10. A method of controlling ambient temperature in at least two spatial zones, using a Heating, ventilation, and Air Conditioning (HVAC) system, the method comprising:

receiving at least two temperature requests associated with at least two spatial zones for controlling the ambient temperature in the at least two spatial zones;

triggering displacement of one or more inlet gates with respect to at least two inlet openings to modify effective opening area of each of the at least two inlet openings, wherein modifying the effective opening area controls the amount of ambient air being received from the at least two inlet openings; and triggering a movement of a vane valve for adjusting an amount of conditioned air to be released from each of at least two outlet vents, based on the at least two temperature requests, wherein the at least two outlet vents are configured to release conditioned air in the at least two spatial zones, respectively.

Dated this 30th day of December 2019

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ABSTRACT

SMART INDOOR AIR HANDLER FOR MULTIZONE APPLICATION

Temperature control system for Heating, Ventilation, and Air Conditioning (HVAC) systems and method thereof is disclosed. The temperature control system includes at least two inlet openings for receiving ambient air, wherein the received ambient air is fed in the HVAC system. The temperature control system further includes one or more inlet gates engaging with the at least two inlet openings for controlling an amount of ambient air being received from the at least two inlet openings and at least two outlet vents for releasing conditioned air generated by the HVAC system, wherein the conditioned air is generated using the received ambient air. The temperature control system includes a vane valve configured to move for adjusting an amount of conditioned air being released from each of the at least two outlet vents.

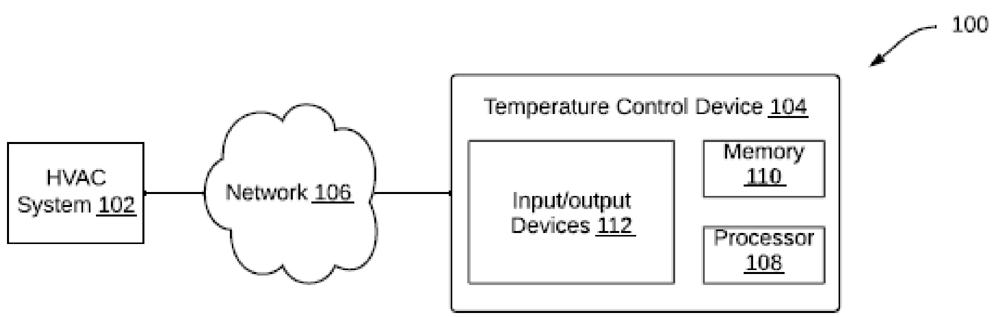

FIG. 1A

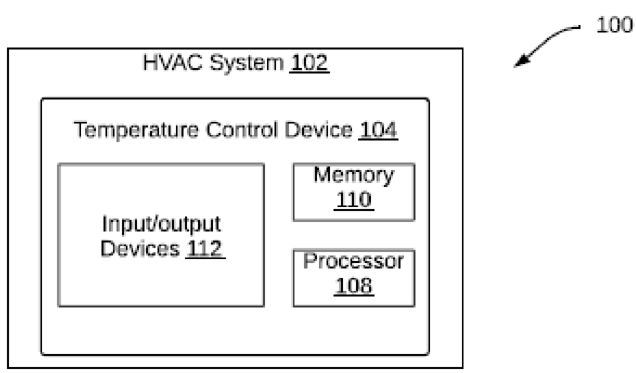

FIG. 1B

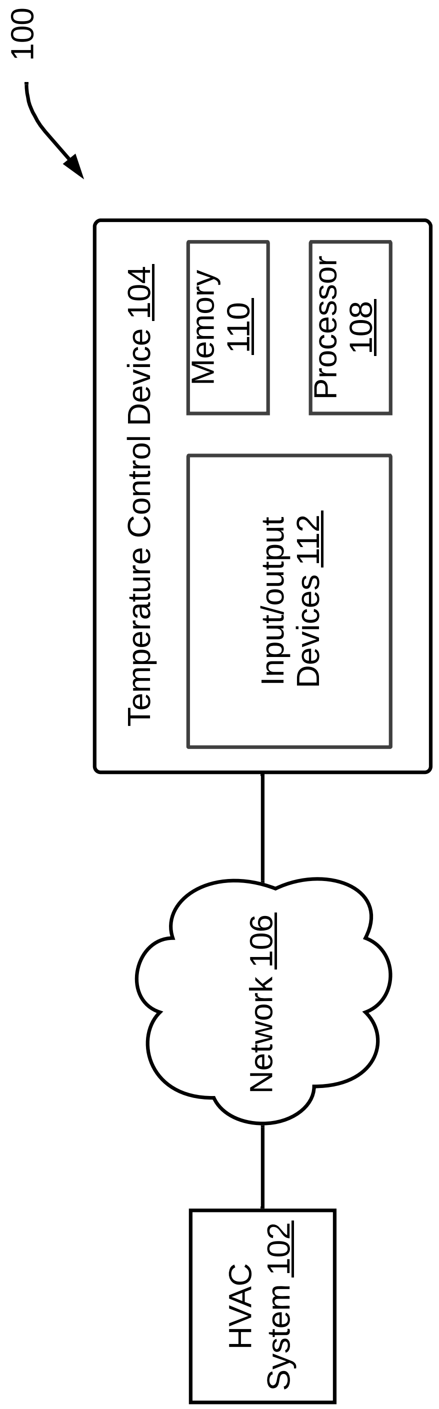

FIG. 1A

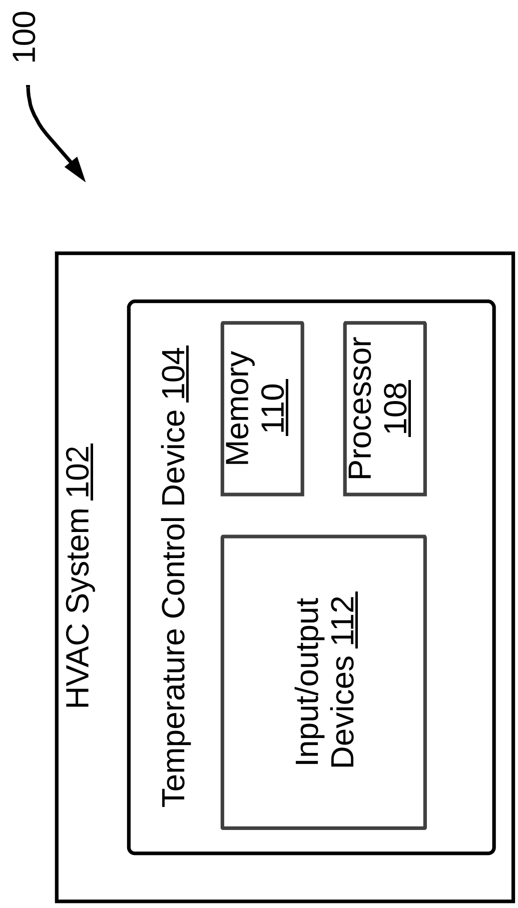

FIG. 1B

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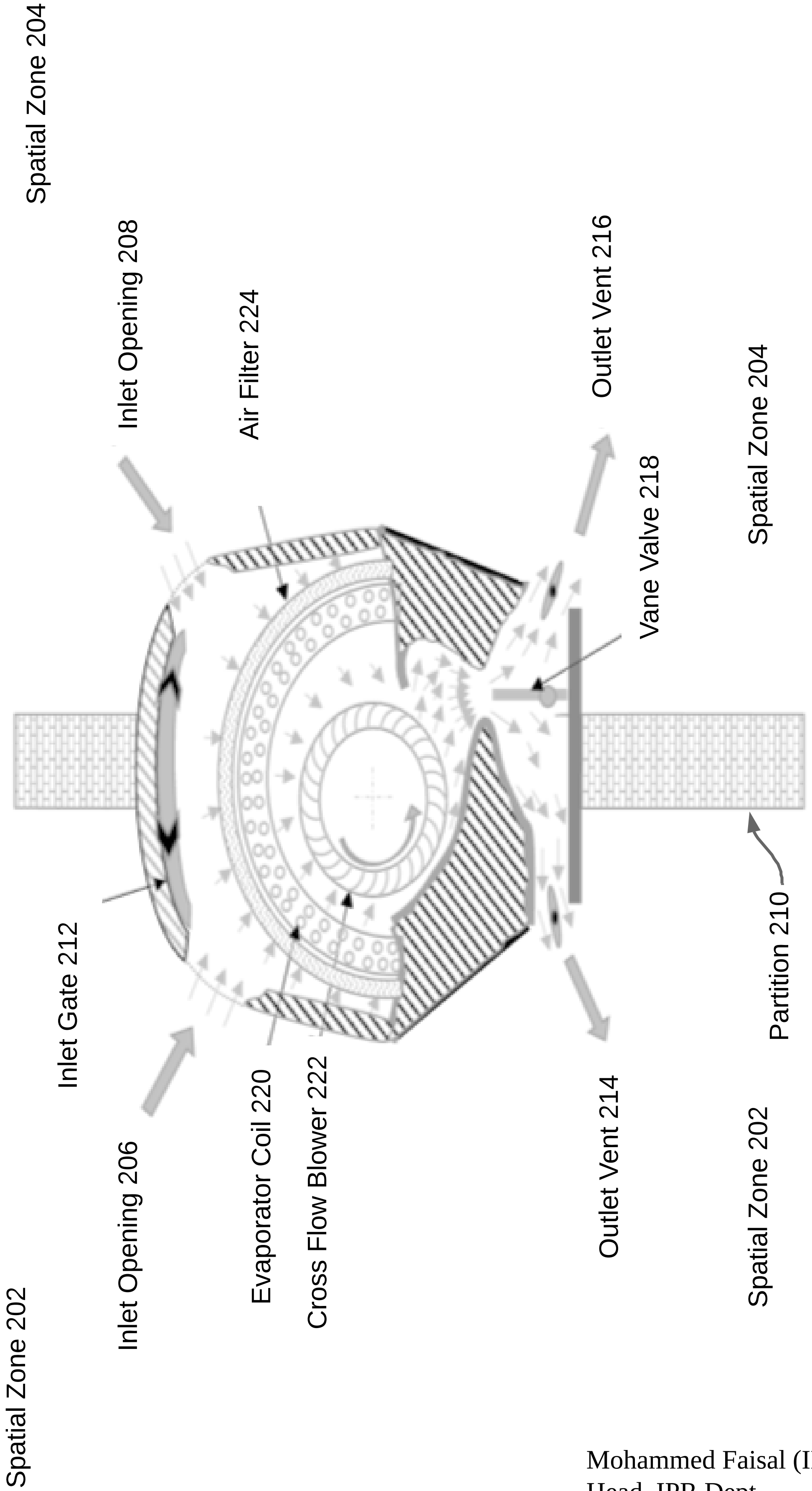

FIG. 2

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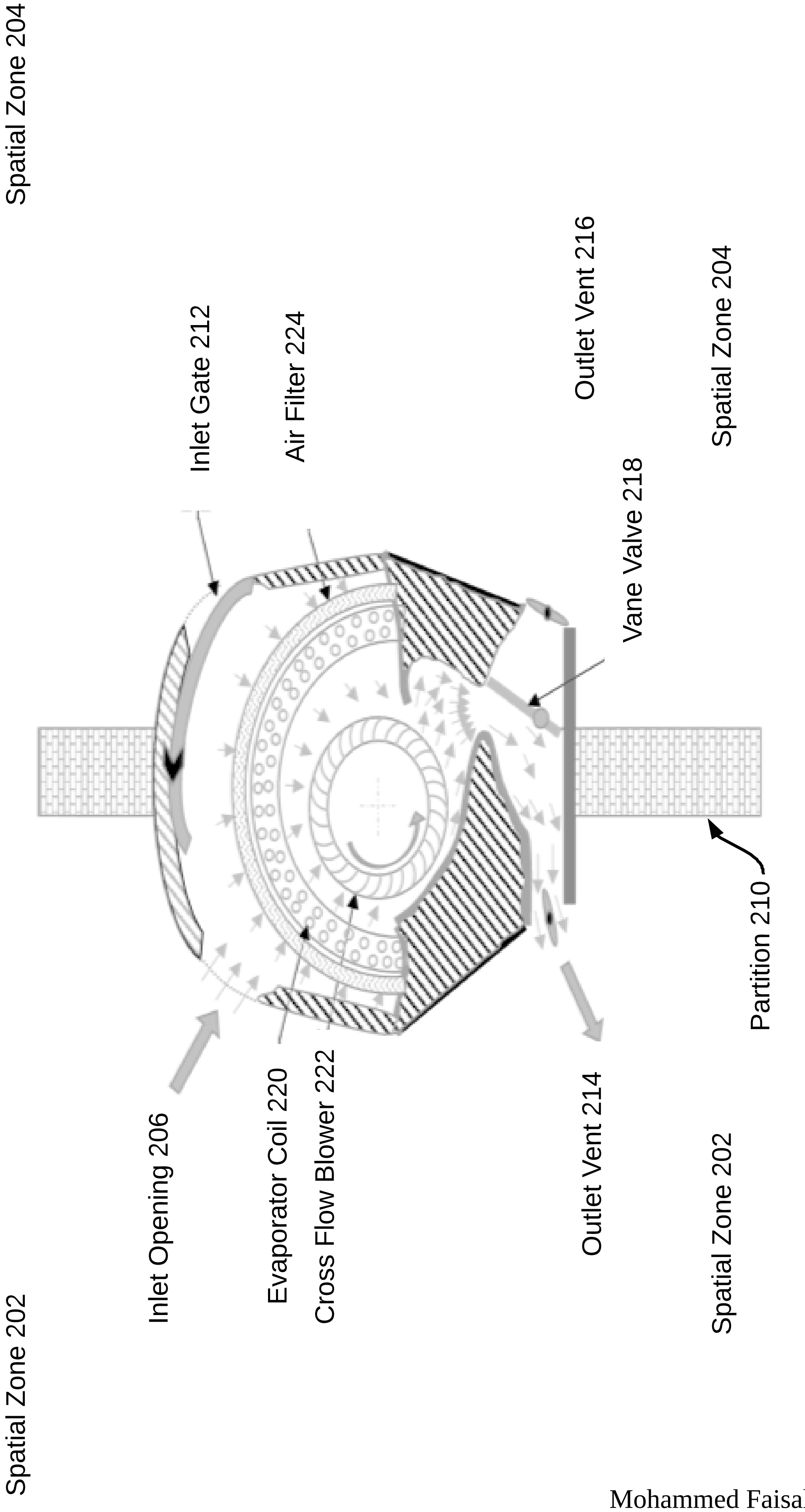

FIG. 3

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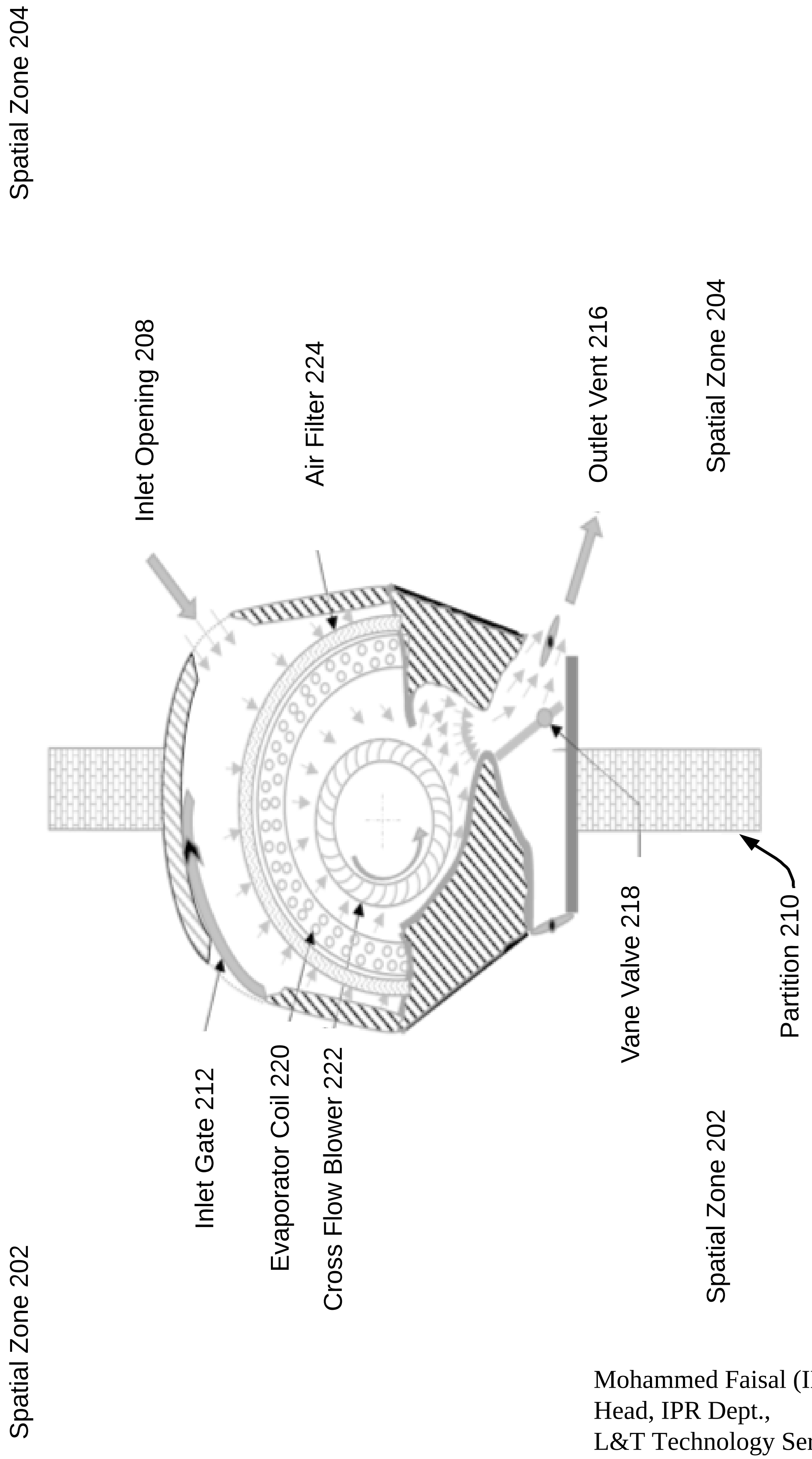

FIG. 4

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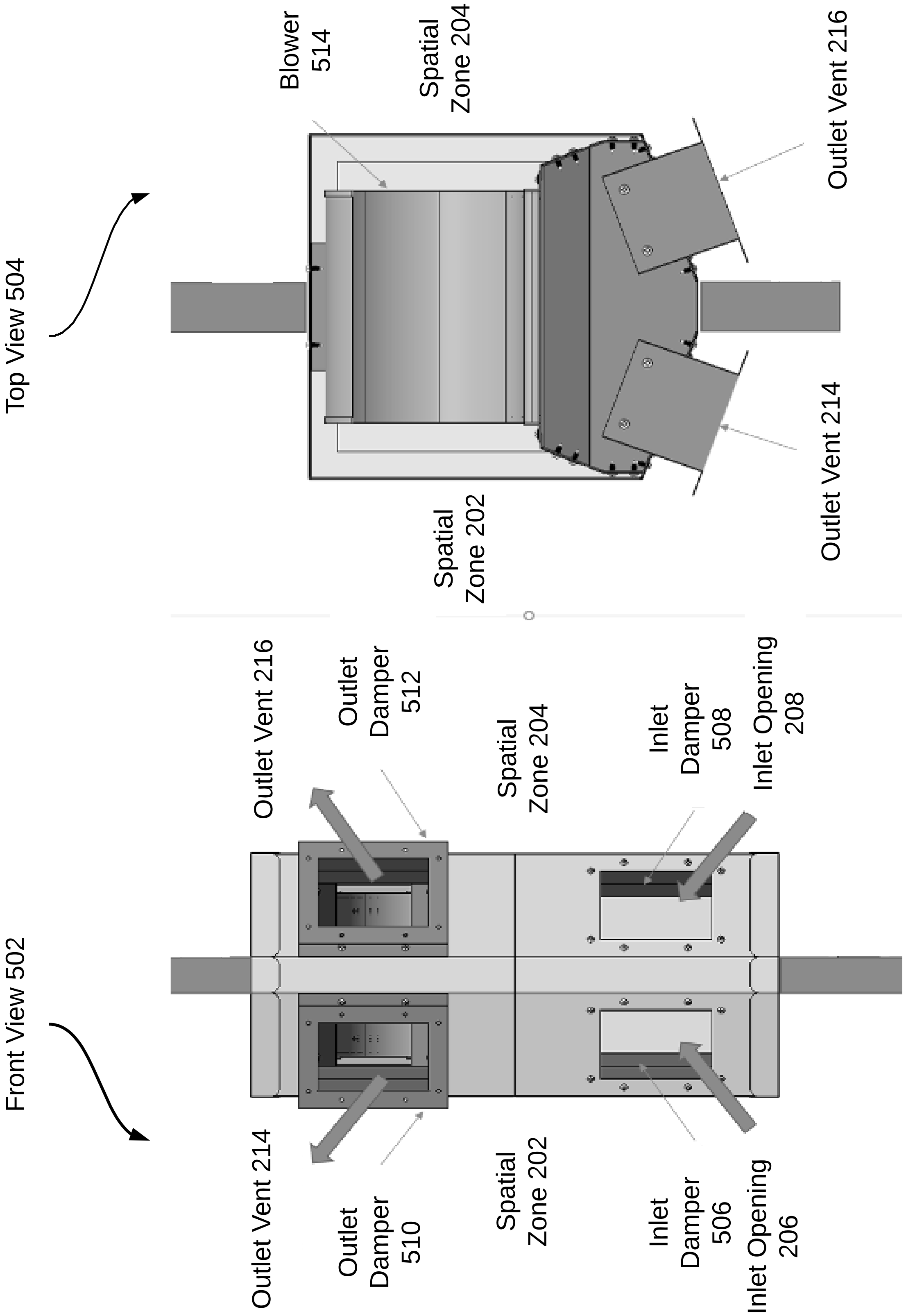

FIG. 5

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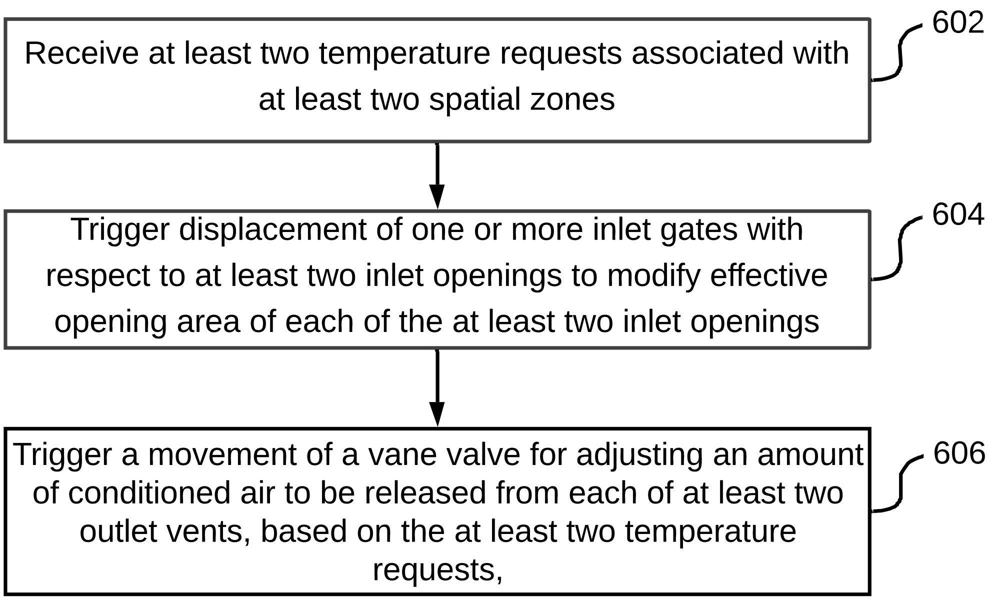

FIG. 6

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