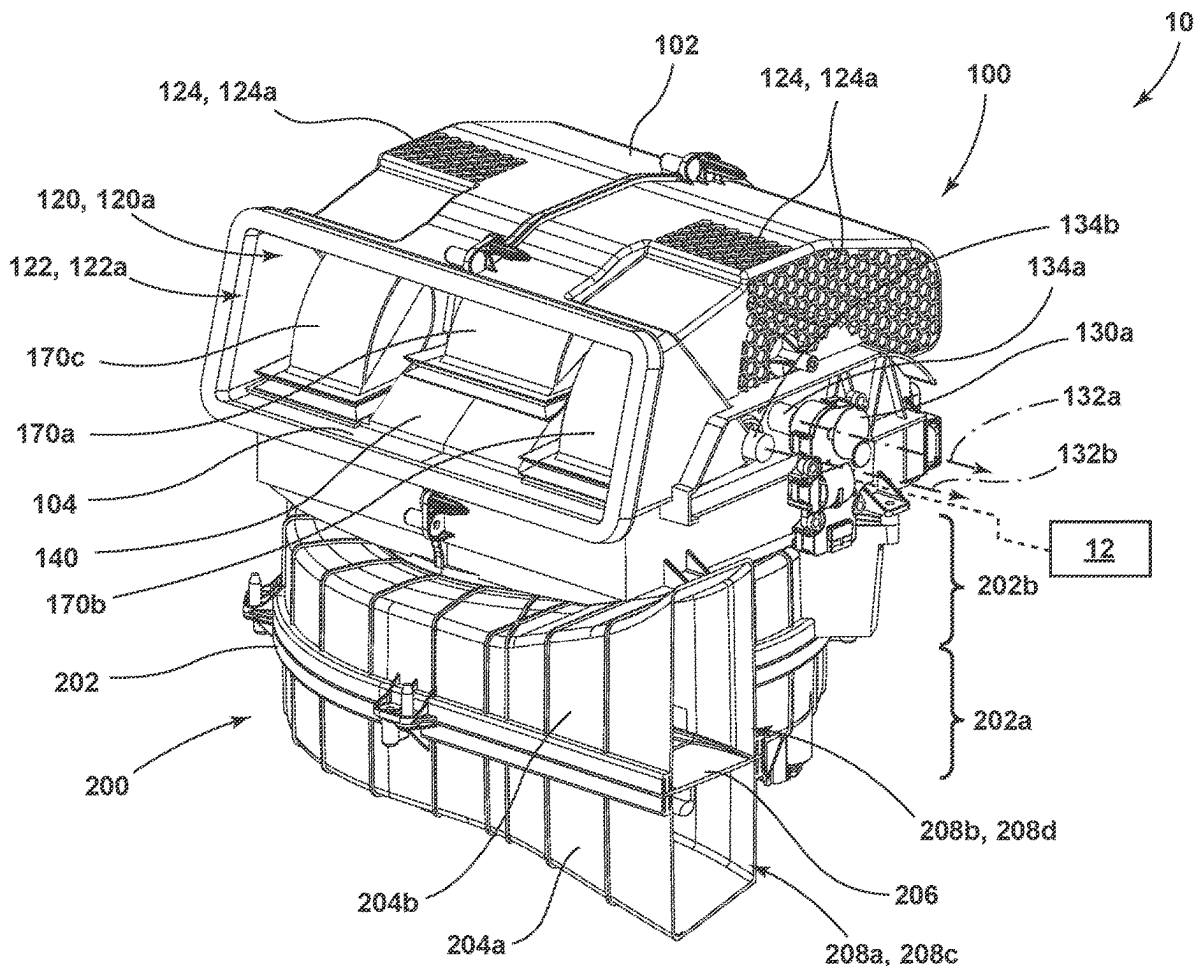




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**Wolfe et al.**(10) **Pub. No.: US 2025/0257889 A1**(43) **Pub. Date: Aug. 14, 2025**(54) **HVAC MODULE WITH OFFSET VALVE AXES**(52) **U.S. Cl.**  
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*F24F 13/32* (2006.01)(57) **ABSTRACT**

A valve assembly for a heating, ventilation, and air conditioning (HVAC) module may include a valve housing and a plurality of adjustable valves. The valve housing may define an internal space. The valve housing may include a first inlet via which a first input air is flowable into a first intake region of the internal space, a second inlet via which a second input air is flowable into a second intake region of the internal space, and a plurality of airflow openings. The adjustable valves may be disposed in the valve housing between the two intake regions. A first valve may be adjustable about a first axis to selectively open and close the first airflow opening with respect to the intake regions. A second valve may be adjustable about a second axis to selectively open and close the second airflow opening with respect to the intake regions.



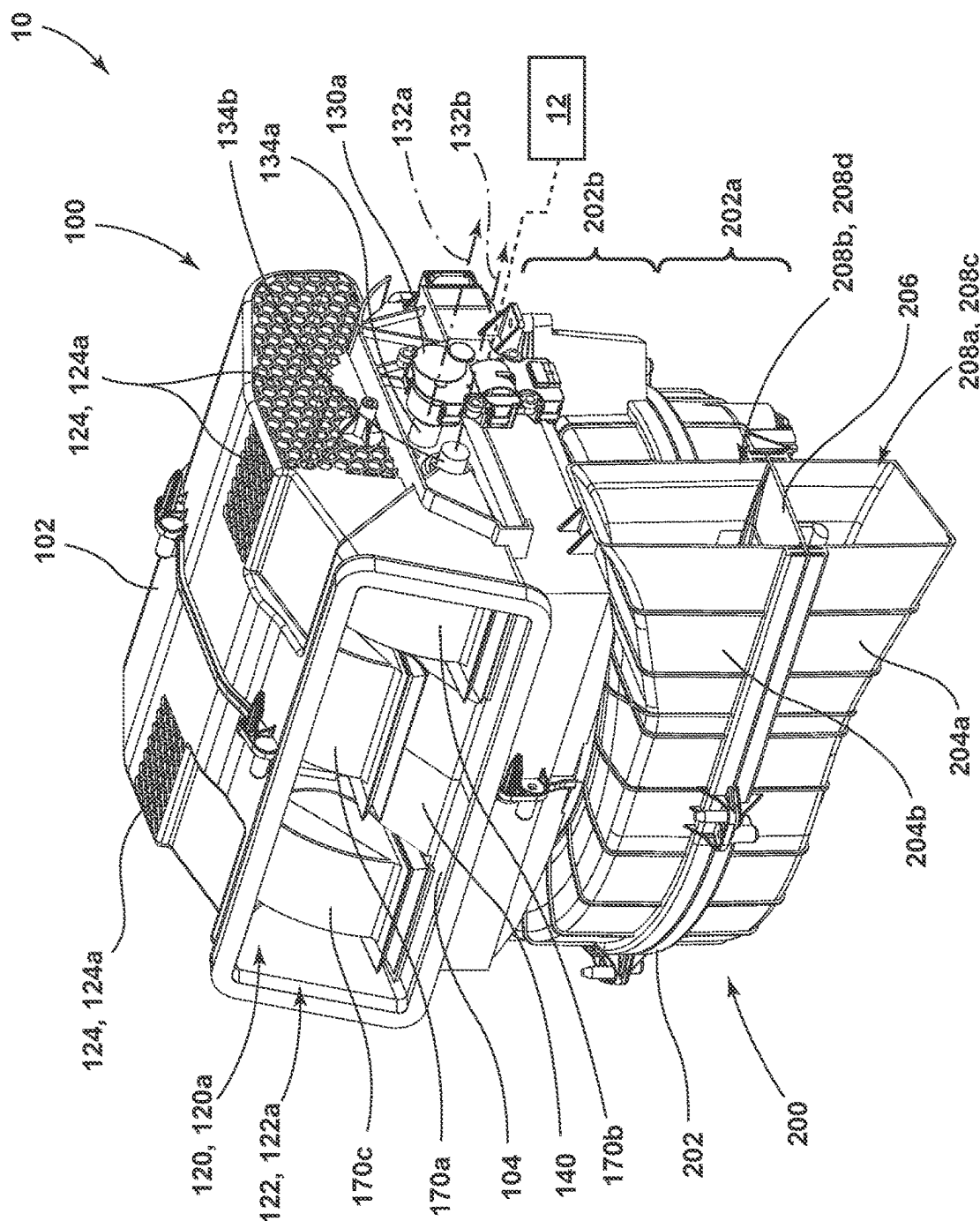
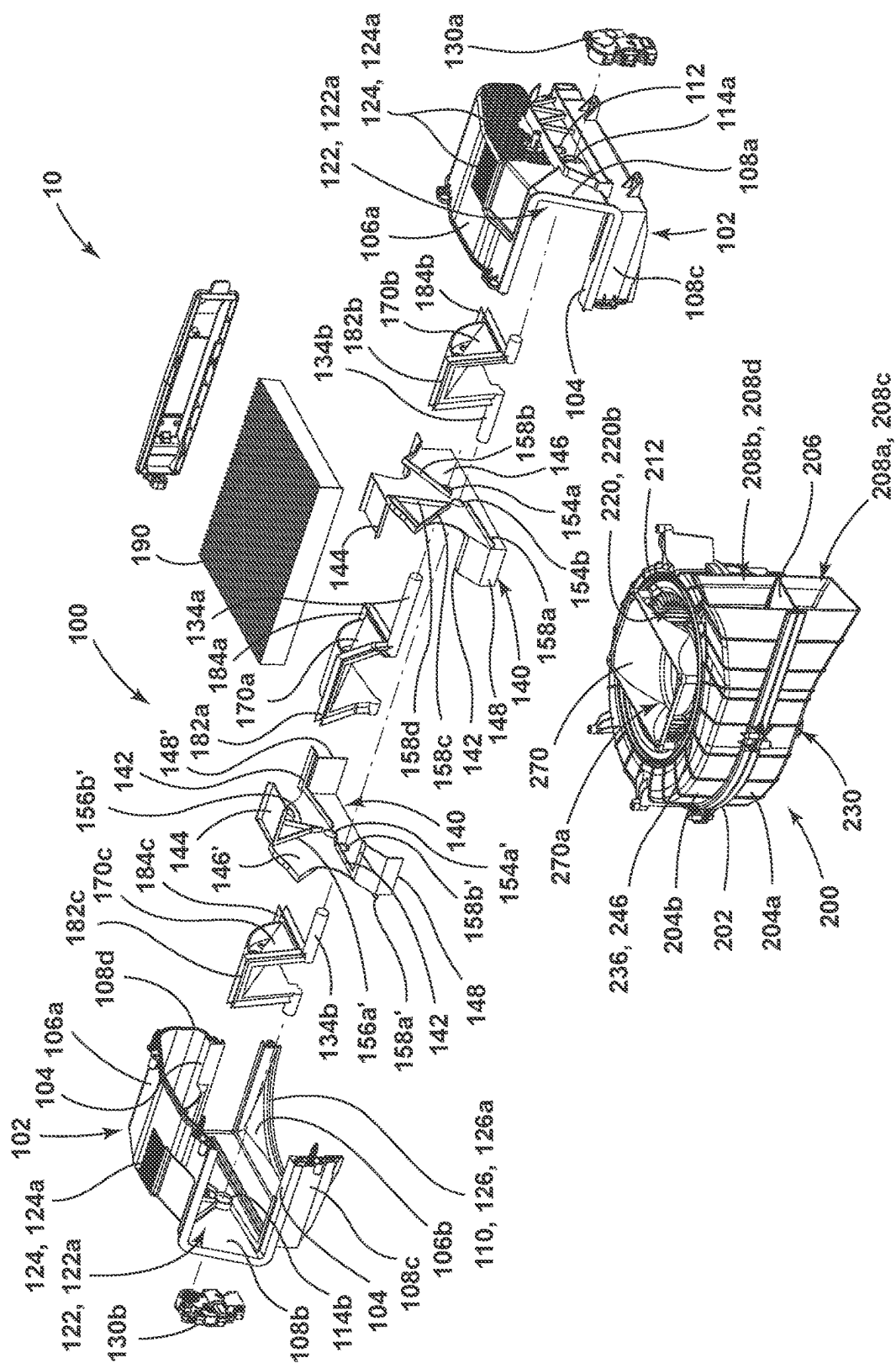
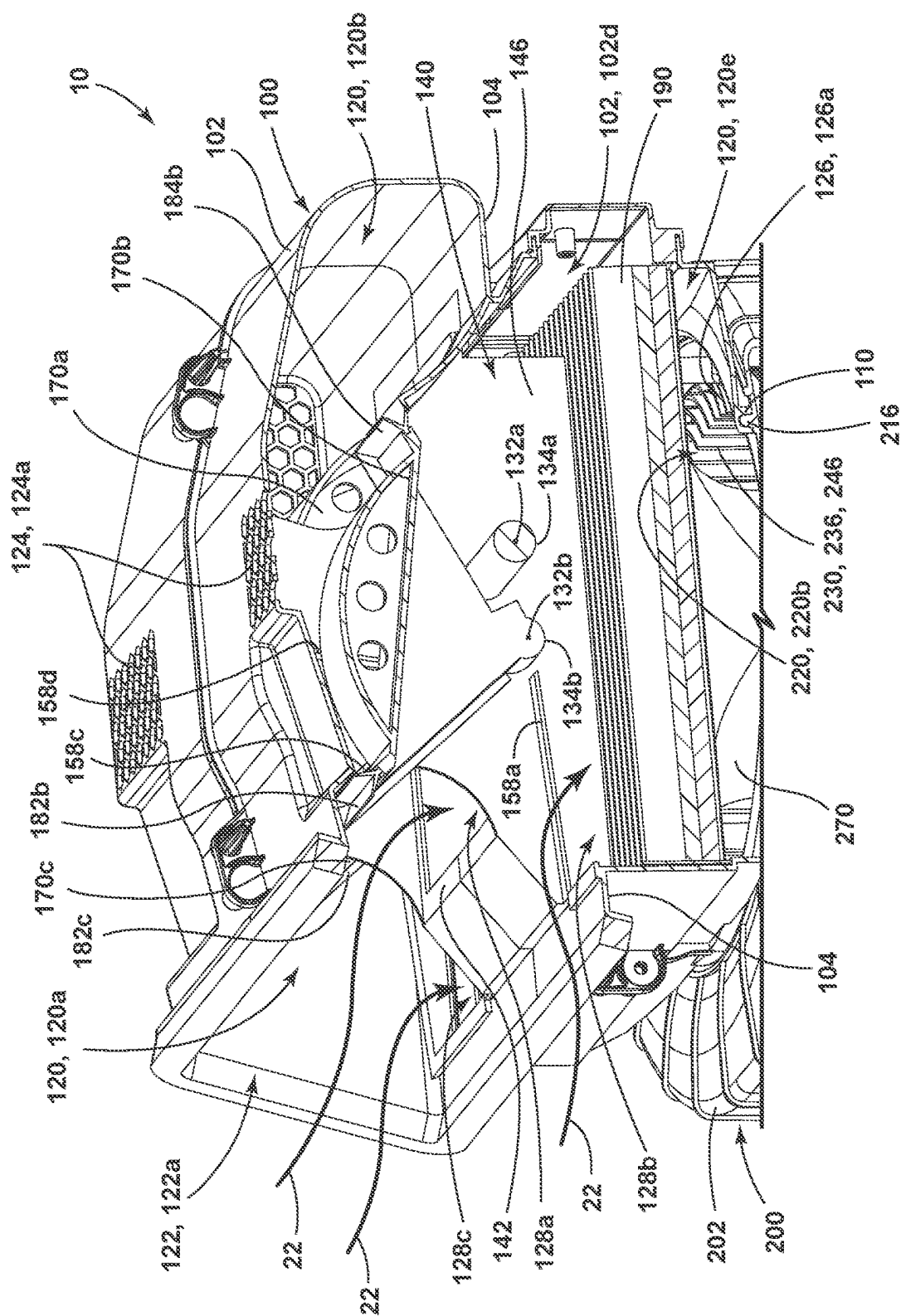


FIG. 1



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3A  
G  
L

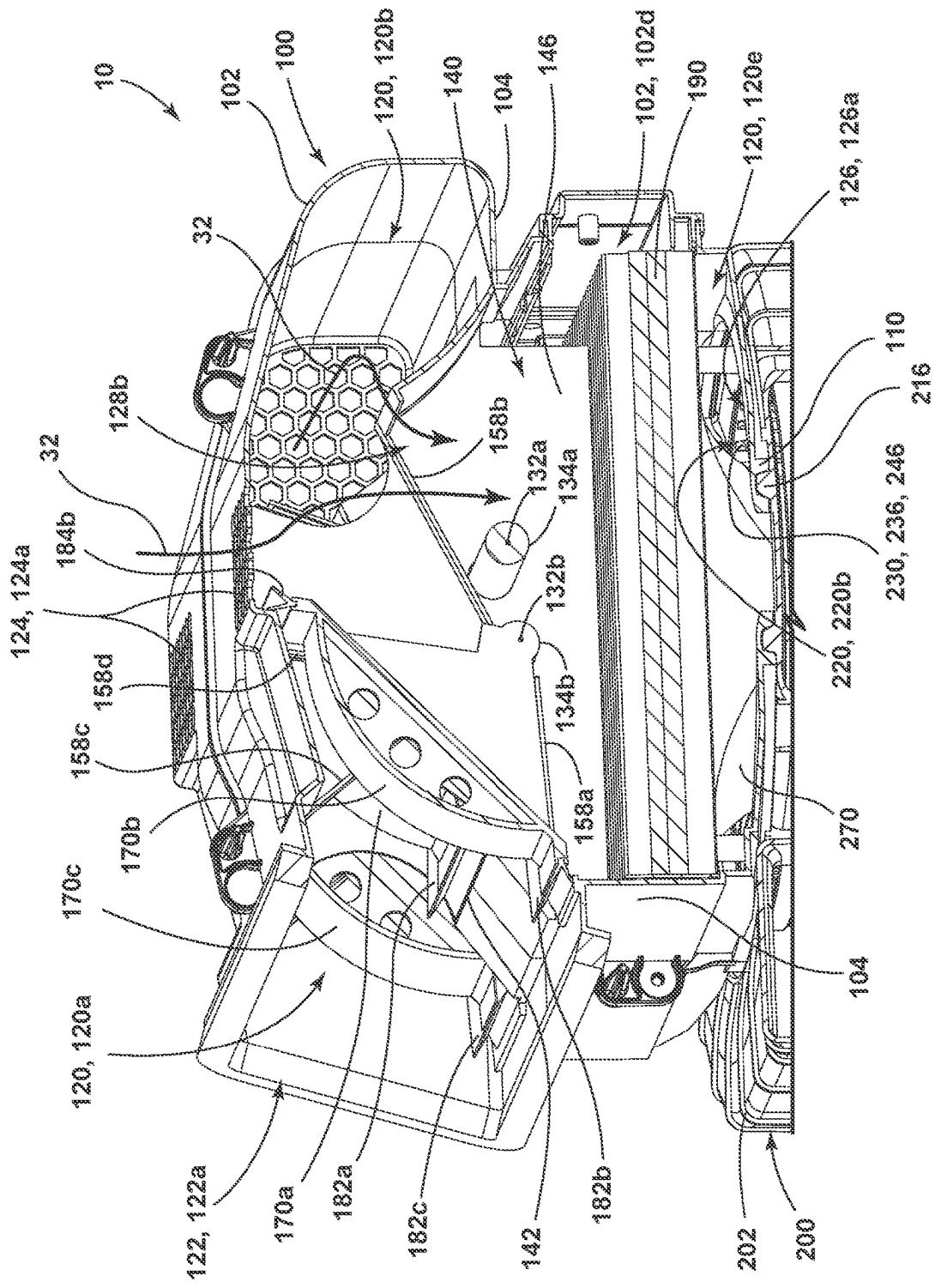


FIG. 3B

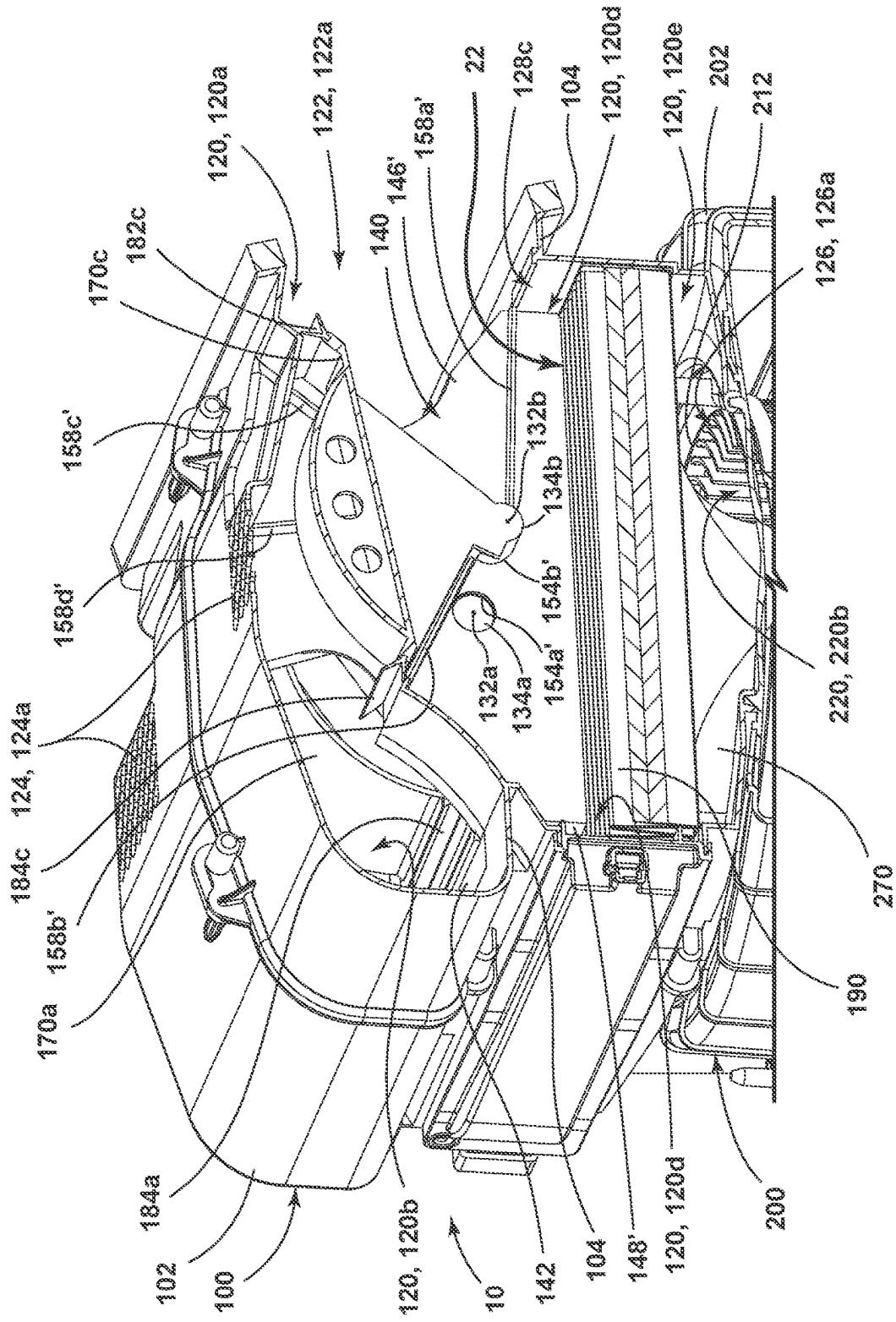


FIG. 4A

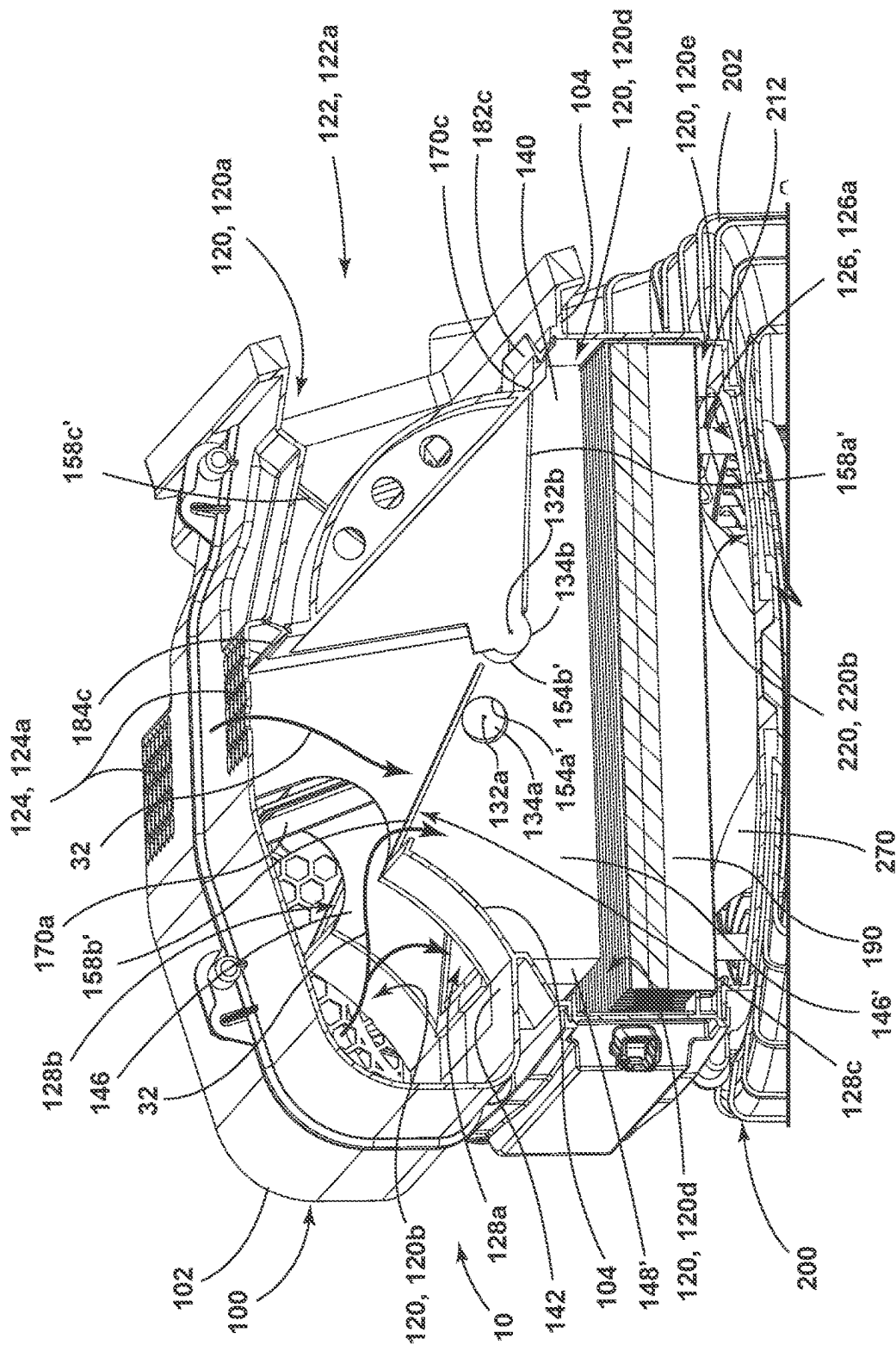


FIG. 4B

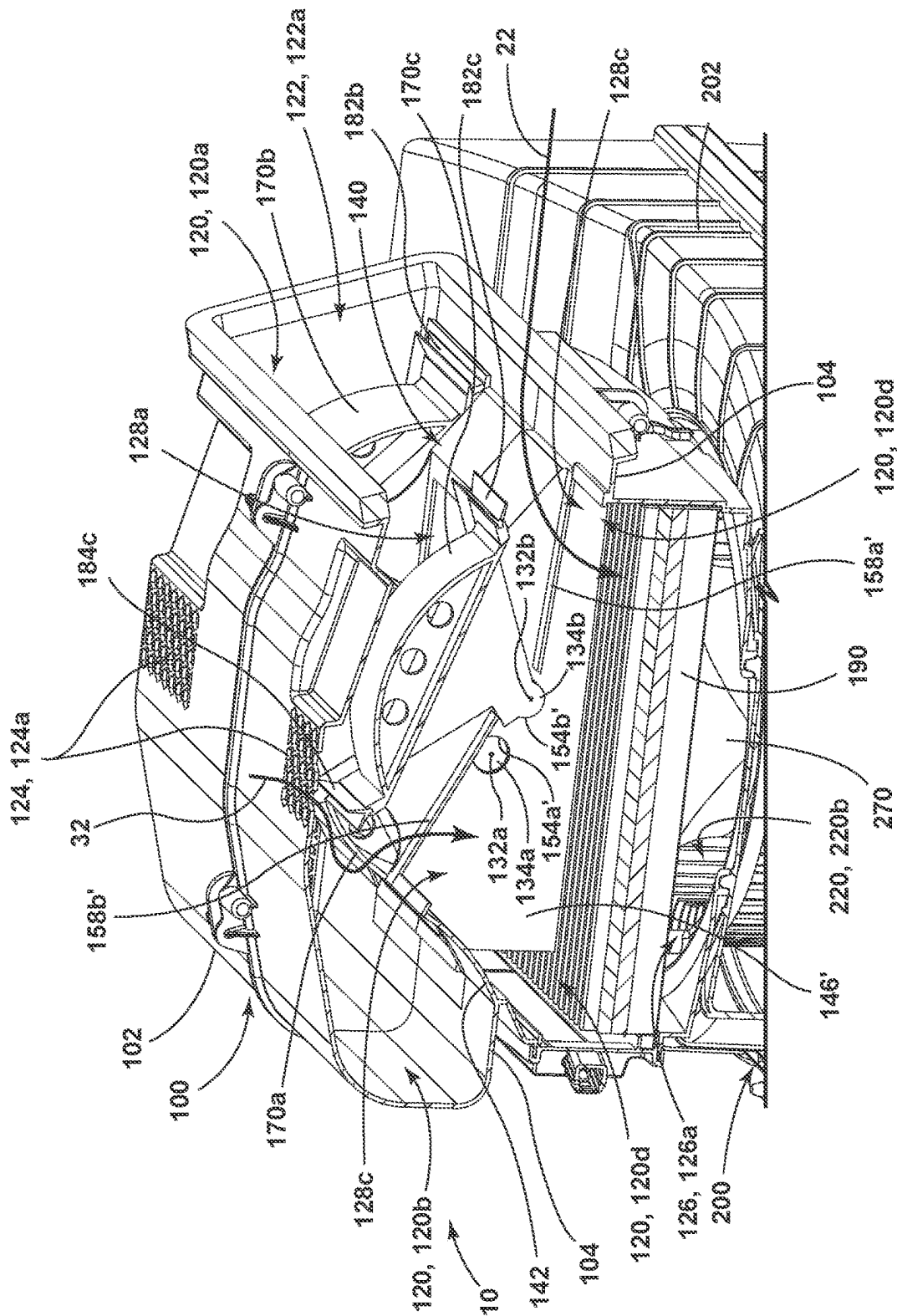
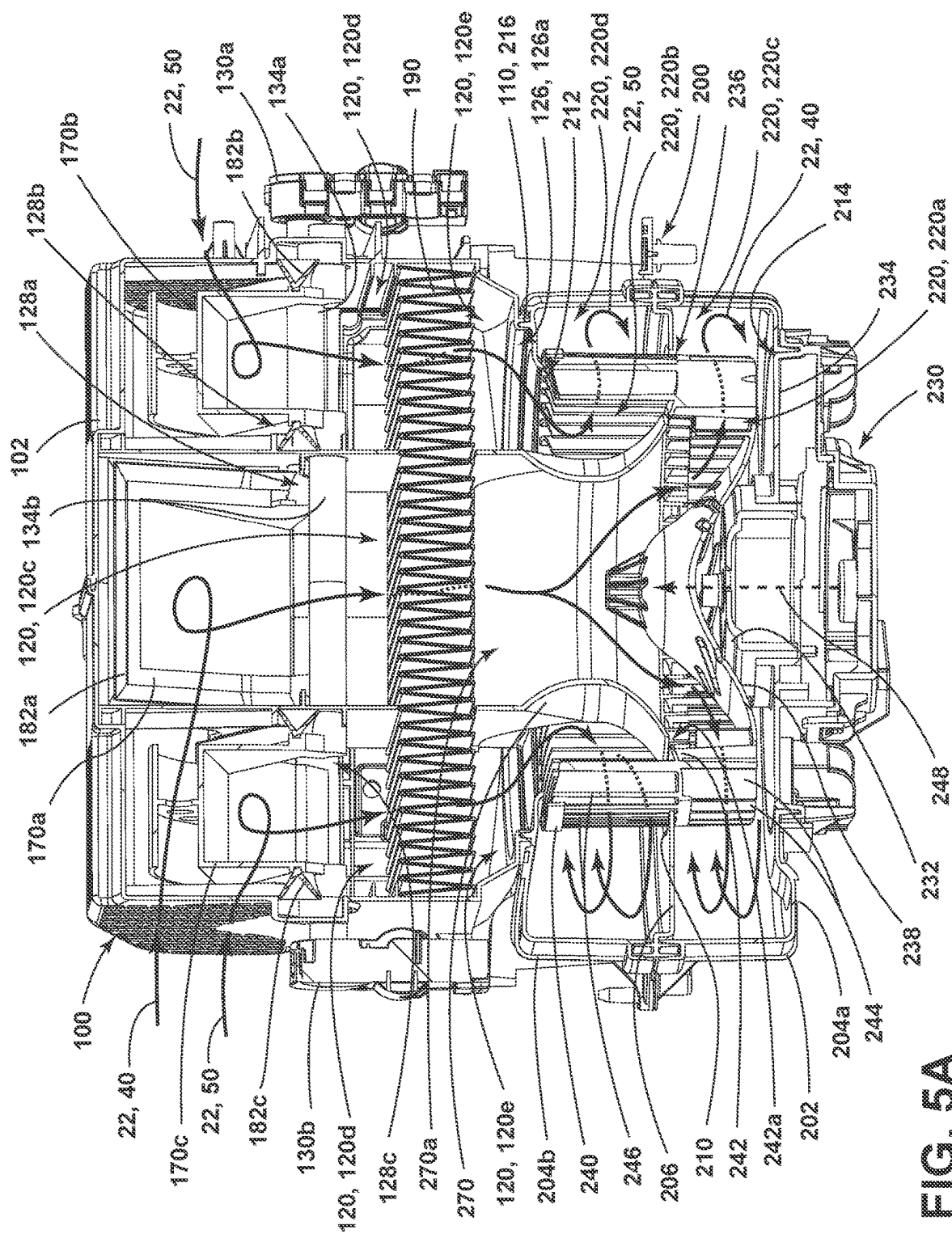


FIG. 4C





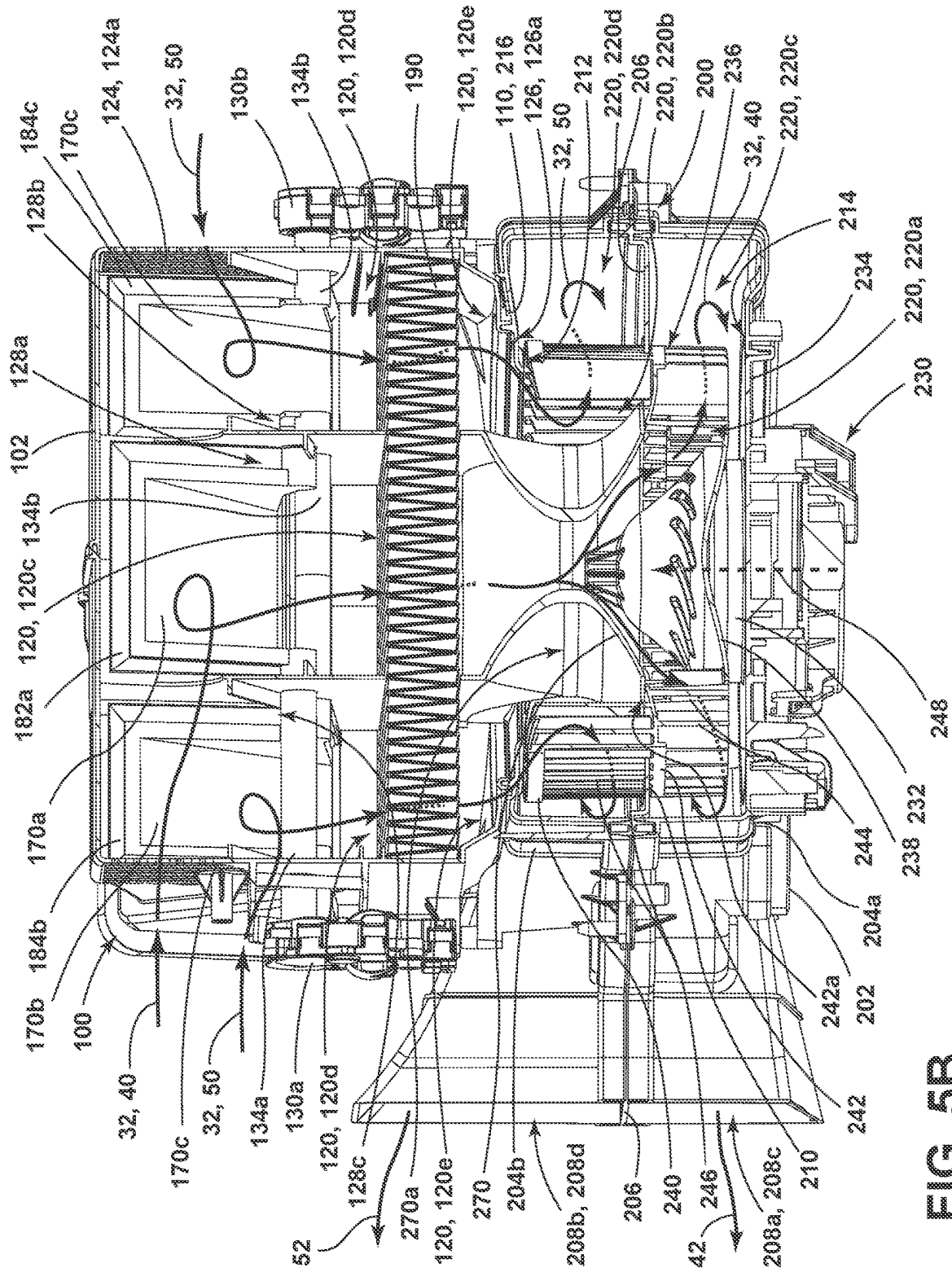


FIG. 5B

## HVAC MODULE WITH OFFSET VALVE AXES

### TECHNICAL FIELD

**[0001]** The present disclosure generally relates to heating, ventilation, and air conditioning (HVAC) modules that may, for example, be used in connection with vehicles.

### BACKGROUND

**[0002]** Vehicles commonly have HVAC systems and/or modules for controlling the climate within the vehicle cabin or another internal space and/or area of the vehicle by providing heated air and/or cooled air into the vehicle cabin. Some HVAC systems and/or modules utilize a nested shaft to control one or more first valves and one or more second valves. The nested shaft includes at least one first/external shaft and at least one second/internal shaft that are rotatable independently of one another. The internal shaft is disposed within and extends parallel to the external shaft, which is hollow. The external shaft is connected to the first valve(s) and the internal shaft is connected to the second valve(s), or vice versa. As such, the first valve(s) is able to be controlled (e.g., actuated, rotated about the nested shaft, etc.) via the external shaft and the second valve(s) is able to be controlled via the internal shaft independently of one another to an extent.

**[0003]** There are many challenges, drawbacks, and/or shortcomings associated with controlling the valves with the nested shaft, however. For example, since the external shaft is hollow, there are issues with respect to the strength, durability, and/or reliability of the external shaft that can result in breakage and/or premature failure of the nested shaft. The nested shaft also complicates assembly and manufacturing of the HVAC system and/or module, and limits kinematic functions due to having a single point of rotation (e.g., the positions to which the first valve(s) and the second valve(s) can be adjusted independently of one another is limited and, thus, independent control thereof is restricted).

**[0004]** Accordingly, there is a need for an improved HVAC system and/or module that minimizes or eliminates one or more challenges or shortcomings of existing HVAC systems and/or modules.

### SUMMARY

**[0005]** A valve assembly for a heating, ventilation, and air conditioning (HVAC) module may include a valve housing and a plurality of adjustable valves. The valve housing may define an internal space. The valve housing may include a first inlet via which a first input air is flowable into a first intake region of the internal space, a second inlet via which a second input air is flowable into a second intake region of the internal space, and a plurality of airflow openings including a first airflow opening and a second airflow opening. The adjustable valves may be disposed in the valve housing between the first intake region and the second intake region. The adjustable valves may include a first valve and a second valve. The first valve may be adjustable about a first axis to selectively open and close the first airflow opening with respect to the first intake region and the second intake region. The second valve may be adjustable about a second axis to selectively open and close the second airflow opening with respect to the first intake region and the second intake region.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]** While the claims are not limited to a specific illustration, an appreciation of various aspects may be gained through a discussion of various examples. The drawings are not necessarily to scale, and certain features may be exaggerated or hidden to better illustrate and explain an innovative aspect of an example. Further, the exemplary illustrations described herein are not exhaustive or otherwise limiting, and embodiments are not restricted to the precise form and configuration shown in the drawings or disclosed in the following detailed description. Exemplary illustrations are described in detail by referring to the drawings as follows:

**[0007]** FIG. 1 is a perspective view of an exemplary HVAC module;

**[0008]** FIG. 2 is a perspective, partially exploded view of the HVAC module of FIG. 1;

**[0009]** FIGS. 3A and 3B are cross-sectional perspective views through a second valve of the HVAC module of FIG. 1 when the valves are each in a first position (FIG. 3A) and when the valves are each in a second position (FIG. 3B), respectively;

**[0010]** FIGS. 4A, 4B, and 4C are cross-sectional perspective views through a third valve of the HVAC module of FIG. 1 when the valves are each in the first position (FIG. 4A), when the valves are each in the second position (FIG. 4B), and when the first valve is in the first position, the second valve is in the second position, and the third valve is in an intermediate position (FIG. 4C), respectively;

**[0011]** FIG. 5A is a cross-sectional perspective front view of the HVAC module of FIG. 1 when the valves are each in the first position; and

**[0012]** FIG. 5B is a cross-sectional perspective rear view of the HVAC module of FIG. 1 when the valves are each in the second position.

### DETAILED DESCRIPTION

**[0013]** Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the various described embodiments. However, it will be apparent to one of ordinary skill in the art that the various described embodiments may be practiced without these specific details. In other instances, well-known methods, procedures, components, circuits, and networks have not been described in detail so as not to unnecessarily obscure aspects of the embodiments.

**[0014]** FIGS. 1-5B present a heating, ventilation, and air conditioning (HVAC) module 10 configured to receive air from one or more air sources (e.g., first and second air sources) and selectively output the received air, such as to one or more portions, areas (e.g., zones), and/or regions within a vehicle. Air (e.g., external air) from a first air source (e.g., an external space outside of the vehicle) may be considered and/or referred to as first input air 22. Air (e.g., recirculation air) from a second air source (e.g., an interior space and/or cabin of the vehicle) may be considered and/or referred to as second input air 32.

**[0015]** As generally illustrated in FIG. 1, the HVAC module 10 includes a valve assembly 100, a blower assembly 200, and a controller 12. The valve assembly 100 and the blower assembly 200 are connected to one another and are

in fluid communication with one another. The valve assembly 100 is configured to receive air 22, 32 from one or more air sources and selectively communicate the received air 22, 32 to the blower assembly 200 (e.g., as a first airflow 40 and/or as a second airflow 50). The blower assembly 200 is configured to receive air (e.g., the first airflow 40 and/or the second airflow 50) from the valve assembly 100 and output that air to one or more structures, spaces, and/or destinations (e.g., as a first output air 42 and a second output air 52). The controller 12 is operatively connected (e.g., communicatively connected, electrically connected, and/or physically connected) to (i) the valve assembly 100 and/or one or portions/parts/elements thereof and (ii) the blower assembly 200 and/or one or portions/parts/elements thereof. The controller 12 is configured to control and/or operate the HVAC module 10, the valve assembly 100, and/or the blower assembly 200.

[0016] As generally illustrated in FIGS. 2-5B and described in further detail below, the blower assembly 200 includes a blower housing 202, a blower 230, and an air funnel 270. The valve assembly 100 includes a valve housing 102, a plurality of actuators and/or motors (e.g., a first and second actuator 130a, 130b), a plurality of shafts (e.g., a first and second shaft 134a, 134b), a plurality of valves (e.g., a first, second, and third valve 170a, 170b, 170c), and a filter 190. The valve housing 102 includes a plurality of air inlets (e.g., a first and second inlet 122, 124), an air outlet 126, and a plurality of airflow openings (e.g., a first, second, and third airflow opening 128a, 128b, 128c; see FIG. 3A). The valve housing 102 also includes a valve support 140 for supporting the valves 170a-170c and the shafts 134a, 134b within the valve housing 102. The valves 170a-170c and the filter 190 are arranged in an internal space 120 of the valve housing 102 (also referred to as the 'valve housing internal space' and/or 'VH internal space'). The VH internal space 120 includes a first intake region 120a, a second intake region 120b, a first unfiltered region 120c, a second unfiltered region 120d, and a filtered region 120e. Air (e.g., first input air 22 and/or external air) from a first air source is flowable into the first intake region 120a via the first inlet 122. Air (e.g., second input air 32 and/or recirculation air) from a second air source is flowable into the second intake region 120b via the second inlet 124. The intake regions 120a, 120b are in selective fluid communication with (i) the first unfiltered region 120c via the first airflow opening 128a and (ii) the second unfiltered region 120d via the second and third airflow openings 128b, 128c. The first valve 170a is adjustable about a first axis 132a to selectively open and close the first airflow opening 128a with respect to the intake regions 120a, 120b. The second and third valves 170b, 170c are adjustable about a second axis 132b to selectively open and close the second and third airflow openings 128b, 128c, respectively, with respect to the intake regions 120a, 120b. The filter 190 is disposed between and/or separates (to at least an extent) the first unfiltered region 120c and an inner space 270a of the air funnel 270, which projects through the air outlet 126 and into the VH internal space 120. The filter 190 is also disposed between and/or separates (to at least an extent) the second unfiltered region 120d and the filtered region 120e. The funnel inner space 270a is in fluid communication with a first inner region 220a of an internal space 220 of the blower housing 202 (also referred to as the 'blower housing internal space' and/or 'BH internal space'), which is in fluid communication with a first flow region 220c

of the BH internal space 220 and a first outlet 208a of the blower housing 202. The filtered region 120e is in fluid communication with a second inner region 220b of the BH internal space 220 via the air outlet 126 of the valve housing 102 and an inflow opening 212 of the blower housing 202. The second inner region 220b is in fluid communication with a second flow region 220d of the BH internal space 220 and a second outlet 208b of the blower housing 202.

[0017] As generally illustrated in FIGS. 3A-5B, during operation of the HVAC module 10, air (e.g., first input air 22) flows into the first intake region 120a via the first inlet 122 and/or air (e.g., second input air 32) flows into the second intake region 120b via the second inlet 124. The first input air 22 in the first intake region 120a and/or the second input air 32 in the second intake region 120b flows through one or more of the airflow openings 128a-128c based on the positions of the valves 170a-170c. Air 22, 32 flowing through the first airflow opening 128a, which may be considered and/or referred to as a first airflow 40, flows into the first unfiltered region 120c, through the filter 190, and into the funnel inner space 270a (i.e., into the blower assembly 200). The first airflow 40 then flows sequentially through the funnel inner space 270a, the first inner region 220a, the first flow region 220c, and the first outlet 208a, at which point the first airflow 40 is output and/or expelled from the blower assembly 200 and/or the HVAC module 10 as first output air 42 that may ultimately be directed to one or more first destinations (e.g., a windshield defrost zone of a vehicle cabin). Air 22, 32 flowing through the second airflow opening 128b and air 22, 32 flowing through the third airflow opening 128c both flow into the second unfiltered region 120d and, thus, may be considered and/or referred to as a second airflow 50. The second airflow 50 then flows into the filtered region 120e by flowing through the filter 190, and subsequently flows into the second inner region 220b of the blower assembly 200 via the air outlet 126 of the valve housing 102 and the inflow opening 212 of the blower housing 202. The second airflow 50 then flows sequentially through the second inner region 220b, the second flow region 220d, and the second outlet 208b, at which point the second airflow 50 is output and/or expelled from the blower assembly 200 and/or the HVAC module 10 as second output air 52 that may ultimately be directed to one or more second destinations (e.g., one or more second/footwell zones of a vehicle cabin).

[0018] As generally illustrated in FIGS. 1-4C, the valve housing 102 defines a VH internal space 120 in which the valves 170a-170c and the filter 190 are arranged. The valve housing 102 includes a partition 104, a first end wall 106a, a second end wall 106b, and one or more sidewalls 108a-108d extending between and connecting the end walls 106a, 106b (see FIG. 2). The partition 104 is disposed between the end walls 106a, 106b. The partition 104 extends transversely to the sidewalls 108a-108d and projects from and/or is connected to the sidewalls 108a-108d.

[0019] As generally illustrated in FIGS. 1-4C, the valve housing 102 includes a plurality of air inlets via which air is flowable into the VH internal space 120. The plurality of air inlets includes a first inlet 122 (e.g., a fresh air inlet) via which first input air 22 (e.g., external air) from the first air source is flowable into the first intake region 120a. The first inlet 122 includes and/or is defined by a first inlet opening 122a, which is disposed in and defined by the valve housing 102.

[0020] The plurality of air inlets further includes a second inlet **124** (e.g., a recirculation air inlet) via which second input air **32** (e.g., recirculation air) from the second air source is flowable into the second intake region **120b**. The second inlet **124** includes and/or is defined by a plurality of second inlet openings **124a**, which are disposed in and/or defined by the valve housing **102** (e.g., the first end wall and/or one or more sidewalls). The valve housing **102** includes several subsets or groups of second inlet openings **124a**. Each subset or group of second inlet openings **124a** includes a plurality of second inlet openings **124a** that are arranged in a closely packed array (e.g., a grid arrangement, a honeycomb arrangement) and defined by a region and/or section of the valve housing **102** that is structured in the manner of a mesh and/or lattice. Conceivably, the second inlet **124** may alternatively include and/or formed by a single second inlet opening **124a**, a single subset or group of second inlet openings **124a**, or in other suitable configurations.

[0021] As generally illustrated in FIGS. 2-5B, the valve housing **102** includes an air outlet **126** via which air (i.e., input air **22**, **32** that has passed through the filter **190**, the first airflow **40**, and/or the second airflow **50**) is expelled and/or flowable out of the valve housing **102**. The air outlet **126** includes and/or is defined by an outlet opening **126a**, which is disposed in and/or defined by the valve housing **102** (e.g., the second end wall **106b**). The filtered region **120e** and the second inner region **220b** are in direct fluid communication with one another via the air outlet **126** and the inflow opening **212**. The air funnel **270** is disposed partially in the air outlet **126** and extends into the VH internal space **120** via the air outlet **126**. As such, the air outlet **126** and the inflow opening **212** enable fluid communication between the first unfiltered region **120c** and the first inner region **220a** via the air funnel **270**.

[0022] As generally illustrated in FIGS. 2-5B, the valve housing **102** includes an attachment formation **110** configured to engage a complimentary attachment formation **216** of the blower housing **202** and at least partially attach and/or seal the valve assembly **100** (e.g., the valve housing **102**) and the blower assembly **200** (e.g., the blower housing **202**). The attachment formation **110** includes a plurality of protrusions (e.g., two protrusions) that define a channel that receives a complimentary projection of the attachment formation **216**. The protrusions and the channel of the attachment formation **110** extend substantially parallel to one another and extend around and/or encircle the air outlet **126**.

[0023] As generally illustrated in FIGS. 2-5B, the valve housing **102** further includes a valve support **140** arranged in the VH internal space **120**. The valve support **140** is formed and/or defined by one or more separate components, structures, and/or elements connected to one or more other portions of the valve housing **102**. Conceivably, the valve support **140** and/or one or more portions thereof may alternatively be formed integrally with one or more other portions of the valve housing **102**.

[0024] As generally illustrated in FIG. 2, the valve support **140** includes a base **142**, an end wall **144**, two support walls **146**, **146'**, and two connecting walls **148**, **148'**. The support walls **146**, **146'** are disposed opposite one another and are connected to one another by the connecting walls **148**, **148'**, which are disposed opposite one another. The base **142** is connected to and extends transversely to the support walls **146**, **146'** and the connecting walls **148**, **148'**. The base **142**

is disposed offset from the partition **104** in a first/vertical direction (e.g., to account for and/or accommodate the offset arrangement of the axes **132a**, **132b** and shafts **134a**, **134b**) as generally shown in FIGS. 3A and 3B. The end wall **144** is connected to and extends between the support walls **146**, **146'**, and is disposed spaced apart from the base **142**. The valve support **140** (e.g., the base **142** and/or support walls **146**, **146'**) includes and/or defines the first airflow opening **128a**. The first unfiltered region **120c** is disposed in the valve support **140** and is at least partially defined by the valve support **140** (e.g., the base **142** and walls **146**, **146'**, **148**, **148'**), which is shown in FIGS. 5A and 5B. As illustrated in FIGS. 3A-4C, the second unfiltered region **120d** is disposed outside the valve support **140** and extends at least partially around the valve support **140**. The end of the valve support **140** and/or the ends of the walls **146**, **146'**, **148**, **148'** opposite the base **150** are disposed near, directly adjacent to, and/or in contact with the filter **190** such that valve support **140** and/or the walls **146**, **146'**, **148**, **148'** at least partially separate and/or seal the first unfiltered region **120c** and the second unfiltered region **120d** from one another.

[0025] As generally illustrated in FIGS. 2-4C, the support walls **146**, **146'** rotatably engage and/or contact the shafts **132a**, **132b** and support the shafts **132a**, **132b** and the valves **170a-170c** within the valve housing **102**. The support walls **146**, **146'** each have a first shaft recess **154a**, **154a'** for receiving the first shaft **134a** and a second shaft recess **154b**, **154b'** for receiving the second shaft **134b**. Additionally, the support walls **146**, **146'** each have a plurality of sealing projections **156a'**, **156b'**, **158a-158d**, **158a'-158d'** the project from and extend longitudinal along the support wall **146**, **146'**. The sealing projections includes a first inner sealing projection **156a'** and a second inner sealing projection **156b'**, which project toward the other support wall **146**, **146'** and are selectively contacted by the first valve **170a** to at least partially seal the first airflow opening **128a**. The sealing projections includes a first, second, third, and fourth outer sealing projection **158a-158d**, **158a'-158d'**, which project away the other support wall **146**, **146'** and are selectively contacted by an associated one of the second and third valves **170b**, **170c** to at least partially seal an associated one of the second and third airflow openings **128b**, **128c**. The valve support **140** (e.g., the first support wall **146** and/or the outer sealing projections **158a**, **158b**) at least partially defines the second airflow opening **128b**. The valve support **140** (e.g., the second support wall **146'** and/or the outer sealing projections **158a'**, **158b'**) at least partially defines the third airflow opening **128c**.

[0026] As generally illustrated in FIGS. 3A-4C, the valve housing **102** includes a plurality of airflow openings, including a first, second, and third airflow opening **128a**, **128b**, **128c**. The first airflow opening **128a** is disposed in and defined by the valve support **140**. More specifically, the first airflow opening **128a** is disposed in the base **142** and is at least partially defined by the base **142** and the support walls **146**, **146'**. The first airflow opening **128a** fluidically connects each of the intake regions **120a**, **120b** to the first unfiltered region **120c**. The first airflow opening **128a** is selectively openable and closeable with respect to the intake regions **120a**, **120b** via the first valve **170a**. The second airflow opening **128b** is defined at least partially by the partition **104** and the valve support **140** (e.g., the first support wall **146** and/or the first and second outer sealing projections **158a**, **158b**). The third airflow opening **128c** is defined at least

partially by the partition **104** and the valve support **140** (e.g., the second support wall **146'** and/or the first and second outer sealing projections **158a'**, **158b'**). The second and third airflow openings **128b**, **128c** each fluidically connect each of the intake regions **120a**, **120b** to the second unfiltered region **120d**. The second airflow opening **128b** is selectively openable and closeable with respect to the intake regions **120a**, **120b** via the second valve **170b**. The third airflow opening **128c** is selectively openable and closeable with respect to the intake regions **120a**, **120b** via the third valve **170c**.

[0027] As generally illustrated in FIGS. 1-5B, the valve assembly **100** includes a plurality of valves **170a-170c** including a first, second, and third valve **170a**, **170b**, **170c**. The valves **170a-170c** are arranged in the valve housing **102** (e.g., in the VH internal space **120**) between the first and second intake regions **120a**, **120b** and control the flow of air through the HVAC module **10**. Each valve **170a-170c** includes at least one seal **182a-182c**, **184a-184c**. The first seal **182a-182c** is connected to and projects outward from the valve **170a-170c** and extends at least partially around a first open end of the valve **170a-170c**. The second seal **184a-184c** is connected to and projects outward from valve **170a-170c** and extends at least partially around a second open end of the valve **170a-170c**. While the first seal **182a-182c** and second seal **184a-184c** are separate and independent elements in the illustrative example herein, the first seal **182a-182c** and the second seal **184a-184c** may conceivably be connected to one another and/or formed as a singular seal.

[0028] As generally illustrated in FIGS. 2-5B, the first valve **170a** is disposed at least partially within the valve support **140**, and is arranged between the second valve **170b** and the third valve **170c** relative to the first and second axes **132a**, **132b**. The first valve **170a** is adjustable and/or rotatable about the first axis **132a** to selectively open and close the first airflow opening **128a** with respect to the intake regions **120a**, **120b**. The first valve **170a** is connected to the first shaft **134a**, which extends along and/or defines the first axis **132a**. The first shaft **134a** is disposed in and/or extends through (i) a first shaft recess **112** disposed in and defined by the first sidewall **108a** of the valve housing **102**, (ii) the first shaft recess **154a** of the first support wall **146**, and (iii) the first shaft recess **154a'** of the second support wall **146'** (see FIG. 2). The first shaft **134a** extends only part way through the valve housing **102** (e.g., does not extend completely through the valve housing **102**, nor contact or engage the second sidewall **108b** of the valve housing **102**). The first valve **170a** and the first shaft **134a** are supported by the valve support **140** and the valve housing **102**. An end of the first shaft **134a** is connected to the first actuator **130a** (see FIGS. 1 and 5B). In other words, the first shaft **134a** connects the first valve **170a** and the first actuator **130a** to one another. The first actuator **130a** is disposed on a first side of the valve housing **102** and is arranged outside of the valve housing **102** adjacent to the first sidewall **108a** of the valve housing **102**. The first actuator **130a** is configured to adjust the first valve **170a** about the first axis **132a**. The first actuator **130a** is connected to the controller **12**. The controller **12** is configured to control, operate, and/or actuate the first actuator **130a** to rotate the first shaft **134a**, which in turn adjusts and/or rotates the first valve **170a** about the first axis **132a**.

[0029] As generally illustrated in FIGS. 2-5B, the second valve **170b** and the third valve **170c** are arranged on opposite

sides of the first valve **170a** relative to the first and second axes **132a**, **132b**. The second valve **170b** and the third valve **170c** are adjustable and/or rotatable about the second axis **132b** to selectively open and close the second airflow opening **128b** and the third airflow opening **128c**, respectively, with respect to the intake regions **120a**, **120b**. The second and third valves **170b**, **170c** are connected to the second shaft **134b**, which extends along and/or defines the second axis **132b**. The second shaft **134b** is disposed in and/or extends through (i) a second shaft recess **114a** disposed in and defined by the first sidewall **108a** of the valve housing **102**, (ii) a second shaft recess **114b** disposed in and defined by the second sidewall **108b** of the valve housing **102**, (iii) the second shaft recess **154b** of the first support wall **146**, and (iv) the second shaft recess **154b'** of the second support wall **146'** (see FIG. 2). The second valve **170b**, the third valve **170c**, and the second shaft **134b** are supported by the valve support **140** and the valve housing **102**. The second shaft **134b** extends completely through the valve housing **102**. An end of the second shaft **134b** is connected to the second actuator **130b** (see FIG. 5A). In other words, the second shaft **134b** connects the second and third valves **170b**, **170c** and the second actuator **130b** to one another. The second actuator **130b** is disposed on a second, opposite side of the valve housing **102** and is arranged outside of the valve housing **102** adjacent to the second sidewall **108b** of the valve housing **102**. The second actuator **130b** is configured to adjust the second valve **170b** and the third valve **170c** about the second axis **132b**. The second actuator **130b** is connected to the controller **12**. The controller **12** is configured to control, operate, and/or actuate the second actuator **130b** to rotate the second shaft **134b**, which in turn simultaneously adjusts and/or rotates the second valve **170b** and the third valve **170c** about the second axis **132b**.

[0030] As generally illustrated in FIGS. 3A-4C, the first axis **132a** and/or first shaft **134a** and the second axis **132b** and/or the second shaft **134b** are offset from one another in a first/vertical direction and a second/horizontal direction. The first/vertical direction generally extends from the first end wall **106a** toward the second end wall **106b** of the valve housing **102** (e.g., generally parallel to the blower axis **248**). The second/horizontal direction generally extends from the first intake region **120a** toward the second intake region **120b**. The first/vertical direction and the second/horizontal direction are perpendicular to one another and are perpendicular to the first and second axes **132a**, **132b**. While the HVAC module **10** described herein includes two actuators **130a**, **130b**, the HVAC module **10** may include a single actuator that is connected to both shafts **134a**, **134b** and that controls, actuates, and/or rotates both shafts **134a**, **134b** independently of one another. As such, the controller **12** can control and/or actuate the second and third valves **170b**, **170c** independently of the first valve **170a**, and vice versa.

[0031] The valves **170a-170c** are independently controllable via the two shafts **134a**, **134b**, which allows for a proportion of first input air **22** and second input air **32** in the first airflow **40** and first outflow **42**, and a proportion of first input air **22** and second input air **32** in the second airflow **50** and second outflow **52** to be controlled independently of one another. Due to the valves **170a-170c** being rotatable about two distinct and offset shafts **134a**, **134b** and axes **132a**, **134b**, independent control of the first valve **170a** and the second and third valves **170b**, **170c** is not limited and/or

restricted like in designs utilizing a nest shaft, and/or adjustment of the valves **170a-170c** is not limited by the kinematics or is at least limited by the kinematics to a lesser extent than in HVAC systems and/or modules utilizing a nested shaft. The utilization of the two distinct and offset shafts **134a**, **134b** and axes **132a**, **134b** in the HVAC module **10** rather than a nested shaft also eliminates, mitigates, and/or avoids the assembly, manufacturing, strength, durability, and/or reliability concerns associated with utilization of a nested shaft. It also enables the input air **22**, **32** to flow more evenly to the blower **230**, which in turn improves efficiency of the blower **230** and/or the HVAC module **10**.

**[0032]** The first valve **170a** is adjustable and/or rotatable about the first axis **132a** to a variety of positions, including a first position (see FIGS. **3A**, **4A**, **4C**, **5A**), a second position (see FIGS. **1**, **3B**, **4B**, **5B**), and a plurality of intermediate positions between the first and second positions (e.g., an intermediate position similar to that of the third valve **170c** shown in FIG. **4C**). When in the first position (see FIGS. **3A**, **4A**, **4C**, **5A**), the second seal **184a** contacts, abuts, and/or presses against the base **142** of the valve support **140** and the first seal **182a** contacts, abuts, and/or presses against the first inner sealing projection **156a'** of each support wall **146**, **146'** and a first end of the end wall **144** of the valve support **140**. Thus, when in the first position, the first valve **170a** closes the first airflow opening **128a** with respect to the second intake region **120b** and does not close the first airflow opening **128a** with respect to the first intake region **120a** such that the first input air **22** is permitted to flow through the first airflow opening **128a** and the second input air **32** is restricted and/or prevented from flowing through the first airflow opening **128a**. When in the second position (see FIGS. **1**, **3B**, **4B**, **5B**), the first seal **182a** contacts, abuts, and/or presses against the base **142** of the valve support **140** and the second seal **184a** contacts, abuts, and/or presses against the second inner sealing projection **156b'** of each support wall **146**, **146'** and a second end of the end wall **144** of the valve support **140**. Thus, when in the second position, the first valve **170a** closes the first airflow opening **128a** with respect to the first intake region **120a** and does not close the first airflow opening **128a** with respect to the second intake region **120b** such that the second input air **32** is permitted to flow through the first airflow opening **128a** and the first input air **22** is restricted and/or prevented from flowing through the first airflow opening **128a**. When in one or more intermediate positions, the seals **182a**, **184a** do not contact the base **142**, the inner sealing projections **156a'**, **156b'**, nor the end wall **144** of the valve support **140**. Thus, when in one or more intermediate positions, the first valve **170a** does not close the first airflow opening **128a** with respect to the first intake region **120a** nor the second intake region **120b** such that both the first and second input air **22**, **32** are permitted to flow through the first airflow opening **128a**.

**[0033]** The second valve **170b** is adjustable and/or rotatable about the second axis **132b** to a variety of positions, including a first position (see FIGS. **3A**, **4A**, **5A**), a second position (see FIGS. **1**, **3B**, **4B**, **4C**, **5B**), and a plurality of intermediate positions between the first and second positions (e.g., an intermediate position similar to that of the third valve **170c** shown in FIG. **4C**). When in the first position (see FIGS. **3A**, **4A**, **5A**), the first seal **182b** contacts, abuts, and/or presses against the first end wall **106a** of the valve housing **102** (e.g., a first protrusion thereof), the first side-

wall **108a** of the valve housing **102** (e.g., a protrusion thereof), and the third outer sealing projection **158c** of the first support wall **146** and the second seal **184b** contacts, abuts, and/or presses against the partition **104** and the second outer sealing projection **158b** of the first support wall **146**. Thus, when in the first position, the second valve **170b** closes the second airflow opening **128b** with respect to the second intake region **120b** and does not close the second airflow opening **128b** with respect to the first intake region **120a** such that the first input air **22** is permitted to flow through the second airflow opening **128b** and the second input air **32** is restricted and/or prevented from flowing through the second airflow opening **128b**. When in the second position (see FIGS. **1**, **3B**, **4B**, **4C**, **5B**), the first seal **182b** contacts, abuts, and/or presses against the partition **104** and the first outer sealing projection **158a** of the first support wall **146** and the second seal **184b** contacts, abuts, and/or presses against the first end wall **106a** of the valve housing **102** (e.g., a first protrusion thereof), the first sidewall **108a** of the valve housing **102** (e.g., a protrusion thereof), and the fourth outer sealing projection **158d** of the first support wall **146**. Thus, when in the second position, the second valve **170b** closes the second airflow opening **128b** with respect to the first intake region **120a** and does not close the second airflow opening **128b** with respect to the second intake region **120b** such that the second input air **32** is permitted to flow through the second airflow opening **128b** and the first input air **22** is restricted and/or prevented from flowing through the second airflow opening **128b**. When in one or more intermediate positions, the seals **182b**, **184b** do not contact the partition **104**, the outer sealing projections **158a-158d** of the first support wall **146**, the first sidewall **108a** of the valve housing **102**, nor the first end wall **106a** of the valve housing **102**. Thus, when in one or more intermediate positions, the second valve **170b** does not close the second airflow opening **128b** with respect to the first intake region **120a** nor the second intake region **120b** such that both the first and second input air **22**, **32** are permitted to flow through the second airflow opening **128b**.

**[0034]** The third valve **170c** is adjustable and/or rotatable about the second axis **132b** to a variety of positions, including a first position (see FIGS. **3A**, **4A**, **5A**), a second position (see FIGS. **1**, **3B**, **4B**, **5B**), and a plurality of intermediate positions between the first and second positions (see FIG. **4C**). When in the first position (see FIGS. **3A**, **4A**, **5A**), the first seal **182c** contacts, abuts, and/or presses against the first end wall **106a** of the valve housing **102** (e.g., a second protrusion thereof), the second sidewall **108b** of the valve housing **102** (e.g., a protrusion thereof), and the third outer sealing projection **158c'** of the second support wall **146'** and the second seal **184c** contacts, abuts, and/or presses against the partition **104** and the second outer sealing projection **158b'** of the second support wall **146'**. Thus, when in the first position, the third valve **170c** closes the third airflow opening **128c** with respect to the second intake region **120b** and does not close the third airflow opening **128c** with respect to the first intake region **120a** such that the first input air **22** is permitted to flow through the third airflow opening **128c** and the second input air **32** is restricted and/or prevented from flowing through the third airflow opening **128c**. When in the second position (see FIGS. **1**, **3B**, **4B**, **5B**), the first seal **182c** contacts, abuts, and/or presses against the partition **104** and the first outer sealing projection **158a'** of the second support wall **146'** and the second seal **184c** contacts, abuts, and/or

presses against the first end wall **106a** of the valve housing **102** (e.g., a second protrusion thereof), the second sidewall **108b** of the valve housing **102** (e.g., a protrusion thereof), and the fourth outer sealing projection **158d'** of the second support wall **146'**. Thus, when in the second position, the third valve **170c** closes the third airflow opening **128c** with respect to the first intake region **120a** and does not close the third airflow opening **128c** with respect to the second intake region **120b** such that the second input air **32** is permitted to flow through the third airflow opening **128c** and the first input air **22** is restricted and/or prevented from flowing through the third airflow opening **128c**. When in one or more intermediate positions (see FIG. 4C), the seals **182c**, **184c** do not contact the partition **104**, the outer sealing projections **158a'**-**158d'** of the second support wall **146'**, the second sidewall **108b** of the valve housing **102**, nor the first end wall **106a** of the valve housing **102**. Thus, when in one or more intermediate positions, the third valve **170c** does not close the third airflow opening **128c** with respect to the first intake region **120a** nor the second intake region **120b** such that both the first and second input air **22**, **32** are permitted to flow through the third airflow opening **128c**.

[0035] As generally illustrated in FIGS. 2-5B, the filter **190** is configured to remove and/or collect impurities from air (e.g., the input air **22**, **33**, the first airflow **40**, and/or the second airflow **50**) flowing through the filter **190**. The filter **190** is arranged in the valve housing **102** (e.g., the VH internal space **120**). The filter **190** is releasably engaged by and/or connected to the valve housing **102** (e.g., one or more sidewalls thereof) enabling the filter **190** to be easily removed and replaced, such as by removing an access panel and/or cover that closes an opening in valve housing **102**. The inlets **122**, **124**, the first end wall **106a** of the valve housing **102**, the partition **104**, the valve support **140**, the airflow openings **170a**-**170c**, and the unfiltered regions **120c**, **120d** are disposed on a first side of the filter **190** and the second end wall **106b** of the valve housing **102**, the air outlet **126**, the air funnel **270**, and the filtered region **120e** are disposed on a second, opposite side of the filter **190**, at least with respect to a throughflow direction of the HVAC module **10**. The filter **190** is disposed between and/or separates (to at least an extent) the first unfiltered region **120c** and the funnel inner space **270a** such that the first airflow **40** is flowable (e.g., exclusively) from the first unfiltered region **120c** into the funnel inner space **270a** via flowing through the filter **190**. The filter **190** is also disposed between and/or separates (to at least an extent) the second unfiltered region **120d** and the filtered region **120e** such that the second airflow **50** is flowable (e.g., exclusively) from the second unfiltered region **120d** into the filtered region **120e** via flowing through the filter **190**.

[0036] As generally illustrated in FIGS. 3A-5B, the VH internal space **120** includes a first intake region **120a**, a second intake region **120b**, a first unfiltered region **120c**, a second unfiltered region **120d**, and a filtered region **120e**.

[0037] As generally illustrated in FIGS. 3A-4C, the first intake region **120a** is defined at least partially by a first section and/or region of the valve housing **102** (e.g., a first portion of the first end wall **106a**, a first portion of the partition **104**, and a first portion of one or more sidewalls **108a**-**108c** disposed on a first side of the valves **170a**-**170c** and/or the valve support **140**). The second intake region **120b** is defined at least partially by a second section and/or region of the valve housing **102** (e.g., a second portion of the

first end wall **106a**, a second portion of the partition **104**, and a second portion of one or more sidewalls disposed **108a**, **108b**, **108d** on a second, opposite side of the valves **170a**-**170c** and/or the valve support **140**). In other words, the first intake region **120a** and the second intake region **120b** are disposed on opposite sides of the valves **170a**-**170c** and/or the valve support **140**.

[0038] The intake regions **120a**, **120b** are in selective fluid communication with one another and may be selectively closed off and/or sealed from one another via the valves **170a**-**170c**. For example, the intake regions **120a**, **120b** are in fluid communication when one another when one or more of the valves **170a**-**170c** is disposed in an intermediate position. The intake regions **120a**, **120b** are fluidically sealed off from one another via the valves **170a**-**170c** when the valves **170a**-**170c** are each disposed in one of the first and second positions (e.g., the valves **170a**-**170c** are each in the first position; the first valve **170a** is in the first position and the second and third valves **170b**, **170c** are in the second position; etc.). The first intake region **120a** and the second intake region **120b** are in selective fluid communication with the unfiltered regions **120c**, **120d** via the valve openings **128a**-**128c** and may be selectively closed off and/or sealed from one or more of the unfiltered regions **120c**, **120d** via the valves **170a**-**170c**.

[0039] As generally illustrated in FIGS. 5A and 5B, the first unfiltered region **120c** is disposed in the valve support **140**. The first unfiltered region **120c** is at least partially defined by the valve support **140** (e.g., the base **142** and walls **146**, **146'**, **148**, **148'**) and the filter **190**. The first unfiltered region **120c** is in fluid communication with the funnel inner space **270a** via the filter **190**. The first unfiltered region **120c** is in selective fluid communication with the intake regions **120a**, **120b** via the first airflow opening **128a** and may be selectively closed off and/or sealed from one or more of the intake regions **120a**, **120b** via the first valve **170a**. The first unfiltered region **120c** and the first intake region **120a** are (i) in fluid communication when the first valve **170a** is the first position or in an intermediate position and (ii) not in fluid communication when the first valve **170a** is in the second position. The first unfiltered region **120c** and the second intake region **120b** are (i) in fluid communication when the first valve **170a** is the second position or in an intermediate position and (ii) not in fluid communication when the first valve **170a** is in the first position.

[0040] As generally illustrated in FIGS. 3A-5B, the second unfiltered region **120d** is defined at least partially by the valve housing **102** (e.g., the partition **104** and one or more of the sidewalls **108a**-**108d**), the valve support **140** (e.g., the walls **146**, **146'**, **148**, **148'** and the outer sealing projections **158a**, **158b**, **158a'**, **158b'**), and the filter **190**. The second unfiltered region **120d** is disposed outside the valve support **140** and extends at least partially around the valve support **140** (e.g., circumferentially). The second unfiltered region **120d** is in fluid communication with the filtered region **120e** via the filter **190**. The second unfiltered region **120d** is in selective fluid communication with the intake regions **120a**, **120b** via the second and third airflow openings **128b**, **128c**, and may be selectively closed off and/or sealed from one or more of the intake regions **120a**, **120b** via the second and third valves **170b**, **170c**. The second unfiltered region **120d** and the first intake region **120a** are (i) in fluid communication when the second and third valves **170b**, **170c** are in the first position or in one or more intermediate positions and (ii)



not in fluid communication when the second and third valves **170b**, **170c** are in the second position. The second unfiltered region **120d** and the second intake region **120b** are (i) in fluid communication when the second and third valves **170b**, **170c** are in the second position or in one or more intermediate positions and (ii) not in fluid communication when the second and third valves **170b**, **170c** are in the first position.

**[0041]** As generally illustrated in FIGS. 3A-5B, the filtered region **120e** is defined at least partially by the filter **190**, the valve housing **102** (e.g., the second end wall **106b** and one or more of the sidewalls **108a-108d**), and the air funnel **270**. The filtered region **120e** is disposed outside of and extends at least partially around the air funnel **270** (e.g., circumferentially). The filtered region **120e** is in fluid communication with the second unfiltered region **120d** via the filter **190**. The filtered region **120e** is in fluid communication with the blower assembly **200** (e.g., the second inner region **220b**) via the air outlet **126** and the inflow opening **212**.

**[0042]** As generally illustrated in FIGS. 1, 2, 5A, and 5B, the blower housing **202** includes two housing shells **204a**, **204b**, a separation panel **206** connected to the housing shells **204a**, **204b**, and a plurality of outlets (e.g., a first outlet **208a** and a second outlet **208b**). The housing shells **204a**, **204b** are attached and/or connected to one another and define an internal space **220** (i.e., BH internal space **220**) in which the blower **230** and the air funnel **270** are at least partially arranged. The separation panel **206** is arranged and/or sandwiched between the housing shells **204a**, **204b** and is disposed at least partially in the BH internal space **220**. The separation panel **206** includes and/or defines a panel aperture **210** that receives at least a portion of the blower **230** (e.g., the blower wheel **236**) and/or at least a portion of the air funnel **270**.

**[0043]** As generally illustrated in FIG. 1, the blower housing **202** may be considered to include and/or be divided into two sections (e.g., a first housing section **202a** and a second housing section **202b**) at or about the separation panel **206**. The first housing section **202a** is the lower portion and/or 'half' of the blower housing **202** defined by and/or including the first housing shell **204a**, the separation panel **206**, and the first outlet **208a**. The second housing section **202b** is the upper portion and/or 'half' of the blower housing **202** defined by and/or including the second housing shell **204b**, the separation panel **206**, and the second outlet **208b**.

**[0044]** As generally illustrated in FIGS. 1, 2, and 5B, the blower housing **202** includes a plurality of outlets **208a**, **208b** via which air (i.e., input air **22**, **32** received from the valve assembly **100** as the first airflow **40** and/or the second airflow **50**) is output, expelled, and/or flowable out of the blower assembly **200** and/or the HVAC module **10**. The first outlet **208a** outputs and/or expels the first airflow **40** as first output air **42**, which may ultimately be directed to one or more first destinations (e.g., one or more first/defrost zones of a vehicle internal space and/or cabin, one or more upper portions or regions of a vehicle internal space and/or cabin, and/or a windshield of a vehicle). The first outlet **208a** includes and/or is defined by a first outlet opening **208c**, which is defined and/or formed by the first housing shell **204a** and the separation panel **206**. The second outlet **208b** outputs and/or expels the second airflow **50** as second output air **52**, which may ultimately be directed to one or more second destinations (e.g., one or more second/lower/footwell zones of a vehicle internal space and/or cabin, lower

portions or regions of a vehicle internal space and/or cabin, and/or footwells of the vehicle). The second outlet **208b** includes and/or is defined by a second outlet opening **208d**, which is defined and/or formed by the second housing shell **204b** and the separation panel **206**.

**[0045]** As generally illustrated in FIGS. 2-5B, the second housing shell **204b** includes and/or defines the inflow opening **212** via which air (i.e., input air **22**, **32** received from the valve assembly **100** as the first airflow **40** and/or the second airflow **50**) is flowable into the blower assembly **200** from the valve assembly **100**. The second inner region **220b** and the filtered region **120e** are in direct fluid communication with one another via the inflow opening **212**. The air funnel **270** is disposed partially in the inflow opening **212** and projects from the blower housing **202** (e.g., the BH internal space **220**) via the inflow opening **212**. As such, the air outlet **126** and the inflow opening **212** enable fluid communication between the first unfiltered region **120c** and the first inner region **220a** via the air funnel **270**.

**[0046]** As generally illustrated in FIGS. 3A, 5A, and 5B, the second housing shell **204b** further includes an attachment formation **216** configured to engage the complimentary attachment formation **110** of the valve housing **102** and at least partially attach and/or seal the valve assembly **100** (e.g., the valve housing **102**) and the blower assembly **200** (e.g., the blower housing **202**). The attachment formation **216** includes a projection that engages and/or is received in the complimentary channel of the attachment formation **110** of the valve housing **102**. The projection of the attachment formation **216** extends around and/or encircles the inflow opening **212**.

**[0047]** As generally illustrated in FIGS. 5A and 5B, the first housing shell **204a** includes a shell aperture **214** that receives and (e.g., releasably) retains at least a portion of the blower **230** (e.g., the blower motor **232**, motor housing **234**). The shell aperture **214** facilitates insertion and/or arrangement of at least a portion the blower **230** (e.g., the blower wheel **236**) within the blower housing **202** and/or the BH internal space **220**. The shell aperture **214** is closed and/or sealed by one or more portions of the blower **230** (e.g., the motor housing **234**).

**[0048]** As generally illustrated in FIGS. 5A and 5B, the blower **230** is at least partially arranged in the blower housing **202** and/or the BH internal space **220**. The blower **230** is partially disposed in and projects through the shell aperture **214** into the BH internal space **220**. The blower **230** includes a blower motor **232**, a motor housing **234**, and a blower wheel **236**. The blower motor **232** is disposed and/or mounted in the motor housing **234**. The motor housing **234** is (e.g., releasably) connected to the blower housing **202** and closes and/or seals the shell aperture **214**. The blower motor **232** and/or the motor housing **234** are disposed at least partially in and/or extend through the shell aperture **214**. The blower motor **232** is connected to the blower wheel **236** (e.g., via a drive shaft). The blower motor **232** is configured to rotate and/or spin the blower wheel **236** about a blower axis **248**. The blower **230** and/or the blower motor **232** is connected to the controller **12**. The controller **12** is configured to control, operate, and/or actuate the blower motor **232** to rotate and/or spin the blower wheel **236**, which in turn generates flow through the HVAC module **10**, the valve assembly **100**, and/or the blower assembly **200** (e.g., draws air **22**, **32** through the inlets **122**, **124** into the valve assembly **100** and through the valve assembly **100** into the blower

assembly 200, and/or drives and/or pushes air through the blower assembly 200 and out the outlets 208a, 208b).

[0049] As generally illustrated in FIGS. 5A and 5B, the blower wheel 236 includes a hub 238, an annular perimeter wall 240, an annular intermediate wall 242, a plurality of first blades 244, and a plurality of second blades 246. The hub 238 is disposed at or about a first axial end of the blower wheel 236 and is connected to the blower motor 232 (e.g., via a drive shaft). The hub 238 generally extends and/or lies transversely to the blower axis 248. The perimeter wall 240 extends around an outer circumference and/or perimeter of the blower wheel 236 at a second axial end of the blower wheel 236 opposite the hub 238. The intermediate wall 242 generally extends and/or lies transversely to the blower axis 248 and is disposed axially between the perimeter wall 240 and at least a portion of the hub 238 (e.g., the portion connected to the first blades 244). The first blades 244 extend axially between and connect the hub 238 and the intermediate wall 242, and are disposed circumferentially spaced apart from one another around a radially outer perimeter of the blower wheel 236. The second blades 246 extend axially between and connect the perimeter wall 240 and the intermediate wall 242, and are disposed circumferentially spaced apart from one another around the radially outer perimeter of the blower wheel 236.

[0050] As generally illustrated in FIGS. 5A and 5B, the intermediate wall 242 is curved and directs and/or guides the second airflow 50 in the second inner region 220b radially outward, where the second airflow 50 passes between the second blades 246 and into the second flow region 220d. The intermediate wall 242 includes and/or defines a through opening 242a that is disposed at least partially axially aligned with the blower axis 248, a portion of the hub 238 (i.e., the bell-shaped dome), and the air funnel 270. An end of the air funnel 270 (e.g., a second end) is disposed near, directly adjacent to, and/or in close proximity to an edge of the intermediate wall 242 defining the through opening 242a such that the first airflow 40 flows from the funnel inner space 270a into the first inner region 220a via the through opening 242a. A central region and/or portion of the hub 238 is structured as a bell-shaped dome that, optionally, projects at least partially into the funnel inner space 270a. The bell-shaped dome directs and/or guides the first airflow 40 in the first inner region 220a radially outward, where the first airflow 40 passes between the first blades 244 and into the first flow region 220c.

[0051] The blower wheel 236 may be considered to include and/or be divided into two sections (e.g., a first wheel section and a second wheel section) at or about the intermediate wall 242. The first wheel section is the lower portion and/or ‘half’ of the blower wheel 236 defined by and/or including the hub 238, the intermediate wall 242, and the first blades 244. The second wheel section is the upper portion and/or ‘half’ of the blower wheel 236 defined by and/or including the perimeter wall 240, the intermediate wall 242, and the second blades 246.

[0052] As generally illustrated in FIGS. 2-5B, the blower assembly 200 includes an air funnel 270 via which the first airflow 40 enters and/or flows into the blower housing 202. The air funnel 270 defines an inner space 270a (also referred to as the ‘funnel inner space’). The air funnel 270 is disposed partially in the valve housing 102 (e.g., the VH internal space 120), the air outlet 126, the blower housing 202 (e.g., the BH internal space 220), and the inflow opening 212. The

air funnel 270 projects from the blower housing 202 via the inflow opening 212 and extends into the valve housing 102 via the air outlet 126. A first axial end of air funnel 270 is connected to the second housing shell 204b and is disposed within the valve housing 102 (e.g., the VH internal space 120) near, directly adjacent to, and/or in contact with the filter 190. A second axial end of the air funnel 270 is disposed in the blower housing 202 (e.g., the BH internal space 220) and the blower wheel 236, near, directly adjacent to, and/or in the through opening 242a and/or the intermediate wall 242 of the blower wheel 236.

[0053] As generally illustrated in FIGS. 5A and 5B, the BH internal space 220 includes a first inner region 220a, a second inner region 220b, a first flow region 220c, and a second flow region 220d.

[0054] The first inner region 220a is at least partially disposed in and/or defined by the first wheel section of the blower wheel 236. More specifically, the first inner region 220a is at least partially defined by the hub 238, the intermediate wall 242, the first blades 244, and the second end of the air funnel 270. The first airflow 40 enters and/or flows into the first inner region 220a via the air funnel 270. The first airflow 40 exits and/or flows out of the first inner region 220a and into the first flow region 220c by passing between the first blades 244 (e.g., via flowing through the gaps and/or openings defined between the first blades 244).

[0055] The second inner region 220b is at least partially disposed in and/or defined by the second wheel section of the blower wheel 236. More specifically, the second inner region 220b is at least partially defined by the first housing shell 204a, the inflow opening 212, the perimeter wall 240, the intermediate wall 242, the second blades 246, and/or the air funnel 270. The second airflow 50 enters and/or flows into the second inner region 220b from the filtered region 120e by way of the air outlet 126 and the inflow opening 212. The second airflow 50 exits and/or flows out of the second inner region 220b and into the second flow region 220d by passing between the second blades 246 (e.g., via flowing through the gaps and/or openings defined between the second blades 246). The first inner region 220a and the second inner region 220b are substantially separated from one another by the intermediate wall 242 of the blower wheel 236 and/or the air funnel 270.

[0056] The first flow region 220c is at least partially disposed in and/or defined by the first housing section 202a of the blower housing 202. More specifically, the first flow region 220c is at least partially defined by the first housing shell 204a, the separation panel 206, and the blower wheel 236 (e.g., the first wheel section). The first inner region 220a, the funnel inner space 270a, and the VH internal space 120 (e.g., the first unfiltered region 120c) are in fluid communication with the first outlet 208a via the first flow region 220c.

[0057] The second flow region 220d is at least partially disposed in and/or defined by the second housing section 202b of the blower housing 202. More specifically, the second flow region 220d is at least partially defined by the second housing shell 204b, the separation panel 206, and the blower wheel 236 (e.g., the second wheel section). The second inner region 220b and the VH internal space 120 (e.g., the second unfiltered region 120d and the filtered region 120e) are in fluid communication with the second outlet 208b via the second flow region 220d. The first flow region 220c and the second flow region 220d are disposed on

opposite sides of the separation panel **206** and substantially separated from one another by the separation panel **206**.

**[0058]** As generally illustrated in FIG. 1, the controller **12** includes an electronic controller and/or includes an electronic processor, such as a programmable microprocessor and/or microcontroller. The controller **12** may also include an application specific integrated circuit (ASIC), a central processing unit (CPU), a memory (e.g., a non-transitory computer-readable storage medium), and/or an input/output (I/O) interface. The controller **12** is configured to perform various functions, including those described in greater detail herein, with appropriate programming instructions and/or code embodied in software, hardware, and/or other medium. The controller **12** is, optionally, connected to a display, such as a touchscreen display.

**[0059]** Various examples/embodiments are described herein for various apparatuses, systems, and/or methods. Numerous specific details are set forth to provide a thorough understanding of the overall structure, function, manufacture, and use of the examples/embodiments as described in the specification and illustrated in the accompanying drawings. It will be understood by those skilled in the art, however, that the examples/embodiments may be practiced without such specific details. In other instances, well-known operations, components, and elements have not been described in detail so as not to obscure the examples/embodiments described in the specification. Those of ordinary skill in the art will understand that the examples/embodiments described and illustrated herein are non-limiting examples, and thus it can be appreciated that the specific structural and functional details disclosed herein may be representative and do not necessarily limit the scope of the embodiments.

**[0060]** Reference throughout the specification to “examples,” “in examples,” “with examples,” “various embodiments,” “with embodiments,” “in embodiments,” or “an embodiment,” or the like, means that a particular feature, structure, or characteristic described in connection with the example/embodiment is included in at least one embodiment. Thus, appearances of the phrases “examples,” “in examples,” “with examples,” “in various embodiments,” “with embodiments,” “in embodiments,” or “an embodiment,” or the like, in places throughout the specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more examples/embodiments. Thus, the particular features, structures, or characteristics illustrated or described in connection with one embodiment/example may be combined, in whole or in part, with the features, structures, functions, and/or characteristics of one or more other embodiments/examples without limitation given that such combination is not illogical or non-functional. Moreover, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from the scope thereof.

**[0061]** It should be understood that references to a single element are not necessarily so limited and may include one or more of such element. Any directional references (e.g., plus, minus, upper, lower, upward, downward, left, right, leftward, rightward, top, bottom, above, below, vertical, horizontal, clockwise, and counterclockwise) are only used for identification purposes to aid the reader's understanding

of the present disclosure, and do not create limitations, particularly as to the position, orientation, or use of examples/embodiments.

**[0062]** “One or more” includes a function being performed by one element, a function being performed by more than one element, e.g., in a distributed fashion, several functions being performed by one element, several functions being performed by several elements, or any combination of the above.

**[0063]** It will also be understood that, although the terms first, second, etc. are, in some instances, used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element, without departing from the scope of the various described embodiments. The first element and the second element are both element, but they are not the same element.

**[0064]** The terminology used in the description of the various described embodiments herein is for the purpose of describing particular embodiments only and is not intended to be limiting. As used in the description of the various described embodiments and the appended claims, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term “and/or” as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms “includes,” “including,” “comprises,” “comprising,” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

**[0065]** Joinder references (e.g., attached, coupled, connected, and the like) are to be construed broadly and may include intermediate members between a connection of elements, relative movement between elements, direct connections, indirect connections, fixed connections, movable connections, operative connections, indirect contact, and/or direct contact. As such, joinder references do not necessarily imply that two elements are directly connected/coupled and in fixed relation to each other. Connections of electrical components, if any, may include mechanical connections, electrical connections, wired connections, and/or wireless connections, among others. Uses of “e.g.” and “such as” in the specification are to be construed broadly and are used to provide non-limiting examples of embodiments of the disclosure, and the disclosure is not limited to such examples.

**[0066]** While processes, systems, and methods may be described herein in connection with one or more steps in a particular sequence, it should be understood that such methods may be practiced with the steps in a different order, with certain steps performed simultaneously, with additional steps, and/or with certain described steps omitted.

**[0067]** As used herein, the term “if” is, optionally, construed to mean “when” or “upon” or “in response to determining” or “in response to detecting,” depending on the context. Similarly, the phrase “if it is determined” or “if [a stated condition or event] is detected” is, optionally, construed to mean “upon determining” or “in response to determining” or “upon detecting [the stated condition or

event]” or “in response to detecting [the stated condition or event],” depending on the context.

**[0068]** All matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative only and not limiting. Changes in detail or structure may be made without departing from the present disclosure.

**[0069]** It should be understood that a controller, a system, and/or a processor as described herein may include a conventional processing apparatus known in the art, which may be capable of executing preprogrammed instructions stored in an associated memory, all performing in accordance with the functionality described herein. To the extent that the methods described herein are embodied in software, the resulting software can be stored in an associated memory and can also constitute means for performing such methods. Such a system or processor may further be of the type having ROM, RAM, ROM and RAM, and/or a combination of non-volatile and volatile memory so that any software may be stored and yet allow storage and processing of dynamically produced data and/or signals.

**[0070]** It should be further understood that an article of manufacture in accordance with this disclosure may include a non-transitory computer-readable storage medium having a computer program encoded thereon for implementing logic and other functionality described herein. The computer program may include code to perform one or more of the methods disclosed herein. Such embodiments may be configured to execute via one or more processors, such as multiple processors that are integrated into a single system or are distributed over and connected together through a communications network, and the communications network may be wired and/or wireless. Code for implementing one or more of the features described in connection with one or more embodiments may, when executed by a processor, cause a plurality of transistors to change from a first state to a second state. A specific pattern of change (e.g., which transistors change state and which transistors do not), may be dictated, at least partially, by the logic and/or code.

What is claimed is:

1. A valve assembly for a heating, ventilation, and air conditioning (HVAC) module, comprising:

- a valve housing defining an internal space, the valve housing including:
  - a first inlet via which a first input air is flowable into a first intake region of the internal space;
  - a second inlet via which a second input air is flowable into a second intake region of the internal space; and
  - a plurality of airflow openings including a first airflow opening and a second airflow opening; and
- a plurality of adjustable valves disposed in the valve housing between the first intake region and the second intake region;

wherein the plurality of adjustable valves includes:

- a first valve adjustable about a first axis to selectively open and close the first airflow opening with respect to the first intake region and the second intake region; and
- a second valve adjustable about a second axis to selectively open and close the second airflow opening with respect to the first intake region and the second intake region.

2. The valve assembly of claim 1, wherein the first axis and the second axis extend parallel to one another and are disposed offset from one another.

3. The valve assembly of claim 1, wherein the first axis and the second axis are offset from one another vertically.

4. The valve assembly of claim 3, wherein the first axis and the second axis are offset from one another horizontally.

5. The valve assembly of claim 1, wherein the first axis and the second axis are offset from one another horizontally.

6. The valve assembly of claim 1, wherein:

the first valve is adjustable about the first axis to:

- a first position in which the first valve closes the first airflow opening with respect to the second intake region and does not close the first airflow opening with respect to the first intake region such that the first input air is permitted to flow through the first airflow opening and the second input air is restricted from flowing through the first airflow opening; and

- a second position in which the first valve closes the first airflow opening with respect to the first intake region and does not close the first airflow opening with respect to the second intake region such that the second input air is permitted to flow through the first airflow opening and the first input air is restricted from flowing through the first airflow opening; and

the second valve is adjustable about the second axis to:

- a first position in which the second valve closes the second airflow opening with respect to the second intake region and does not close the second airflow opening with respect to the first intake region such that the first input air is permitted to flow through the second airflow opening and the second input air is restricted from flowing through the second airflow opening;

- a second position in which the second valve closes the second airflow opening with respect to the first intake region and does not close the second airflow opening with respect to the second intake region such that the second input air is permitted to flow through the second airflow opening and the first input air is restricted from flowing through the second airflow opening.

7. The valve assembly of claim 1, further comprising:

a first actuator configured to adjust the first valve about the first axis;

a first shaft connecting the first valve to the first actuator;

a second actuator configured to adjust the second valve about the second axis; and

a second shaft connecting the second valve to the second actuator;

wherein the first shaft defines the first axis and the second shaft defines the second axis.

8. The valve assembly of claim 7, wherein the first actuator and the second actuator are disposed outside of the valve housing.

9. The valve assembly of claim 8, wherein:

the first actuator is disposed on a first side of the valve housing; and

the second actuator is disposed on an opposite, second side of the valve housing.

10. The valve assembly of claim 7, wherein the valve housing includes a valve support arranged in the internal space between the first intake region and the second intake region, wherein:

the first shaft extends through a first shaft recess of the valve housing and a first shaft recess of the valve support and is supported by the valve housing and the valve support; and

the second shaft extends through a second shaft recess of the valve housing and a second shaft recess of the valve support and is supported by the valve housing and the valve support.

**11.** The valve assembly of claim **10**, wherein the first airflow opening is disposed in and defined by the valve support.

**12.** The valve assembly of claim **7**, wherein the first shaft extends only part way through the valve housing.

**13.** The valve assembly of claim **1**, wherein:

the plurality of airflow openings further includes a third airflow opening; and

the plurality of valves further includes a third valve adjustable about the second axis to selectively open and close the third airflow opening with respect to the first intake region and the second intake region.

**14.** The valve assembly of claim **13**, wherein the first valve is disposed between the second valve and the third valve.

**15.** The valve assembly of claim **13**, further comprising: a first actuator configured to adjust the first valve about the first axis;

a first shaft connecting the first valve to the first actuator; a second actuator configured to adjust the second valve and the third valve about the second axis; and

a second shaft connecting the second valve and the third valve to the second actuator;

wherein the first shaft defines the first axis and the second shaft defines the second axis.

**16.** A heating, ventilation, and air conditioning (HVAC) module, comprising the valve assembly of claim **1**.

**17.** The HVAC module of claim **16**, further comprising a blower assembly connected to the valve assembly and in fluid communication with the internal space of the valve housing.

**18.** The HVAC module of claim **17**, wherein the blower assembly includes a blower housing, the blower housing including (i) a first airflow section for conducting a first airflow and (ii) a second airflow section for conducting a separate, second airflow.

**19.** The HVAC module of claim **18**, wherein:

the blower housing defines an internal space including (i) a first airflow region disposed in the first airflow section of the blower housing and (ii) a second airflow region disposed in the second airflow section of the blower housing; and

the first intake region and the second intake region of the valve housing are in selective fluid communication with:

the first airflow region of the blower housing via the first airflow opening of the valve housing such that the first input air and the second input air are flowable into and through the first airflow section of the blower housing as the first airflow; and

the second airflow region of the blower housing via the second airflow opening of the valve housing such that the first input air and the second input air are flowable into and through the second airflow section of the blower housing as the second airflow.

**20.** The HVAC module of claim **19**, wherein:

the blower housing includes a funnel arranged in the internal space of the blower housing; and

the first airflow opening of the valve housing and the first airflow section of the blower housing are in fluid communication via the funnel.

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