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- (71) **Applicant:** ELWHA LLC [US/US]; 3150 139th Ave SE, Bellevue, Washington 98005-4046 (US).
- (72) **Inventors:** CHAN, Alistair K.; 9769 NE Murden Cove Dr., Bainbridge Island, Washington 98110 (US). HYDE, Roderick A.; 9915 161st Ave NE, Redmond, Washington 98052 (US). SWEENEY, Elizabeth A.; 702 N. 143rd Street, Seattle, Washington 98133 (US). WOOD, Lowell L., Jr.; 989 112th Ave NE #2310, Bellevue, Washington 98004 (US).
- (74) **Agents:** CHAN, Alistair K. et al.; 3150 139th Ave SE, Bellevue, Washington 98005-4046 (US).

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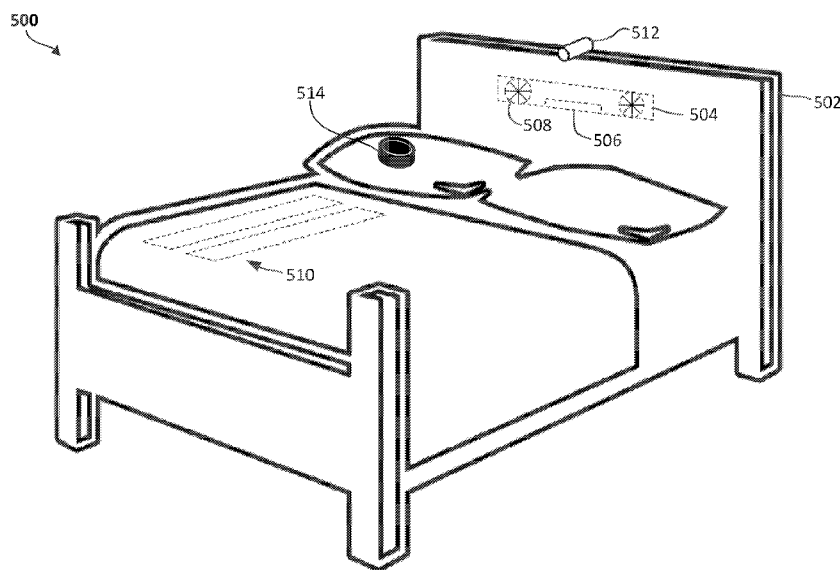


FIG. 5

(57) **Abstract:** An air treatment system includes an air control device and a processing circuit. The air control device is configured to compositionally control air to be delivered to a region proximate to an occupant of a bed, and deliver the compositionally controlled air to the region proximate to the occupant of the bed. The processing circuit is configured to control operation of the air control device, wherein the air control device is configured to be coupled to the bed.

SLEEP ZONE AIR TREATMENT SYSTEMS AND METHODS

BACKGROUND

[0001] Dust, pollen, pet dander, mold spores, smoke particles, and volatile organic compounds, among others, can be found as airborne contaminants. In general, such
5 airborne contaminants reduce the quality of air inhaled and can also pose a health risk. In some cases, such contaminants also act as allergens that trigger certain allergies. Air purifiers can be used to reduce the concentration of these airborne contaminants and thereby reduce the amount of contaminants that are inhaled.

SUMMARY

10 **[0002]** One embodiment relates to an air treatment system comprising an air control device and a processing circuit. The air control device is configured to compositionally control air to be delivered to a region proximate to an occupant of a bed, and deliver the compositionally controlled air to the region proximate to the occupant of the bed. The processing circuit is configured to control operation of the air control device, wherein the
15 air control device is configured to be coupled to the bed.

[0003] Another embodiment relates to a method of air treatment. The method comprises compositionally controlling, with an air control device configured to be coupled to a bed, air to be delivered to a region proximate to an occupant of the bed. The method further comprises delivering the compositionally controlled air to the region proximate to the
20 occupant of the bed, and controlling, with a processing circuit, operation of the air control device.

[0004] Another embodiment relates to an air treatment system comprising one or more sensors, an air control device, and a processing circuit. The one or more sensors are configured to generate sensor data based on a position of an occupant of a bed. The air
25 control device is configured to control a property of air to be delivered to the occupant, and deliver the controlled air to the position of the occupant of a bed. The processing circuit is configured to determine, based on the sensor data, the position of the occupant of the bed, and control, based on the determined position, operation of the air control device, wherein the air control device is configured to be coupled to the bed.

[0005] Another embodiment relates to a method of air treatment. The method comprises generating sensor data, with one or more sensors, based on a position of an occupant of a bed. The method further comprises controlling, with an air control device configured to be coupled to a bed, a property of air to be delivered to the occupant. The method further
5 comprises determining, based on the sensor data, the position of the occupant of the bed. The method further comprises controlling, with a processing circuit, operation of the air control device based on the determined position, and delivering the controlled air to the determined position of the occupant of a bed.

[0006] Another embodiment relates to an air treatment system comprising one or more
10 sensor devices, an air control device, and a processing circuit. The one or more sensor devices are configured to generate sensor data based on a condition of an occupant of a bed. The air control device configured to control a property of air to be delivered to a region proximate to an occupant of a bed, and deliver the controlled air to the region proximate to the occupant of the bed. The processing circuit is configured to determine
15 the condition based on the sensor data, and control, based on the determined condition, operation of the air control device, wherein the air control device is configured to be coupled to the bed.

[0007] Another embodiment relates to a method of air treatment. The method comprises generating, with one or more sensor devices, sensor data based on a condition of an
20 occupant of a bed. The method further comprises determining, with a processing circuit, the condition based on the sensor data. The method further comprises controlling, using an air control device configured to be coupled to the bed, a property of air to be delivered to a region proximate to an occupant of a bed. The method further comprises controlling, with the processing circuit, operation of the air control device based on the determined
25 condition, and delivering the controlled air to the region proximate to the occupant of the bed.

[0008] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to
30 the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE FIGURES

[0009] FIG. 1 is a block diagram of an air treatment system, according to one embodiment.

5 [0010] FIG. 2 is a block diagram of an air treatment system, according to one embodiment.

[0011] FIG. 3 is a block diagram of an air treatment system, according to one embodiment.

[0012] FIG. 4 is a block diagram of a processing circuit of an air treatment system, according to one embodiment.

10 [0013] FIG. 5 is a schematic diagram of an air treatment system, according to one embodiment.

[0014] FIG. 6 is a flow diagram of a process for air treatment using an air treatment system, according to one embodiment.

15 [0015] FIG. 7 is a flow diagram of a process for air treatment using an air treatment system, according to one embodiment.

[0016] FIG. 8 is a flow diagram of a process for air treatment using an air treatment system, according to one embodiment.

DETAILED DESCRIPTION

20 [0017] In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the scope of the subject matter presented here.

25 [0018] Referring generally to the figures, various embodiments of systems, methods, and computer readable media for sleep zone air treatment are shown and described. Various airborne contaminants (e.g., dust, pollen, pet dander, mold spores, smoke particles, volatile

organic compounds, etc.) reduce the quality of air inhaled. Based on a recommended average amount of sleep-per-day required for adults (e.g., 7-9 hours), adults spend approximately a third of their time relatively stationary (e.g., in a bed) while sleeping. By utilizing the air control devices and processing circuits as described herein, air inhaled by an individual may be “polished” (i.e. treated) to regulate and alter the air’s composition such that higher quality air is delivered as the individual sleeps. In this manner, the individual can inhale an increased percentage of higher quality air. Because a bed (or couch, chair, other sleeping/sitting zone, etc.) is typically a relatively small and stationary target environment, polished air may be directed to the area of air-intake of the individual. In addition to being compositionally controlled, such polished air may also be temperature-controlled, humidity-controlled, and otherwise filtered. Although discussed herein as having embodiments related to beds, in other embodiments, the disclosed air treatment systems and methods may be configured according to other types of furniture/sleep zones (e.g., chairs, couches, etc.).

[0019] In some embodiments, an air control device may be mounted to a bed in order to deliver compositionally controlled air to an occupant of the bed. A processing circuit can control the operation the air control device. For example, the processing circuit can generate the signals required to activate/deactivate the air control device, control fan speeds or directions of air flows generated by the device, adjust air temperature and other settings, etc. In some embodiments, sensors may be utilized to detect the position and/or orientation of the occupant, and treated air may be directed at the occupant based on the detected position and/or orientation of the occupant. In some embodiments, sensors may be used to detect conditions related to the occupant, and air may be treated and delivered based on the conditions. For example, a physiological state (e.g., temperature, sweat, respiration, heartbeat, oxygen saturation (SpO2), carbon dioxide exhalation amounts, etc.) of the occupant may be monitored, and the processing circuit may control delivery of air based on the occupant’s physiological state. The various air control devices and configurations of such air treatment systems will be described in further detail below.

[0020] Referring to FIG. 1, a block diagram of an air treatment system 100 is shown, according to one embodiment. Air treatment system 100 includes air control device 102 and processing circuit 104. Air treatment system 100 may be configured to be coupled to a bed. In one embodiment, air treatment system 100 is mounted to a headboard,

sideboard, baseboard, or bedframe of the bed. For example, air treatment system 100 may include various mounting features, such as clamps, hooks, bolts, etc., used to couple air treatment system 100 to the bed. In another embodiment, air treatment system 100 is integrated into the bed (e.g., within the headboard or throughout the bedframe). For example, a bed can be manufactured to include the air treatment system as described herein. Air control device 102 generally includes the components necessary to control a composition of air and deliver compositionally controlled air. For example, air control device 102 may include oxygen concentration devices, reservoirs for storage of gases fully or partially enriched with oxygen, carbon dioxide filtration devices, PSA (pressure swing adsorption) devices for nitrogen removal, etc. In one embodiment, air control device 102 includes one or more adsorptive materials (e.g., zeolites, activated carbon, molecular sieves, etc.) used to separate one or more target gas species. Air control device 102 may also filter air, adjust the temperature of air, add (e.g., for aromatherapy) or remove odorants and adjust the humidity of air. For example, air control device 102 may include one or more fans, filters, heating/cooling devices, humidifiers/dehumidifiers, piping, ducts, valves, compressors, an array of nozzles, etc. In some embodiments, air control device 102 may be configured to control the composition of air by adding additives to the air. For example, in one embodiment, air control device 102 may be configured to add inhalable stimulants, relaxants, or medicaments to the compositionally controlled air. Inhalable medicaments can include COPD treatments (e.g., Perforomist from Dey, AZD5423 from AstraZeneca, etc.), cough suppressants, a corticosteroid, bronchodilator, beta-blocker, anti-histamine, or other agents. Medicaments may be prescription drugs, over-the-counter drugs, nutraceuticals, or other agents. Inhalable medicaments may be delivered within the air as gas, as aerosols, or as powders. For example, inhalable stimulants may include caffeine, ammonia, Sports-Boost (available from Inhalex), Insufflalex HLE, or the like. Inhalable relaxants may be used as sedatives to help induce sleep, as muscle relaxants (e.g., for COPD, asthma, sleep apnea, environmental sensitivities, allergies, or other conditions), or the like. Inhalable sedatives, for example, may include any of those disclosed in German Patent Application No. DE 10130449, entitled "Inhalable sedative and hypnotic medicaments, e.g. containing benzodiazepine active agent, having high bioavailability and rapid action," which is hereby incorporated by reference in its entirety. Inhalable muscle relaxants, for example, may include any of

those disclosed by U.S. Patent No. 7,507,397, entitled “Delivery of Muscle Relaxants Through an Inhalation Route,” which is hereby incorporated by reference in its entirety.

[0021] Processing circuit 104 controls the operation of air control device 102.

Processing circuit 104 generates the signals necessary to cause air control device 102 to
5 alter the composition of air delivered by air control device 102. For example, processing circuit may receive data related to a composition of source air (e.g., percentages of gases comprising the source air), and may determine adjustment amounts to be applied to the source air. Such data can be provided by sensors configured to detect components of air. As another example, processing circuit can monitor the temperature or humidity of source
10 air, and may determine adjustments to be applied to the source air. In general, processing circuit 104 generates the signals required to interface with the various components of air control device 102 in order to control its operation.

[0022] Referring to FIG. 2, a block diagram of an air treatment system 200 is shown, according to one embodiment. Air treatment system 200 includes air control device 202
15 (which may be configured as air control device 102), processing circuit 204, and one or more position detection sensors 206. Air treatment system 200 may be configured to be coupled to a bed. In one embodiment, air treatment system 200 is mounted to a headboard, sideboard, footboard, or bedframe of the bed. In another embodiment, air treatment system 200 is integrated into the bed (e.g., within the headboard, sideboard,
20 footboard, or frame). Air control device 202 generally includes the components necessary to control a property (e.g., composition, temperature, humidity, odor, filtration, etc.) of air and deliver the controlled air. Processing circuit 204 controls the operation of air control device 202 and causes the controlled air to be directed based on a detected position and/or orientation of an occupant of the bed. Processing circuit 204 can receive data from
25 position detection sensors 206 (e.g., one or more cameras, wide-field-of-view cameras, RFID sensors, infrared devices, optical links, micro-impulse radars, ultrasonic sensors, mattress pressure/deflection sensors, temperature sensors, etc.), which are generally configured to provide data related to the position of an occupant of the bed. Accordingly, the occupant may be detected through analyzing the data provided by position detection
30 sensors 206, which are able to sense the position of the occupant within the bed. Processing circuit 204 may determine a precise location and orientation of the occupant based on the data. In some embodiments, the orientation of an occupant may be estimated

or inferred based on knowledge of human anatomy. For example, in an embodiment utilizing pressure/deflection sensors, different parts of the body produce different characteristics with respect to the pressure induced on the mattress of the bed, and by comparing various pressure points, the orientation of an occupant (e.g., the position of an occupant's legs, arms, back, etc.) can be determined. Processing circuit 204 may also compare the sensor data to skeletal models and estimate an orientation of an occupant. Based on the determined position and/or orientation of an occupant, processing circuit 204 can adjust the positioning or output direction of air flow from air control device 202 (e.g., by adjusting fan positioning, nozzle positioning, fan speed, etc.) so that the air is directed at the occupant's general position (or more specifically toward the position of the occupant's head).

[0023] Referring to FIG. 3, a block diagram of an air treatment system 300 is shown, according to one embodiment. Air treatment system 300 includes air control device 302 (which may be configured as air control device 102), processing circuit 304, and one or more sensor devices 306. Air treatment system 300 may be configured to be coupled to a bed. In one embodiment, air treatment system 300 is mounted to a headboard, sideboard, footboard, or bedframe of the bed. In another embodiment, air treatment system 300 is integrated into the bed (e.g., within the headboard, sideboard, footboard, or bedframe). Air control device 302 generally includes the components necessary to control a property (e.g., composition, temperature, humidity, odor, filtration, etc.) of air and deliver the controlled air. Processing circuit 304 controls the operation of air control device 302 and causes the controlled air to be directed based on sensed conditions of the occupant of the bed. Processing circuit 304 can receive data from sensor devices 306 (e.g., one or more cameras, wide-field-of-view cameras, infrared devices, thermometers, gas detectors, functional near-infrared spectroscopy (fNIR) devices, electroencephalography (EEG) devices, Fluorescence spectroscopy devices, pulse oximeters, a pupillometer, an electromagnetic sensor, an electrical potential sensor, micro-impulse radars, light sensors, laser devices, and microphones, etc.), which are generally configured to provide data related to a condition of the occupant. Physiological sensors may include jewelry-embedded sensors, furniture-embedded sensors, as well as area-effect systems that use electromagnetic signals. Sensors used, for example, may include any of those disclosed in U.S. Patent Application Publication No. 2006/0058694 entitled "Electrodynamic sensors

and applications thereof,” U.S. Patent No. 7,245,956 entitled “Unobtrusive measurement system for bioelectric signals,” U.S. Patent No. 7,272,431 entitled “Remote-sensing method and device,” and U.S. Patent Application Publication No. 2008/0045832 entitled “Remote-sensing method and device,” and C. J. Harland et al., 2003 Meas. Sci. Technol. 14 923-928, entitled “High resolution ambulatory electrocardiographic monitoring using wrist-mounted electric potential sensors,” which are hereby incorporated by reference in their entirety. Sensors 206 may be attached to the bed, worn by the occupant, or mounted elsewhere in the room. For example, sensor devices 306 may provide data related to a physiological condition of the occupant. In another example, sensor devices 306 may provide data related the SpO2 levels of the occupant. As another example, sensor devices 306 may provide data related to a sleep-state of the occupant. In another example, sensor devices 306 may monitor the breathing patterns or interruptions of the occupant. Accordingly, processing circuit 304 may analyze the data provided by sensor devices 306 and manage the delivery of controlled air by air control device 302 based on a determined occupant condition. In some embodiments, based on the data provided by sensors devices 306, air control device 302 may deliver more or less air, oxygen, or other medicaments, relaxants, or stimulants to the occupant. For example, air control device 302 may deliver more oxygen to the occupant if SpO2 levels drop below 85%.

[0024] Referring to FIG. 4, a detailed block diagram of processing circuit 400 for completing the systems and methods of the present disclosure is shown according to one embodiment. Processing circuit 400 may be processing circuit 104 of FIG. 1, processing circuit 204 of FIG. 2, or processing circuit 304 of FIG. 3. Processing circuit 400 is generally configured to control the operation of an air control device (e.g., device 102, device 202, or device 302), and processing circuit 400 may be the processing components of the air control device. For example, processing circuit 400 can generate the signals required to activate or deactivate the air control device and manage delivery of air. As another example, processing circuit 400 may generate the signals to communicate with components of the air control device in order to manage a composition of air to be delivered. Processing circuit 400 is further configured to receive sensor data and configuration and preference data. Input data may be accepted continuously or periodically. Processing circuit 400 may analyze the input data to determine the position and orientation of an occupant of a bed such that air may be directed toward the occupant.

Processing circuit 400 may also analyze the input data to determine a condition of an occupant of a bed such that air may be delivered in response to stimuli related to the condition of the occupant. In controlling the operation of an air control device, in detecting the positioning of an occupant, and in determining a condition of an occupant, 5 processing circuit 400 may make use of machine learning, artificial intelligence, interactions with local and/or remote databases and database table lookups, pattern recognition and logging, intelligent control, neural networks, fuzzy logic, etc.

[0025] According to one embodiment, processing circuit 400 includes processor 406. Processor 406 may be implemented as a general-purpose processor, an application specific 10 integrated circuit (ASIC), one or more field programmable gate arrays (FPGAs), a digital-signal-processor (DSP), a group of processing components, or other suitable electronic processing components. Processor 406 may be implemented as any commercially available processor. Processing circuit 400 also includes memory 408. Memory 408 is one or more devices (e.g., RAM, ROM, flash memory, hard disk storage, etc.) for storing 15 data and/or computer code for facilitating the various processes described herein. Memory 408 may be or include non-transient volatile memory or non-volatile memory. Memory 408 may include database components, object code components, script components, or any other type of information structure for supporting the various activities and information structures described herein. Memory 408 may be communicably connected to 20 processor 406 and include computer code or instructions for executing the processes described herein.

[0026] Memory 408 includes memory buffer 410. Memory buffer 410 is configured to receive a data stream (e.g. from sensors 206 or 306, from a user input device, etc.) through input 402. For example, the data may include a real-time stream of sensor data, etc. The 25 data received through input 402 may be stored in memory buffer 410 until memory buffer 410 is accessed for data by the various modules of memory 408. For example, air control module 414 can access the data that is stored in memory buffer 410.

[0027] Memory 408 further includes configuration data 412. Configuration data 412 includes data related to processing circuit 400. For example, configuration data 412 may 30 include information related to interfacing with other components (e.g., sensors of systems 200 or 300, a user input device, etc.) and can include data required to configure

communication between the various components of processing circuit 400. This may include the command set needed to interface with a computer system used transfer user settings or otherwise set up the system. This may further include the command set needed to generate graphical user interface (GUI) controls, menus, warning information,
5 feedback, and visual information. As another example, configuration data 412 may include the command set needed to interface with communication components (e.g., a universal serial bus (USB) interface, a Wi-Fi interface, an Ethernet interface, etc.). Processing circuit 400 may format data for output via output 404 to allow a user to configure the systems as described herein. Processing circuit may also format visual
10 information to be output for display on a display device. Processing circuit may also generate commands necessary to drive fans, compressors, motors, actuators, and other components of an air control device. Configuration data 412 may also include information as to how often input should be accepted from a sensor. Configuration data 412 may include default values required to initiate the air control device and initiate communication
15 with sensors or other peripheral systems.

[0028] Processing circuit 400 further includes input 402 and output 404. Input 402 is configured to receive a data stream (e.g., a stream of data from sensors), configuration information, and preference information. Output 404 is configured to provide an output to an external system (e.g., a remote computer), an air control device, or other components of
20 the systems as described herein.

[0029] Memory 408 further includes module 414 for executing the systems and methods described herein. Module 414 may access received sensor data, configuration information, user preference data, and other data as provided by processing circuit 400. Module 414 is generally configured to analyze the sensor data, detect a position and
25 orientation of one or more occupants of a bed (or other furniture such as a couch, chair, etc.), determine a condition of one or more occupants, and control the operation of an air control device such that controlled air is delivered to the occupants. Module 414 may be further configured to operate according to a user's preferences. In this manner, air delivery characteristics may be adjusted according to a user's desires or a manufacturer's
30 settings.

[0030] In one embodiment, processing circuit 400 is configured to control a bed mounted air control device in order to deliver air to an occupant of the bed. The air can be compositionally controlled in order to create a mixture containing certain percentages of gases. For example, the oxygen and carbon dioxide fractions of the air may be adjusted.

5 These percentages may be based on user settings or configuration settings. The delivered air may be directed toward the head region of the occupant. For example, fans or output ports of air control device may be aimed at the head region of the occupant. In this manner, a direct, but unconstrained air flow may be provided. In one embodiment, the air is also filtered to remove particulate matter or other contaminants. In another

10 embodiment, the air is also humidified or dehumidified in order to obtain a certain moisture level of the air. In another embodiment, the air is also heated or cooled in order to obtain a certain temperature of the delivered air.

[0031] In one embodiment, processing circuit 400 controls the air control device such that air flow delivered by the device is virtually constrained. For example, an output air

15 flow may be configured to induce a gas curtain effect. Such an output can also include a differentiated peripheral flow of gas. The peripheral air flow may be treated in the same manner or in a different manner as a main air flow. Additionally, the peripheral flow may have a different velocity (e.g., higher or lower) and different direction than the main air flow. For example, the peripheral flow may be directed away from the area to which the

20 main controlled air is directed (e.g., the peripheral flow may be directed such that it flows into ambient air). In one embodiment, to achieve such differentiated flow, the main and peripheral flows may be directed through different output components of the air control device. In another embodiment, a single output may be used that is configured to produce one or more differentiated air flows. Processing circuit 400 may also simultaneously

25 control flow regulating components of the air control device in order to implement such a configuration.

[0032] In one embodiment, the air control device is configured to provide an air flow in a primarily vertical direction (i.e., downward) or in a primarily horizontal direction (i.e. parallel) with respect to the occupant. For example, the air flow may be from the head-

30 side of the occupant towards the feet of the occupant. As another example, the air flow may be side to side (e.g., left to right, or right to left) over the occupant. In another embodiment, the air flow may be from the feet of the occupant toward the head of the

occupant. Depending on the particular configuration of the system including the air control device, air may be delivered from various locations. The system may be built-in or may be an add-on unit. In one embodiment, air flow is delivered from the bedframe. For example, air delivery device (fans, piping, nozzles, etc.) may be embedded within the bedframe, mattress, suspension, or may be coupled to the bedframe. In this manner, air flow may be delivered from the headboard, sideboards, footboard, etc. In one embodiment, the air control device is configured to deliver an air flow that originates at or above a typical head level of the occupant. In another embodiment, the air flow may originate from the mattress, from the mattress level, or below. Any of the air flows described herein may be delivered to cover the full width of the bed or a portion of the bed. Additionally, the flows may be based on a detected position and orientation of the occupant.

[0033] In one embodiment, processing circuit 400 controls the air control device based on feedback. In this manner, the treatment of the air and air flow velocities/directions may be adjusted by processing circuit 400 in response to the feedback. One or more sensors may be used to provide such feedback, as will be described further herein. In general, the feedback may be related to the air as delivered to the occupant, sensed conditions related to the occupant (e.g., sleep state, physiological state, environmental conditions, etc.), or the positioning or orientation of the occupant. Based on the feedback, processing circuit 400 may drive the air control device in order to reach or maintain target values (e.g., a target temperature, a target air flow rate, a target humidity level, etc.). The target values may be constant or may be specified by a schedule. For example, at a certain time, a fast and warm flow of compositionally controlled air may be desired, and at a different time, a slower flow of cooled air may be desired. Such a schedule may be defined and stored as a configuration setting (e.g., stored in configuration data 412, etc.). In one embodiment, target values are based on an ID or preferences for the occupant. The target values and preferences may be stored in a user profile for the occupant. As an example, the air control device may include an RFID tag reader capable of detecting an RFID tag of the occupant. Processing circuit 400 may communicate with the RFID tag reader to identify a particular occupant based on the RFID tag information. As another example, the occupant can be identified by physical characteristics (e.g., weight, size, facial features, respiration pattern, etc.). As another example, the air control device may be configured for wireless

communications (e.g., via Wi-Fi, Bluetooth, etc.). An occupant's identification may be transmitted to the air control device via a wireless connection when the occupant desires, or automatically when the occupant nears the bed. In this manner, after identifying the particular occupant, processing circuit 400 may then access a profile for the occupant and
5 set target values and other device preferences based on the profile.

[0034] In one embodiment, processing circuit 400 is configured to control a bed mounted air control device that delivers air to an occupant of the bed, where the air is delivered based on a detected position and/or orientation of the occupant. Processing circuit may receive positioning data from a variety of sensors of the air control device.
10 The sensors may be mounted to the bed or the air control device. For example, the sensors may include mattress pressure or deflection sensors. In this manner, the position of the occupant can be determined by analyzing the pressure/deflection data to detect when an occupant is in the bed. Further, the location of the sensors and the pressure gradient across the mattress can be further analyzed to determine the location and orientation of the
15 occupant. For example, different parts of the human body induce different pressures on the mattress. In another example, temperature sensors in the bed (e.g., in a mattress pad) can be monitored to determine the location and orientation of the occupant. Accordingly, the location of an occupant's head, mid-section, and feet, can be estimated based on the sensor values. As another example, the sensors may include one or more remote sensors
20 (e.g., micro-impulse radar, cameras, ultrasonic sensors, thermal imagers, etc.). A stream of sensor data can then be monitored to determine when and where an occupant is on the bed. For example, a feed from a camera can be analyzed to detect the presence of an occupant. The camera data can also be further analyzed to determine the location and orientation on the bed with respect to the camera. Based on this analysis, processing
25 circuit 400 can determine in which direction the compositionally controlled air should be delivered such that it is aimed at the occupant. Processing circuit 400 can generate the appropriate signals to adjust the directional output of the air control device. For example, the direction of fans, nozzles, vents, or other air flow control devices may be adjusted.

[0035] In one embodiment, control of the air control device by processing circuit 400 is
30 triggered by one or events. Any of the sensors described herein may provide data signals that trigger the operation of the air control device. For example, the air control device may be triggered by the presence of an occupant, by a light level, according to a schedule,

etc. In an embodiment utilizing cameras, the camera data may be analyzed by processing circuit 400 to determine the presence of an occupant, and when an occupant is detected, further operation of the air control device may be triggered. This may include activating or deactivating an air flow, position an air flow, adjusting a flow rates, adjusting a
5 temperature or humidity level of an air flow, altering a composition of the air of an air flow, etc. In an embodiment utilizing pressure sensors, a certain detected pressure may trigger such control of the air control device. For example, processing circuit 400 may automatically begin to control the device when a pressure of at least 50 pounds is detected on the mattress of the bed. In an embodiment utilizing micro-impulse radar, a detected
10 motion or proximity of an occupant may trigger such control of the air control device. For example, processing circuit 400 may automatically begin to control the device when a motion is detected within a few feet from the air control device. In an embodiment utilizing a light sensor, a detected level of light may trigger such control of the air control device. For example, processing circuit 400 may automatically begin to control the device
15 when the light level is that of typical sleeping conditions. For example, processing circuit 400 may automatically begin to add a stimulant to the air 30 minutes before the occupant is scheduled (e.g., based on an alarm clock, an electronic calendar, etc.) to wake up.

[0036] In one embodiment, processing circuit 400 is configure to control a bed mounted air control device that delivers air to an occupant of the bed, where the air is delivered
20 based on one or more sensed conditions related to the occupant. In one embodiment, the sensed conditions are physiological-related conditions. For example, a condition may include the temperature of the occupant and/or the environment surrounding the occupant. In this manner, processing circuit 400 may control and configure the air control device based on temperature. As another example, the condition may include detected sweat
25 (perspiration) from the occupant. In this manner, processing circuit 400 may control and configure the air control device based on whether the occupant is sweating (e.g., processing circuit may cause a temperature of an air flow to decrease if the occupant is exhibiting signs that he or she is hot, etc.). As another example, the condition may include detecting respiration characteristics of the occupant. In this manner, processing
30 circuit 400 may control and configure the air control device based on the respiration of the occupant (e.g., processing circuit may adjust the composition of an air flow based on one or more respiration characteristics, etc.). As another example, the condition may include

detecting heartbeat characteristics of the occupant. In this manner, processing circuit 400 may control and configure the air control device based on the pulse of an occupant. As another example, the condition may include detecting exhalation characteristics (e.g., a carbon-dioxide amount, etc.) via data from sensor devices. In this manner, processing circuit 400 may control and configure the air control device based on the contents of what the occupant is exhaling. In another embodiment, the sensed conditions are related to a sleep-state of the occupant, and processing circuit 400 may control and configure the air control device based on any of these conditions. For example, a condition may be whether the occupant is asleep or awake. As another example, a condition may include a REM-pattern of the occupant. As another example, the condition may include whether the occupant is snoring. As another example, the condition may include a breathing pattern. As another example, the condition may include physical movements of the occupant during sleep.

[0037] The conditions discussed above may be detected utilizing a variety of sensors that supply data to processing circuit 400. The sensors may be part of the air control device, or the sensors may be remote. In a remote configuration, such sensors may provide data to processing circuit 400 via a wired or wireless connection, and processing circuit 400 may analyze the data in order to detect a condition. Sensors may include a visible or infrared camera, a pulse oximeter, a thermometer, a gas detection sensor, a functional near-infrared spectroscopy (fNIR) device, an electroencephalography (EEG) device, a Fluorescence spectroscopy device, micro-impulse radar, a laser, and/or a microphone.

[0038] In any of the configurations disclosed herein, air may be delivered to multiple occupants of a bed. For example, processing circuit 400 may utilize the techniques discussed above to detect the location and orientation of multiple occupants and the conditions related to the multiple occupants. When multiple occupants are present, the same air flow or differentiated air flows may be provided to each of the occupants. In embodiments where multiple different air flows are provided, the corresponding air control device may include air supply components that are independently controllable by processing circuit 400 such that different air flows may be simultaneously generated. Alternatively, the components of the air control device may be toggled between multiple

occupants, and processing circuit 400 may manage the configuration of the air control device as it toggles such that each occupant receives a particular air flow.

[0039] Additionally, in any of the configurations disclosed herein, the air control device may include an articulating boom that can be used to deliver an air flow (e.g., via an outlet
5 of the boom) to an occupant of a bed. For example, in an embodiment where processing circuit 400 uses sensor data to detect the location and orientation of the occupant, the articulating boom may be automatically positioned based on the location of the occupant. For example, such an articulating boom may include various motors or actuators that can be controlled by processing circuit 400 in order to position the boom. In one embodiment,
10 the articulating boom also includes any of the sensors discussed herein. For example, the articulating boom may include sensors configured to provide data related to the location and orientation of an occupant. As another example, the articulating boom may include sensors configured to provide data related a condition of the occupant. In one embodiment, the articulating boom also includes an air intake, which can be used to
15 supply source air to compositionally controlled and otherwise adjusted by the air control device. Such an air intake may also be used to provide air used to detect exhalation characteristics of a bed occupant.

[0040] Referring to FIG. 5, a schematic diagram of an air treatment system 500 is shown, according to one embodiment. System 500 includes air control device 504, which
20 includes processing circuit 506. Processing circuit 506 may be any of the processing circuits disclosed herein and is configured to control the operation air control device 504. Air control device 504 is depicted as being mounted to the headboard of bed 502 and further includes air delivery mechanisms 508. In FIG. 5, air delivery mechanisms 508 are depicted as including fans. However, any of the air flow delivery mechanisms disclosed
25 herein may be utilized. In one embodiment, air delivery mechanisms 508 include conduit that is embedded throughout the frame of bed 502 such that an air flow of compositionally controlled air may be delivered to an occupant of bed 502 at various locations and at various air flow configurations. For example, an air flow may be directed through the mattress of bed 502, or from the footboard area of bed 502. Processing circuit 506 may be
30 configured to communicate with one or more sensors as disclosed herein. For example, pressure sensors 510 may be embedded in the frame or mattress of bed 502. Based on data from sensors 510, processing circuit 506 may detect the position and orientation of an

occupant of the bed, and control the operation of air control device 506 based on the position and orientation. For example, processing circuit 506 may adjust the orientation of fans 508 (e.g., via controlling actuators of the fans, etc.) in order to obtain a desired air flow. As another example, an EEG device 514 may be worn by the occupant of the bed as he or she sleeps. EEG device 514 may provide data to processing circuit 506 so that processing circuit 506 can detect conditions related to the occupant, and adjust the operation of air control device 504 based on the conditions.

[0041] Referring to FIG. 6, a flow diagram of a process 600 for air treatment, using an air treatment system, is shown according to one embodiment. In alternative embodiments, fewer, additional, and/or different actions may be performed. Also, the use of a flow diagram is not meant to be limiting with respect to the order of actions performed. Source air is compositionally controlled by an air control device (602). The source air is to be controlled and delivered to a region proximate to an occupant of the bed. For example, the source air's concentration of oxygen (604) and carbon dioxide (606) may be adjusted. Additionally, the source air may be filtered, may have its temperature adjusted, and may have its humidity adjusted. The compositionally controlled air is then delivered to the region proximate to the occupant of the bed (608). For example, the air flow of the compositionally controlled air may be direct and unconstrained, or it may be virtually constrained via a gas curtain effect. Multiple aspects of the air flow may be controlled, and the direction of the air flow may be adjusted. A processing circuit can be used to control the operation of the air control device (610).

[0042] Referring to FIG. 7, a flow diagram of a process 700 for air treatment, using an air treatment system, is shown according to one embodiment. In alternative embodiments, fewer, additional, and/or different actions may be performed. Also, the use of a flow diagram is not meant to be limiting with respect to the order of actions performed. Sensor data is generated based on a position of an occupant of a bed (702). Source air is property controlled by an air control device (704). For example, the source air's concentration of oxygen (706) and carbon dioxide (708) may optionally be altered. The position of the occupant is determined based on the sensor data (710). For example, a camera may be used to determine where an occupant is positioned on the bed. The orientation of the occupant may also be determined. A processing circuit can be used to control the operation of the air control device based on the sensor data (e.g., the determined position)

(712). The controlled air may then be delivered based on the sensor data such that the air is directed toward the determined position of the occupant (714).

[0043] Referring to FIG. 8, a flow diagram of a process 800 for air treatment, using an air treatment system, is shown according to one embodiment. In alternative embodiments, fewer, additional, and/or different actions may be performed. Also, the use of a flow diagram is not meant to be limiting with respect to the order of actions performed. Sensor data is generated based on one or more conditions of an occupant of a bed (802). The sensor data is analyzed to determine the condition (804). Source air is properly controlled by an air control device (806). For example, the source air's concentration of oxygen (808) and carbon dioxide (810) may be optionally adjusted based on the condition. Other aspects of the air may also be adjusted based on the condition (e.g., temperature, humidity, filtration, etc.). A processing circuit may be used to control the operation of the air control device based on the sensor data (e.g., the sensed condition of the occupant) (812). For example, the air control device may be activated/deactivated based on the sensed condition. As another example, the air flow provided by the air control device may be adjusted based on the sensed condition. The controlled air is delivered, based on the sensed condition, to a region proximate the occupant of the bed (814).

[0044] The construction and arrangement of the systems and methods as shown in the various embodiments are illustrative only. Although only a few embodiments have been described in detail in this disclosure, many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.). For example, the position of elements may be reversed or otherwise varied and the nature or number of discrete elements or positions may be altered or varied. Accordingly, all such modifications are intended to be included within the scope of the present disclosure. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Other substitutions, modifications, changes, and omissions may be made in the design, operating conditions and arrangement of the embodiments without departing from the scope of the present disclosure.

[0045] The present disclosure contemplates methods, systems and program products on any machine-readable media for accomplishing various operations. The embodiments of

the present disclosure may be implemented or modeled using existing computer processors, or by a special purpose computer processor for an appropriate system, incorporated for this or another purpose, or by a hardwired system. Embodiments within the scope of the present disclosure include program products comprising machine-readable media for carrying or having machine-executable instructions or data structures stored thereon. Such machine-readable media can be any available media that can be accessed by a general purpose or special purpose computer or other machine with a processor. By way of example, such machine-readable media can comprise RAM, ROM, EPROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to carry or store desired program code in the form of machine-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer or other machine with a processor. When information is transferred or provided over a network or another communications connection (either hardwired, wireless, or a combination of hardwired or wireless) to a machine, the machine properly views the connection as a machine-readable medium. Thus, any such connection is properly termed a machine-readable medium. Combinations of the above are also included within the scope of machine-readable media. Machine-executable instructions include, for example, instructions and data which cause a general purpose computer, special purpose computer, or special purpose processing machines to perform a certain function or group of functions.

[0046] Although the figures may show a specific order of method steps, the order of the steps may differ from what is depicted. Also two or more steps may be performed concurrently or with partial concurrence. All such variations are within the scope of the disclosure. Likewise, software implementations could be accomplished with standard programming techniques with rule-based logic and other logic to accomplish the various connection steps, processing steps, comparison steps and decision steps.

Aspects of the subject matter described herein are set out in the following numbered clauses:

1. An air treatment system, comprising:
an air control device configured to:
compositionally control air to be delivered to a region proximate to

an occupant of a bed; and

deliver the compositionally controlled air to the region proximate to the occupant of the bed; and

a processing circuit configured to control operation of the air control
5 device, wherein the air control device is configured to be coupled to the bed.

2. The air treatment system of clause 1, wherein compositionally controlling the air comprises altering an oxygen proportion of the air.

3. The air treatment system of clause 2, wherein altering an oxygen proportion of the air comprises obtaining oxygen-enriched air from a reservoir.

10 4. The air treatment system of clause 2, wherein altering an oxygen proportion of the air comprises selectively removing at least some nitrogen from the air.

5. The air treatment system of clause 1, wherein compositionally controlling the air comprises altering a carbon dioxide proportion of the air.

6. The air treatment system of clause 5, wherein altering a carbon dioxide
15 proportion of the air comprises selectively removing at least some carbon dioxide from the air.

7. The air treatment system of clause 1, wherein the air control device is further configured to control a temperature of the compositionally controlled air.

8. The air treatment system of clause 1, wherein the air control device is
20 further configured to control a humidity of the compositionally controlled air.

9. The air treatment system of clause 1, wherein the air control device is further configured to control an odor of the compositionally controlled air.

10. The air treatment system of clause 1, wherein the air control device is further configured to filter the compositionally controlled air.

25 11. The air treatment system of clause 1, wherein delivering the compositionally controlled air comprises controlling an air flow such that the delivered air is constrained via a gas curtain effect.

12. The air treatment system of clause 11, wherein the air flow is based on a detected position of the occupant.

13. The air treatment system of clause 1, wherein the air flow comprises the compositionally controlled air and a peripheral flow.

5 14. The air treatment system of clause 13, wherein the peripheral flow is treated differently than the compositionally controlled air.

15. The air treatment system of clause 14, wherein the peripheral flow has a different velocity than the compositionally controlled air.

10 16. The air treatment system of clause 14, wherein the peripheral flow has a different temperature than the compositionally controlled air.

17. The air treatment system of clause 14, wherein the peripheral flow has a different directional flow than the compositionally controlled air.

15 18. The air treatment system of clause 1, wherein delivering the compositionally controlled air comprises controlling a plurality of air flows such that the delivered air is directed to a plurality of occupants of the bed.

19. The air treatment system of clause 1, wherein the compositionally controlled air is delivered in a horizontal direction with respect to the occupant.

20. The air treatment system of clause 1, wherein the compositionally controlled air is delivered in a vertical direction with respect to the occupant.

20 21. The air treatment system of clause 1, further comprising a sensor configured to generate feedback related to the delivered air, wherein the processing circuit is configured to:

receive the feedback related to the delivered air; and
control the operation of the air control device based on the feedback.

25 22. The air treatment system of clause 21, wherein the processing circuit is configured to maintain, using the feedback, a target value related to the delivered air.

23. The air treatment system of clause 22, wherein the target value is based on a schedule.

24. The air treatment system of clause 22, wherein the target value includes a constant value.

5 25. The air treatment system of clause 22, wherein the target value includes a user preference.

26. The air treatment system of clause 22, wherein the target value is based on a sensed condition.

10 27. The air treatment system of clause 26, wherein the sensed condition comprises at least one of a sleep state of the occupant, a physiological state of the occupant, and an environmental condition.

28. The air treatment system of clause 1, wherein controlling the operation of the air control device is triggered by at least one of a presence of the occupant, a light level, and a schedule.

15 29. The air treatment system of clause 1, wherein the compositionally controlled air is delivered via a duct through at least one of a headboard of the bed, a sideboard of the bed, and a footboard of the bed.

30. The air treatment system of clause 1, wherein the compositionally controlled air originates from at least one of above a mattress level of the bed, below a mattress level of the bed, and at a mattress level of the bed.

31. The air treatment system of clause 1, wherein the air treatment system is at least one of built in to a bedframe of the bed, built in to a mattress of the bed, and an add-on unit for the bed.

25 32. The air treatment system of clause 1, wherein the compositionally controlled air is delivered to cover a full width of the bed.

33. The air treatment system of clause 1, wherein the compositionally controlled air is delivered toward a position based on a detected orientation or position of the occupant.

34. The air treatment system of clause 1, wherein the compositionally controlled air includes an inhalable stimulant.

35. The air treatment system of clause 1, wherein the compositionally controlled air includes an inhalable relaxant.

36. The air treatment system of clause 1, wherein the compositionally controlled air includes an inhalable medicament.

37. The air treatment system of clause 1, further comprising a sensor configured to generate feedback related to the occupant, wherein the processing circuit is configured to:

receive the feedback related to the occupant; and
control the operation of the air control device based on the feedback.

38. The air treatment system of clause 37, wherein the processing circuit is configured to alter the compositionally controlled air based on the feedback.

39. The air treatment system of clause 38, wherein the feedback relates to SpO2 levels of the occupant, and wherein the processing circuit is configured to alter, based on the feedback, at least one of an oxygen proportion of the compositionally controlled air, an air proportion of the compositionally controlled air, a relaxant proportion of the compositionally controlled air, a medicament proportion of the compositionally controlled air, or a stimulant proportion of the compositionally controlled air.

40. The air treatment system of clause 38, wherein the feedback relates to at least one of breathing patterns and breathing interruptions of the occupant.

41. The air treatment system of clause 40, wherein the processing circuit is configured to alter, based on the feedback, at least one of an oxygen proportion of the compositionally controlled air, an air proportion of the compositionally controlled air, a relaxant proportion of the compositionally controlled air, a medicament proportion of the

compositionally controlled air, or a stimulant proportion of the compositionally controlled air.

42. A method of air treatment, comprising:
compositionally controlling, with an air control device configured to be
5 coupled to a bed, air to be delivered to a region proximate to an occupant of the bed;
delivering the compositionally controlled air to the region proximate to the
occupant of the bed; and
controlling, with a processing circuit, operation of the air control device.

43. The method of clause 42, wherein compositionally controlling the air
10 comprises altering an oxygen proportion of the air.

44. The method of clause 43, wherein altering an oxygen proportion of the air
comprises obtaining oxygen-enriched air from a reservoir.

45. The method of clause 43, wherein altering an oxygen proportion of the air
comprises selectively removing at least some nitrogen from the air.

15 46. The method of clause 42, wherein compositionally controlling the air
comprises altering a carbon dioxide proportion of the air.

47. The method of clause 46, wherein altering a carbon dioxide proportion of
the air comprises selectively removing at least some carbon dioxide from the air.

48. The method of clause 42, further comprising controlling a temperature of
20 the compositionally controlled air.

49. The method of clause 42, further comprising controlling a humidity of the
compositionally controlled air.

50. The method of clause 42, wherein compositionally controlling the air
includes controlling an odor of the compositionally controlled air.

25 51. The method of clause 42, further comprising filtering the compositionally
controlled air.

52. The method of clause 42, wherein delivering the compositionally controlled air comprises controlling an air flow such that the delivered air is constrained via a gas curtain effect.

53. The method of clause 52, wherein the air flow is based on a detected
5 position of the occupant.

54. The method of clause 42, wherein the air flow comprises the compositionally controlled air and a peripheral flow.

55. The method of clause 54, wherein the peripheral flow is treated differently than the compositionally controlled air.

10 56. The method of clause 54, wherein the peripheral flow has a different velocity than the compositionally controlled air.

57. The method of clause 54, wherein the peripheral flow has a different temperature than the compositionally controlled air.

15 58. The method of clause 54, wherein the peripheral flow has a different directional flow than the compositionally controlled air.

59. The method of clause 42, wherein delivering the compositionally controlled air comprises controlling a plurality of air flows such that the delivered air is directed to a plurality of occupants of the bed.

20 60. The method of clause 42, wherein the compositionally controlled air is delivered in a horizontal direction with respect to the occupant.

61. The method of clause 42, wherein the compositionally controlled air is delivered in a vertical direction with respect to the occupant.

25 62. The method of clause 42, further comprising:
receiving, from a sensor, feedback related to the delivered air; and
controlling the operation of the air control device based on the feedback.

63. The method of clause 62, further comprising maintaining, using the feedback, a target value related to the delivered air.

64. The method of clause 63, wherein the target value is based on a schedule.
65. The method of clause 63, wherein the target value includes a constant value.
66. The method of clause 63, wherein the target value includes a user
5 preference.
67. The method of clause 63, wherein the target value is based on a sensed condition.
68. The method of clause 67, wherein the sensed condition comprises at least one of a sleep state of the occupant, a physiological state of the occupant, and an
10 environmental condition.
69. The method of clause 42, further comprising triggering the operation of the air control device by at least one of a presence of the occupant, a light level, and a schedule.
70. The method of clause 42, wherein the compositionally controlled air is
15 delivered via a duct through at least one of a headboard of the bed, a sideboard of the bed, and a footboard of the bed.
71. The method of clause 42, wherein the compositionally controlled air originates from at least one of above a mattress level of the bed, below a mattress level of the bed, and at a mattress level of the bed.
72. The method of clause 42, wherein the air control device is at least one of
20 built-in to a bedframe of the bed, built-in to a mattress of the bed, and an add-on unit for the bed.
73. The method of clause 42, wherein the compositionally controlled air is delivered to cover a full width of the bed.
74. The method of clause 42, wherein the compositionally controlled air is
25 delivered toward a position based on a detected orientation or position of the occupant.

75. The method of clause 42, wherein compositionally controlling the air includes adding an inhalable stimulant to the air.

76. The method of clause 42, wherein the compositionally controlled air includes an inhalable relaxant.

5 77. The method of clause 42, wherein the compositionally controlled air includes an inhalable medicament.

78. The method of clause 42, further comprising:
receiving, from a sensor, feedback related to the occupant; and
controlling the operation of the air control device based on the feedback.

10 79. The method of clause 78, further comprising altering the compositionally controlled air based on the feedback.

80. The method of clause 79, wherein the feedback relates to SpO₂ levels of the occupant, and wherein altering the compositionally controlled air includes altering at least one of an oxygen proportion of the compositionally controlled air, an air proportion
15 of the compositionally controlled air, a relaxant proportion of the compositionally controlled air, a medicament proportion of the compositionally controlled air, and a stimulant proportion of the compositionally controlled air.

81. The method of clause 79, wherein the feedback relates to at least one of breathing patterns and breathing interruptions of the occupant.

20 82. The method of clause 81, further comprising altering the compositionally controlled air based on the feedback, and wherein altering the compositionally controlled air includes altering at least one of an oxygen proportion of the compositionally controlled air, an air proportion of the compositionally controlled air, a relaxant proportion of the compositionally controlled air, a medicament proportion of the compositionally controlled
25 air, and a stimulant proportion of the compositionally controlled air.

83. An air treatment system, comprising:
one or more sensors configured to generate sensor data based on a position
of an occupant of a bed;

an air control device configured to:

control a property of air to be delivered to the occupant; and
deliver the controlled air to the position of the occupant of a bed;

and

5 a processing circuit configured to:

determine, based on the sensor data, the position of the occupant of
the bed; and

control, based on the determined position, operation of the air
control device, wherein the air control device is configured to be coupled to the bed.

10 84. The air treatment system of clause 83, wherein determining the position of
the occupant of the bed comprises determining an orientation of the occupant.

85. The air treatment system of clause 83, wherein controlling a property of air
comprises altering an oxygen proportion of the air.

15 86. The air treatment system of clause 85, wherein altering an oxygen
proportion of the air comprises obtaining oxygen-enriched air from a reservoir.

87. The air treatment system of clause 85, wherein altering an oxygen
proportion of the air comprises selectively removing at least some nitrogen from the air.

88. The air treatment system of clause 83, wherein controlling a property of air
comprises altering a carbon dioxide proportion of the air.

20 89. The air treatment system of clause 88, wherein altering a carbon dioxide
proportion of the air comprises selectively removing at least some carbon dioxide from the
air.

90. The air treatment system of clause 83, wherein controlling a property of air
comprises controlling a temperature of the air.

25 91. The air treatment system of clause 83, wherein controlling a property of air
comprises controlling a humidity of the air.

92. The air treatment system of clause 83, wherein controlling a property of air
comprises controlling an odor of the air.

93. The air treatment system of clause 83, wherein controlling a property of air comprises filtering the air.

94. The air treatment system of clause 83, wherein delivering the controlled air comprises controlling an air flow such that the delivered air is constrained via a gas curtain
5 effect.

95. The air treatment system of clause 94, wherein the air flow is based on the determined position of the occupant.

96. The air treatment system of clause 83, wherein the air flow comprises the controlled air and a peripheral flow.

10 97. The air treatment system of clause 96, wherein the peripheral flow is treated differently than the controlled air.

98. The air treatment system of clause 96, wherein the peripheral flow has a different velocity than the controlled air.

99. The air treatment system of clause 96, wherein the peripheral flow has a
15 different temperature than the controlled air.

100. The air treatment system of clause 96, wherein the peripheral flow has a different directional flow than the controlled air.

101. The air treatment system of clause 83, wherein the processing circuit is further configured to:

20 determine, based on the sensor data, a position of an additional occupant of the bed; and

control, based on the determined position of the additional occupant, operation of the air control device such that the delivered air is directed to the occupant and the additional occupant.

25 102. The air treatment system of clause 101, wherein a first air flow of the delivered air to the occupant is different than a second air flow of the delivered air to the additional occupant.

103. The air treatment system of clause 83, wherein the controlled air is delivered in a horizontal direction with respect to the occupant.

104. The air treatment system of clause 83, wherein the controlled air is delivered in a vertical direction with respect to the occupant.

5 105. The air treatment system of clause 83, further comprising a sensor configured to generate feedback related to the delivered air, wherein the processing circuit is configured to:

receive the feedback related to the delivered air; and
control the operation of the air control device based on the feedback.

10 106. The air treatment system of clause 105, wherein the processing circuit is configured to maintain, using the feedback, a target value related to the delivered air.

107. The air treatment system of clause 106, wherein the target value is based on a schedule.

15 108. The air treatment system of clause 106, wherein the target value includes a constant value.

109. The air treatment system of clause 106, wherein the target value includes a user preference.

110. The air treatment system of clause 106, wherein the target value is based on a sensed condition.

20 111. The air treatment system of clause 110, wherein the sensed condition comprises at least one of a sleep state of the occupant, a physiological state of the occupant, and an environmental condition.

112. The air treatment system of clause 83, wherein controlling the operation of the air control device is triggered by at least one of a presence of the occupant, a light
25 level, and a schedule.

113. The air treatment system of clause 83, wherein the controlled air is delivered via a duct through at least one of a headboard of the bed, a sideboard of the bed, and a footboard of the bed.

114. The air treatment system of clause 83, wherein the controlled air originates
5 from at least one of above a mattress level of the bed, below a mattress level of the bed, and at a mattress level of the bed.

115. The air treatment system of clause 83, wherein the air treatment system is at least one of built-in to a bedframe of the bed, built-in to a mattress of the bed, and an add-on unit for the bed.

10 116. The air treatment system of clause 83, wherein the controlled air is delivered to cover a full width of the bed.

117. The air treatment system of clause 83, wherein the one or more sensors comprise at least one sensor mounted on the bed.

118. The air treatment system of clause 117, wherein the at least one sensor
15 mounted on the bed comprises at least one of a mattress pressure sensor, a temperature sensor, and a mattress deflection sensor.

119. The air treatment system of clause 83, wherein the one or more sensors comprise at least one remote sensor.

120. The air treatment system of clause 119, wherein the at least one remote
20 sensor comprises at least one of an infrared sensor, a micro-impulse radar, an ultrasonic sensor, and a camera.

121. The air treatment system of clause 83, further comprising an articulated boom, wherein the air control device is configured to deliver the controlled air via the articulated boom, and wherein the articulated boom is positioned based on the determined
25 position of the occupant.

122. The air treatment system of clause 83, wherein the controlled air includes an inhalable stimulant.

123. The air treatment system of clause 83, wherein the controlled air includes an inhalable relaxant.

124. The air treatment system of clause 83, wherein the controlled air includes an inhalable medicament.

5 125. The air treatment system of clause 83, further comprising a sensor configured to generate feedback related to the occupant, wherein the processing circuit is configured to:

 receive the feedback related to the occupant; and
 control the operation of the air control device based on the feedback.

10 126. The air treatment system of clause 125, wherein the processing circuit is configured to alter the controlled air based on the feedback.

 127. The air treatment system of clause 126, wherein the feedback relates to SpO₂ levels of the occupant, and wherein the processing circuit is configured to alter, based on the feedback, at least one of an oxygen proportion of the controlled air, an air
15 proportion of the controlled air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

 128. The air treatment system of clause 126, wherein the feedback relates to at least one of breathing patterns and breathing interruptions of the occupant.

 129. The air treatment system of clause 128, wherein the processing circuit is
20 configured to alter, based on the feedback, at least one of an oxygen proportion of the controlled air, an air proportion of the controlled air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

 130. A method of air treatment, comprising:
25 generating sensor data, with one or more sensors, based on a position of an occupant of a bed;

 controlling, with an air control device configured to be coupled to a bed, a property of air to be delivered to the occupant;

 determining, based on the sensor data, the position of the occupant of the

bed; controlling, with a processing circuit, operation of the air control device based on the determined position; and delivering the controlled air to the determined position of the occupant of a bed.

5 131. The method of clause 130, wherein determining the position of the occupant of the bed comprises determining an orientation of the occupant.

 132. The method of clause 130, wherein controlling a property of air comprises altering an oxygen proportion of the air.

 133. The method of clause 132, wherein altering an oxygen proportion of the air
10 comprises obtaining oxygen-enriched air from a reservoir.

 134. The method of clause 132, wherein altering an oxygen proportion of the air comprises selectively removing at least some nitrogen from the air.

 135. The method of clause 130, wherein controlling a property of air comprises altering a carbon dioxide proportion of the air.

15 136. The method of clause 135, wherein altering a carbon dioxide proportion of the air comprises selectively removing at least some carbon dioxide from the air.

 137. The method of clause 130, further comprising controlling a temperature of the air.

 138. The method of clause 130, further comprising controlling a humidity of the
20 air.

 139. The method of clause 130, further comprising controlling an odor of the air.

 140. The method of clause 130, further comprising filtering the air.

 141. The method of clause 130, wherein delivering the controlled air comprises controlling an air flow such that the delivered air is constrained via a gas curtain effect.

25 142. The method of clause 141, wherein the air flow is based on the determined position of the occupant.

143. The method of clause 130, wherein the air flow comprises the controlled air and a peripheral flow.

144. The method of clause 143, wherein the peripheral flow is treated differently than the controlled air.

5 145. The method of clause 143, wherein the peripheral flow has a different velocity than the controlled air.

146. The method of clause 143, wherein the peripheral flow has a different temperature than the controlled air.

10 147. The method of clause 143, wherein the peripheral flow has a different directional flow than the controlled air.

148. The method of clause 130, further comprising:
determining, based on the sensor data, a position of an additional occupant of the bed; and
controlling, based on the determined position of the additional occupant,
15 operation of the air control device such that the delivered air is directed to the occupant and the additional occupant.

149. The method of clause 148, wherein a first air flow of the delivered air to the occupant is different than a second air flow of the delivered air to the additional occupant.

20 150. The method of clause 130, wherein the controlled air is delivered in a horizontal direction with respect to the occupant.

151. The method of clause 130, wherein the controlled air is delivered in a vertical direction with respect to the occupant.

152. The method of clause 130, further comprising:
receiving, from a sensor, feedback related to the delivered air; and
25 controlling the operation of the air control device based on the feedback.

153. The method of clause 152, further comprising maintaining, using the feedback, a target value related to the delivered air.

154. The method of clause 153, wherein the target value is based on a schedule.
155. The method of clause 153, wherein the target value includes a constant value.
156. The method of clause 153, wherein the target value includes a user
5 preference.
157. The method of clause 153, wherein the target value is based on a sensed condition.
158. The method of clause 157, wherein the sensed condition comprises at least one of a sleep state of the occupant, a physiological state of the occupant, and an
10 environmental condition.
159. The method of clause 130, further comprising triggering the operation of the air control device by at least one of a presence of the occupant, a light level, and a schedule.
160. The method of clause 130, wherein the controlled air is delivered via a duct
15 through at least one of a headboard of the bed, a sideboard of the bed, and a footboard of the bed.
161. The method of clause 130, wherein the controlled air originates from at least one of above a mattress level of the bed, below a mattress level of the bed, and at a mattress level of the bed.
- 20 162. The method of clause 130, wherein the air control device is at least one of built-in to a bedframe of the bed, built-in to a mattress of the bed, and an add-on unit for the bed.
163. The method of clause 130, wherein the controlled air is delivered to cover a full width of the bed.
- 25 164. The method of clause 130, wherein the one or more sensors comprise at least one sensor mounted on the bed.

165. The method of clause 164, wherein the at least one sensor mounted on the bed comprises at least one of a mattress pressure sensor, a temperature sensor, and a mattress deflection sensor.

166. The method of clause 130, wherein the one or more sensors comprise at
5 least one remote sensor.

167. The method of clause 166, wherein the at least one remote sensor comprises at least one of an infrared sensor, a micro-impulse radar, an ultrasonic sensor, and a camera.

168. The method of clause 130, wherein the controlled air is delivered via an
10 articulated boom positioned based on the determined position of the occupant.

169. The method of clause 130, wherein controlling the air includes adding an inhalable stimulant to the air.

170. The method of clause 130, wherein the controlled air includes an inhalable relaxant.

171. The method of clause 130, wherein the controlled air includes an inhalable
15 medicament.

172. The method of clause 130, further comprising:
receiving, from a sensor, feedback related to the occupant; and
controlling the operation of the air control device based on the feedback.

173. The method of clause 172, further comprising altering the controlled air
20 based on the feedback.

174. The method of clause 173, wherein the feedback relates to SpO2 levels of the occupant, and wherein altering the compositionally controlled air includes altering at least one of an oxygen proportion of the controlled air, an air proportion of the controlled
25 air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

175. The method of clause 173, wherein the feedback relates to at least one of breathing patterns and breathing interruptions of the occupant.

176. The method of clause 175, further comprising altering the controlled air based on the feedback, and wherein altering the controlled air includes altering at least one
5 of an oxygen proportion of the controlled air, an air proportion of the controlled air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

177. An air treatment system, comprising:
one or more sensor devices configured to generate sensor data based on a
10 condition of an occupant of a bed;
an air control device configured to:
control a property of air to be delivered to a region proximate to an occupant of a bed;
deliver the controlled air to the region proximate to the occupant of
15 the bed; and
a processing circuit configured to:
determine the condition based on the sensor data; and
control, based on the determined condition, operation of the air control device, wherein the air control device is configured to be coupled to the bed.

20 178. The air treatment system of clause 177, wherein controlling a property of air comprises altering an oxygen proportion of the air.

179. The air treatment system of clause 178, wherein altering an oxygen proportion of the air comprises obtaining oxygen-enriched air from a reservoir.

25 180. The air treatment system of clause 178, wherein altering an oxygen proportion of the air comprises selectively removing at least some nitrogen from the air.

181. The air treatment system of clause 177, wherein controlling a property of air comprises altering a carbon dioxide proportion of the air.

182. The air treatment system of clause 181, wherein altering a carbon dioxide proportion of the air comprises selectively removing at least some carbon dioxide from the air.

183. The air treatment system of clause 177, wherein the condition includes a
5 physiological condition of the occupant.

184. The air treatment system of clause 183, wherein the physiological condition comprises at least one of a temperature, sweat production, a pulse rate, an SpO2 level, a respiration rate, a heartbeat, and a carbon-dioxide amount exhaled by the occupant.

185. The air treatment system of clause 177, wherein the condition includes a
10 sleep-state of the occupant.

186. The air treatment system of clause 185, wherein the sleep-state comprises at least one of asleep, awake, a REM pattern, NREM sleep stage, snoring, a breathing pattern, and a certain movement.

187. The air treatment system of clause 177, wherein the one or more sensor
15 devices comprise at least one of an infrared sensor, a gas detector, a thermometer, a pulse oximeter, a functional near-infrared spectroscopy (fNIR) device, an electroencephalography (EEG) device, a Fluorescence spectroscopy device, a pupillometer, an electromagnetic sensor, an electrical potential sensor, a micro-impulse radar, a laser, a microphone, and a camera.

20 188. The air treatment system of clause 177, wherein controlling a property of air comprises controlling a temperature of the controlled air.

189. The air treatment system of clause 177, wherein controlling a property of air comprises controlling a humidity of the controlled air.

190. The air treatment system of clause 177, wherein controlling a property of
25 air comprises controlling an odor of the controlled air.

191. The air treatment system of clause 177, wherein controlling a property of air comprises filtering the controlled air.

192. The air treatment system of clause 177, wherein an air flow of the delivered air is an unconstrained air flow.

193. The air treatment system of clause 192, wherein the unconstrained air flow is indirect and through at least one of a pillow, a bed cover, and a mattress.

5 194. The air treatment system of clause 177, wherein an air flow of the delivered air is constrained by a physical canopy covering at least a portion of the bed.

195. The air treatment system of clause 177, wherein delivering the controlled air comprises controlling an air flow such that the delivered air is constrained via a gas curtain effect.

10 196. The air treatment system of clause 177, wherein the air flow comprises the controlled air and a peripheral flow.

197. The air treatment system of clause 196, wherein the peripheral flow is treated differently than the controlled air.

15 198. The air treatment system of clause 196, wherein the peripheral flow has a different velocity than the controlled air.

199. The air treatment system of clause 196, wherein the peripheral flow has a different temperature than the controlled air.

200. The air treatment system of clause 196, wherein the peripheral flow has a different directional flow than the controlled air.

20 201. The air treatment system of clause 177, wherein the processing circuit is further configured to:

determine, based on the sensor data, a position of the occupant; and
control, based on the determined position of the occupant, operation of the air control device such that the delivered air is directed to the occupant.

25 202. The air treatment system of clause 177, wherein delivering the controlled air comprises controlling a plurality of air flows such that the delivered air is directed to a plurality of occupants of the bed.

203. The air treatment system of clause 202, wherein a first air flow of the delivered air to the occupant is different than a second air flow of the delivered air to an additional occupant.

204. The air treatment system of clause 177, wherein the controlled air is
5 delivered in a horizontal direction with respect to the occupant.

205. The air treatment system of clause 177, wherein the controlled air is delivered in a vertical direction with respect to the occupant.

206. The air treatment system of clause 177, further comprising a sensor configured to generate feedback related to the delivered air, wherein the processing circuit
10 is configured to:

receive the feedback related to the delivered air; and
control the operation of the air control device based on the feedback.

207. The air treatment system of clause 206, wherein the processing circuit is configured to maintain, using the feedback, a target value related to the delivered air.

208. The air treatment system of clause 207, wherein the target value is based on
15 a schedule.

209. The air treatment system of clause 207, wherein the target value includes a constant value.

210. The air treatment system of clause 207, wherein the target value includes a
20 user preference.

211. The air treatment system of clause 207, wherein the target value is based on the sensed condition.

212. The air treatment system of clause 177, wherein controlling the operation of the air control device is triggered by at least one of a presence of the occupant, a light
25 level, and a schedule.

213. The air treatment system of clause 177, wherein the controlled air is delivered via a duct through at least one of a headboard of the bed, a sideboard of the bed, and a footboard of the bed.

214. The air treatment system of clause 177, wherein the controlled air
5 originates from at least one of above a mattress level of the bed, below a mattress level of the bed, and at a mattress level of the bed.

215. The air treatment system of clause 177, wherein the air treatment system is at least one of built-in to a bedframe of the bed, built-in to a mattress of the bed, and an add-on unit for the bed.

10 216. The air treatment system of clause 177, wherein the controlled air is delivered to cover a full width of the bed.

217. The air treatment system of clause 177, wherein the controlled air includes an inhalable stimulant.

218. The air treatment system of clause 177, wherein the controlled air includes
15 an inhalable relaxant.

219. The air treatment system of clause 177, wherein the controlled air includes an inhalable medicament.

220. The air treatment system of clause 177, further comprising a sensor configured to generate feedback related to the occupant, wherein the processing circuit is
20 configured to:

receive the feedback related to the occupant; and
control the operation of the air control device based on the feedback.

221. The air treatment system of clause 220, wherein the processing circuit is configured to alter the controlled air based on the feedback.

25 222. The air treatment system of clause 221, wherein the feedback relates to SpO2 levels of the occupant, and wherein the processing circuit is configured to alter, based on the feedback, at least one of an oxygen proportion of the controlled air, an air

proportion of the controlled air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

223. The air treatment system of clause 221, wherein the feedback relates to at least one of breathing patterns and breathing interruptions of the occupant.

5 224. The air treatment system of clause 223, wherein the processing circuit is configured to alter, based on the feedback, at least one of an oxygen proportion of the controlled air, an air proportion of the controlled air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

10 225. A method of air treatment, comprising:
generating, with one or more sensor devices, sensor data based on a condition of an occupant of a bed;
determining, with a processing circuit, the condition based on the sensor data;
controlling, using an air control device configured to be coupled to the bed,
15 a property of air to be delivered to a region proximate to an occupant of a bed;
controlling, with the processing circuit, operation of the air control device based on the determined condition; and
delivering the controlled air to the region proximate to the occupant of the bed.

20 226. The method of clause 225, wherein controlling a property of air comprises altering an oxygen proportion of the air.

227. The method of clause 226, wherein altering an oxygen proportion of the air comprises obtaining oxygen-enriched air from a reservoir.

25 228. The method of clause 226, wherein altering an oxygen proportion of the air comprises selectively removing at least some nitrogen from the air.

229. The method of clause 225, wherein controlling a property of air comprises altering a carbon dioxide proportion of the air.

230. The method of clause 229, wherein altering a carbon dioxide proportion of the air comprises selectively removing at least some carbon dioxide from the air.

231. The method of clause 225, wherein the condition includes a physiological condition of the occupant.

5 232. The method of clause 231, wherein the physiological condition comprises at least one of a temperature, sweat production, a pulse rate, an SpO₂ level, a respiration rate, a heartbeat, and a carbon-dioxide amount exhaled by the occupant.

233. The method of clause 225, wherein the condition includes a sleep-state of the occupant.

10 234. The method of clause 233, wherein the sleep-state comprises at least one of asleep, awake, a REM pattern, snoring, a breathing pattern, and a certain movement.

235. The method of clause 225, wherein the one or more sensor devices comprise at least one of an infrared sensor, a gas detector, a thermometer, a pulse oximeter, a functional near-infrared spectroscopy (fNIR) device, an
15 electroencephalography (EEG) device, a Fluorescence spectroscopy device, a micro-impulse radar, a laser, a microphone, and a camera.

236. The method of clause 225, further comprising controlling a temperature of the air.

237. The method of clause 225, further comprising controlling a humidity of the
20 air.

238. The method of clause 225, further comprising filtering the air.

239. The method of clause 225, wherein an air flow of the delivered air is an unconstrained air flow.

240. The method of clause 239, wherein the unconstrained air flow is indirect
25 with respect to the occupant and provided through at least one of a pillow, a bed cover, and a mattress.

241. The method of clause 225, wherein an air flow of the delivered air is constrained by a physical canopy covering at least a portion of the bed.

242. The method of clause 225, wherein delivering the compositionally controlled air comprises controlling an air flow such that the delivered air is constrained
5 via a gas curtain effect.

243. The method of clause 242, wherein the air flow comprises the controlled air and a peripheral flow.

244. The method of clause 243, wherein the peripheral flow is treated differently than the controlled air.

10 245. The method of clause 243, wherein the peripheral flow has a different temperature than the controlled air.

246. The method of clause 243, wherein the peripheral flow has a different velocity than the controlled air.

15 247. The method of clause 243, wherein the peripheral flow has a different directional flow than the controlled air.

248. The method of clause 225, further comprising:
determining, based on the sensor data, a position of the occupant; and
controlling, based on the determined position of the occupant, operation of
the air control device such that the delivered air is directed to the occupant.

20 249. The method of clause 225, wherein delivering the controlled air comprises controlling a plurality of air flows such that the delivered air is directed to a plurality of occupants of the bed.

250. The method of clause 249, wherein a first air flow of the delivered air to the occupant is different than a second air flow of the delivered air to an additional occupant.

25 251. The method of clause 225, wherein the controlled air is delivered in a horizontal direction with respect to the occupant.

252. The method of clause 225, wherein the controlled air is delivered in a vertical direction with respect to the occupant.

253. The method of clause 225, further comprising:
receiving, from a sensor, feedback related to the delivered air; and
5 controlling the operation of the air control device based on the feedback.

254. The method of clause 253, further comprising maintaining, using the feedback, a target value related to the delivered air.

255. The method of clause 254, wherein the target value is based on a schedule.

256. The method of clause 254, wherein the target value includes a constant
10 value.

257. The method of clause 254, wherein the target value includes a user preference.

258. The method of clause 254, wherein the target value is based on the conditions.

259. The method of clause 225, further comprising triggering the operation of
15 the air control device by at least one of a presence of the occupant, a light level, and a schedule.

260. The method of clause 225, wherein the controlled air is delivered via a duct
through at least one of a headboard of the bed, a sideboard of the bed, and a footboard of
20 the bed.

261. The method of clause 225, wherein the controlled air originates from at least one of above a mattress level of the bed, below a mattress level of the bed, and at a mattress level of the bed.

262. The method of clause 225, wherein the air control device is at least one of
25 built-in to a bedframe of the bed, built-in to a mattress of the bed, and an add-on unit for the bed.

263. The method of clause 225, wherein the controlled air is delivered to cover a full width of the bed.

264. The method of clause 225, wherein controlling the air includes adding an inhalable stimulant to the air.

5 265. The method of clause 225, wherein the controlled air includes an inhalable relaxant.

266. The method of clause 225, wherein the controlled air includes an inhalable medicament.

267. The method of clause 225, further comprising:
10 receiving, from a sensor, feedback related to the occupant; and
 controlling the operation of the air control device based on the feedback.

268. The method of clause 267, further comprising altering the controlled air based on the feedback.

269. The method of clause 268, wherein the feedback relates to SpO₂ levels of
15 the occupant, and wherein altering the compositionally controlled air includes altering at
 least one of an oxygen proportion of the controlled air, an air proportion of the controlled
 air, a medicament proportion of the controlled air, a relaxant proportion of the controlled
 air, and a stimulant proportion of the controlled air.

270. The method of clause 268, wherein the feedback relates to at least one of
20 breathing patterns and breathing interruptions of the occupant.

271. The method of clause 270, further comprising altering the controlled air
based on the feedback, and wherein altering the controlled air includes altering at least one
of an oxygen proportion of the compositionally controlled air, an air proportion of the
controlled air, a medicament proportion of the controlled air, a relaxant proportion of the
25 controlled air, and a stimulant proportion of the controlled air.

While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and

embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope being indicated by the following claims.

CLAIMS

1. An air treatment system, comprising:

an air control device configured to:

5 compositionally control air to be delivered to a region proximate to an occupant of a bed; and

deliver the compositionally controlled air to the region proximate to the occupant of the bed; and

a processing circuit configured to control operation of the air
10 control device, wherein the air control device is configured to be coupled to the bed.
2. The air treatment system of claim 1, wherein compositionally controlling the air comprises altering an oxygen proportion of the air.
3. The air treatment system of claim 2, wherein altering an oxygen proportion of the air comprises obtaining oxygen-enriched air from a reservoir.
- 15 4. The air treatment system of claim 2, wherein altering an oxygen proportion of the air comprises selectively removing at least some nitrogen from the air.
5. The air treatment system of claim 1, wherein compositionally controlling the air comprises altering a carbon dioxide proportion of the air, wherein altering a carbon dioxide proportion of the air comprises selectively removing at least some carbon dioxide
20 from the air.
6. The air treatment system of claim 1, wherein the air control device is further configured to control a temperature of the compositionally controlled air.
7. The air treatment system of claim 1, wherein the air control device is further configured to control an odor of the compositionally controlled air.

8. The air treatment system of claim 1, wherein delivering the compositionally controlled air comprises controlling an air flow such that the delivered air is constrained via a gas curtain effect.

9. The air treatment system of claim 1, wherein the air flow comprises the compositionally controlled air and a peripheral flow.

10. The air treatment system of claim 9, wherein the peripheral flow is treated differently than the compositionally controlled air.

11. The air treatment system of claim 10, wherein the peripheral flow has a different velocity than the compositionally controlled air.

12. The air treatment system of claim 10, wherein the peripheral flow has a different temperature than the compositionally controlled air.

13. An air treatment system, comprising:

one or more sensors configured to generate sensor data based on a position of an occupant of a bed;

an air control device configured to:

control a property of air to be delivered to the occupant; and

deliver the controlled air to the position of the occupant of a bed; and

a processing circuit configured to:

determine, based on the sensor data, the position of the occupant of the bed; and

control, based on the determined position, operation of the air control device, wherein the air control device is configured to be coupled to the bed.

14. The air treatment system of claim 13, wherein determining the position of the occupant of the bed comprises determining an orientation of the occupant.

15. The air treatment system of claim 13, wherein the air flow is based on the determined position of the occupant.

16. The air treatment system of claim 13, wherein the processing circuit is further configured to:

5 determine, based on the sensor data, a position of an additional occupant of the bed; and

control, based on the determined position of the additional occupant, operation of the air control device such that the delivered air is directed to the occupant and the additional occupant.

10 17. The air treatment system of claim 16, wherein a first air flow of the delivered air to the occupant is different than a second air flow of the delivered air to the additional occupant.

18. The air treatment system of claim 13, further comprising a sensor configured to generate feedback related to the delivered air, wherein the processing circuit
15 is configured to:

receive the feedback related to the delivered air; and

control the operation of the air control device based on the feedback.

19. The air treatment system of claim 18, wherein the processing circuit is
20 configured to maintain, using the feedback, a target value related to the delivered air.

20. The air treatment system of claim 19, wherein the target value is based on a schedule.

21. The air treatment system of claim 19, wherein the target value includes a constant value.

25 22. The air treatment system of claim 19, wherein the target value includes a user preference.

23. The air treatment system of claim 19, wherein the target value is based on a sensed condition.

24. The air treatment system of claim 23, wherein the sensed condition comprises at least one of a sleep state of the occupant, a physiological state of the
5 occupant, and an environmental condition.

25. The air treatment system of claim 13, wherein controlling the operation of the air control device is triggered by at least one of a presence of the occupant, a light level, and a schedule.

26. A method of air treatment, comprising:

10 generating sensor data, with one or more sensors, based on a position of an occupant of a bed;

controlling, with an air control device configured to be coupled to a bed, a property of air to be delivered to the occupant;

15 determining, based on the sensor data, the position of the occupant of the bed;

controlling, with a processing circuit, operation of the air control device based on the determined position; and

delivering the controlled air to the determined position of the occupant of a bed.

20 27. The method of claim 26, further comprising triggering the operation of the air control device by at least one of a presence of the occupant, a light level, and a schedule.

28. The method of claim 26, wherein the air control device is at least one of built-in to a bedframe of the bed, built-in to a mattress of the bed, and an add-on unit for
25 the bed.

29. The method of claim 26, wherein the one or more sensors comprise at least one sensor mounted on the bed.

30. The method of claim 26, wherein controlling the air includes adding an inhalable stimulant to the air.

31. The method of claim 26, wherein the controlled air includes an inhalable medicament.

5 32. The method of claim 26, further comprising:

receiving, from a sensor, feedback related to the occupant; and

controlling the operation of the air control device based on the feedback.

33. The method of claim 32, further comprising altering the controlled air based on the feedback.

10 34. The method of claim 33, wherein the feedback relates to SpO2 levels of the occupant, and wherein altering the compositionally controlled air includes altering at least one of an oxygen proportion of the controlled air, an air proportion of the controlled air, a medicament proportion of the controlled air, a relaxant proportion of the controlled air, and a stimulant proportion of the controlled air.

15 35. The method of claim 33, wherein the feedback relates to at least one of breathing patterns and breathing interruptions of the occupant.

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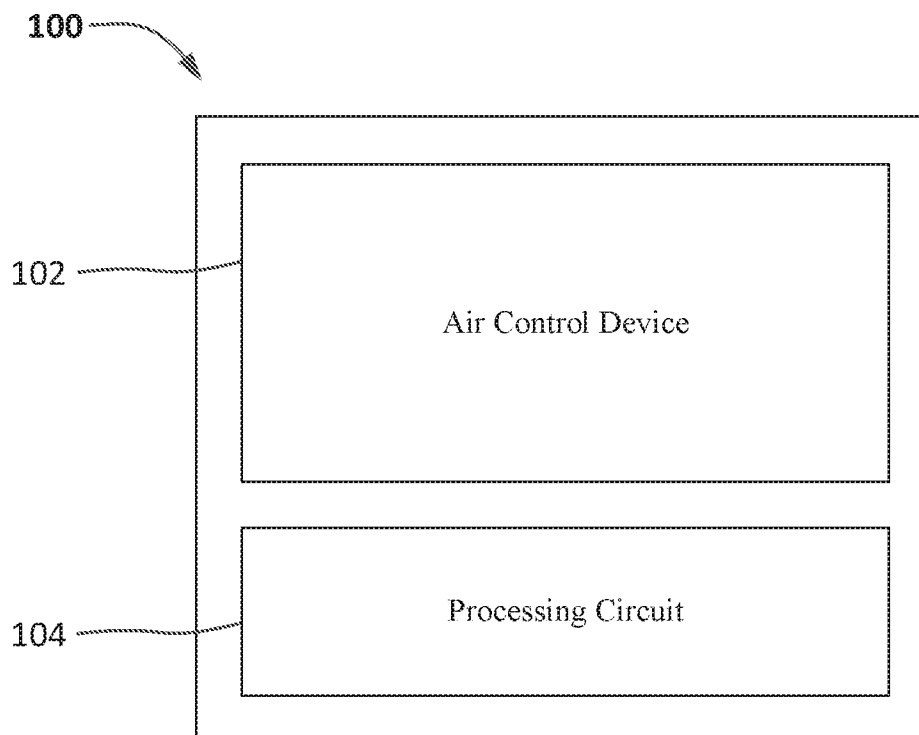


FIG. 1

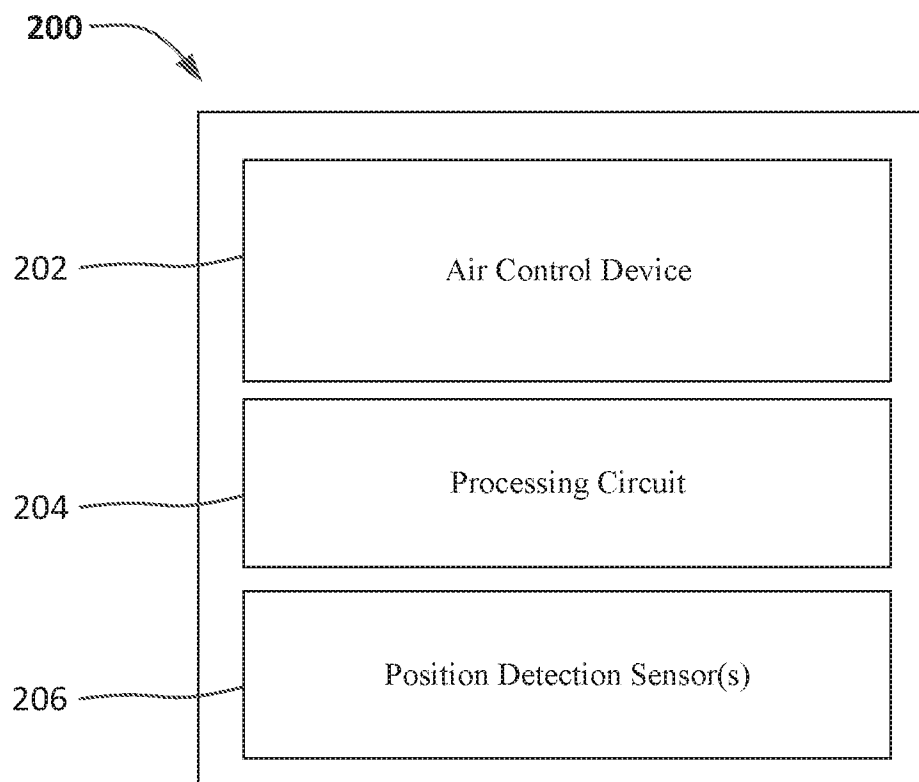


FIG. 2

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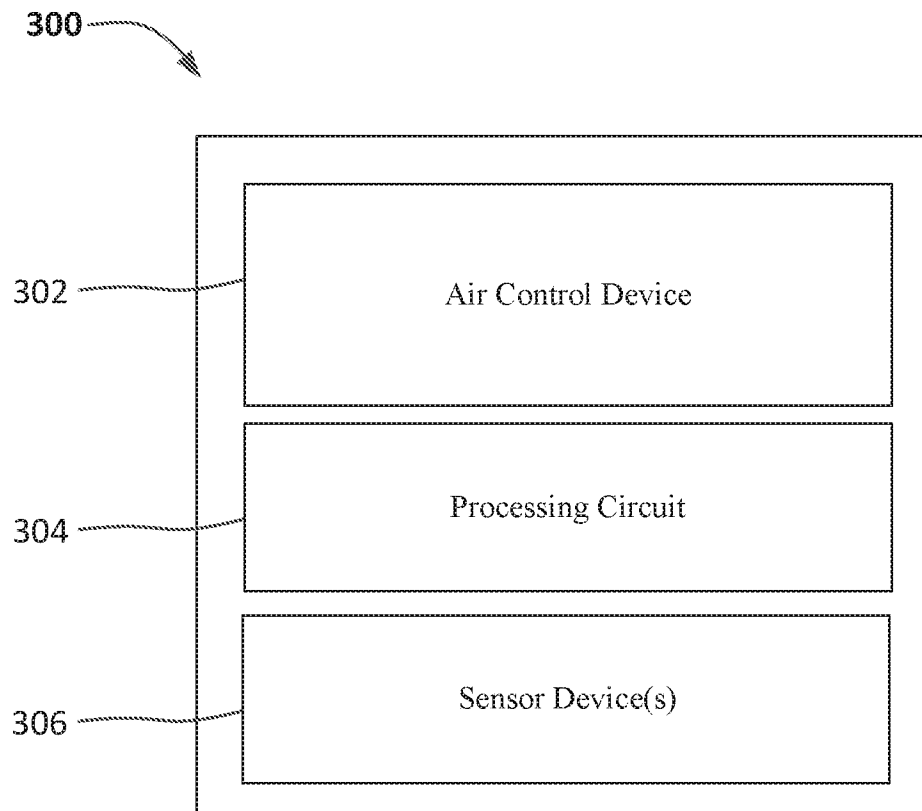


FIG. 3

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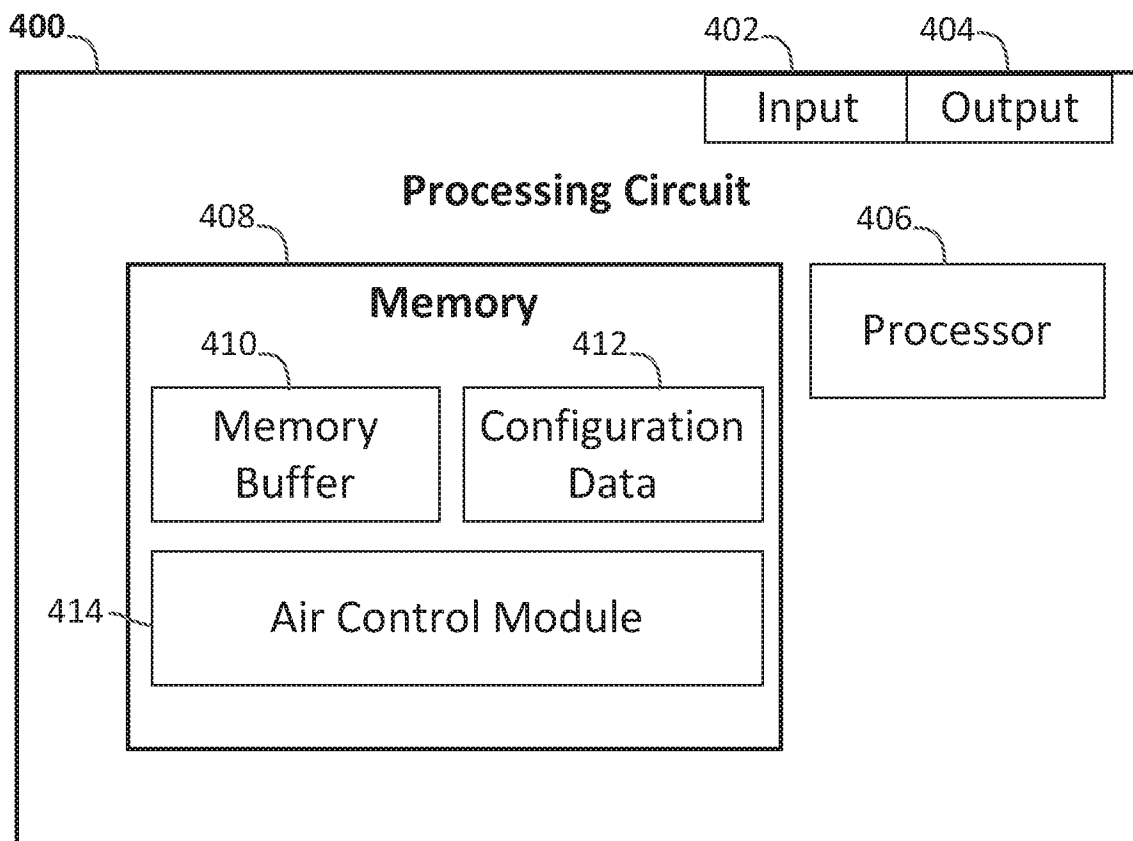


FIG. 4

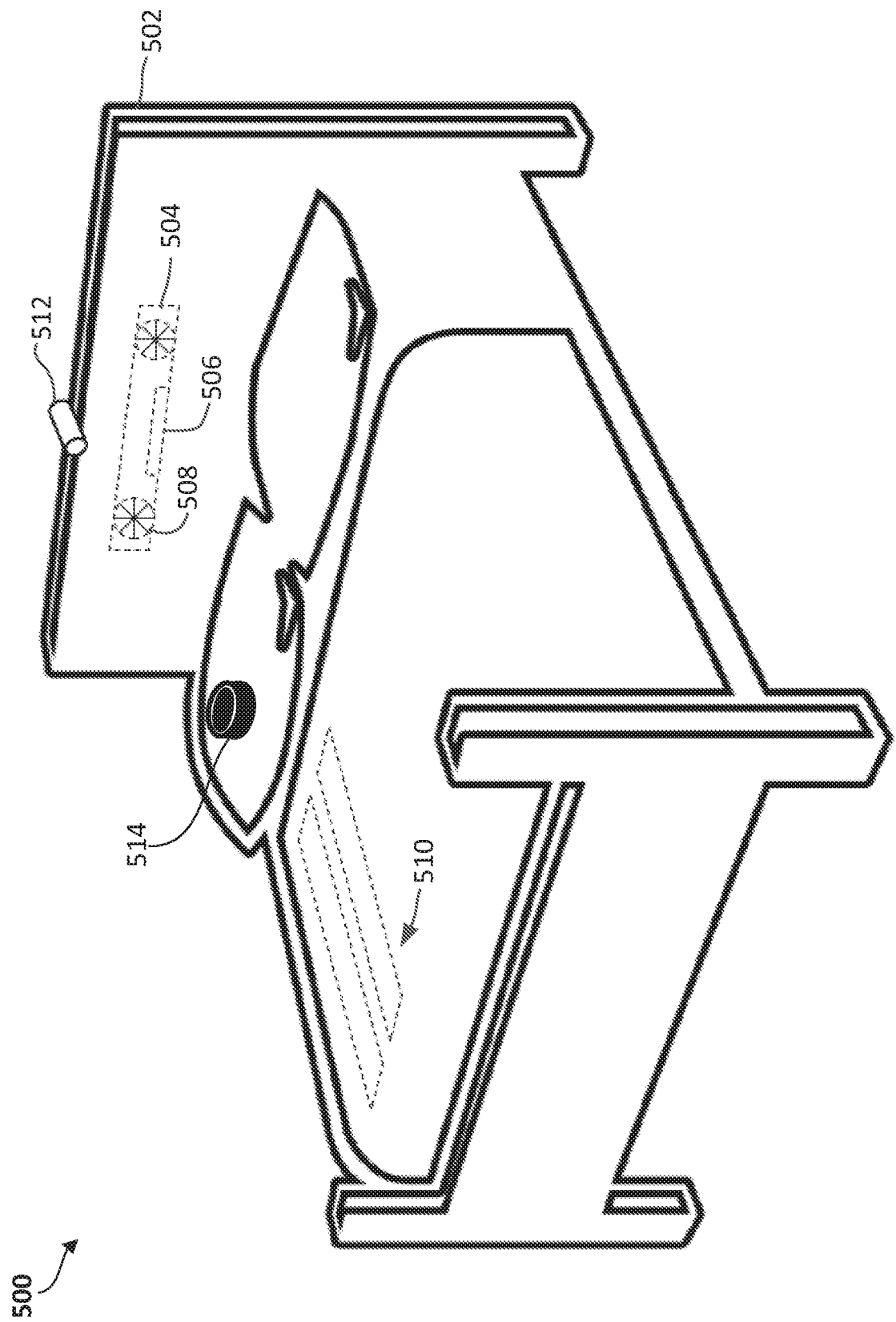


FIG. 5

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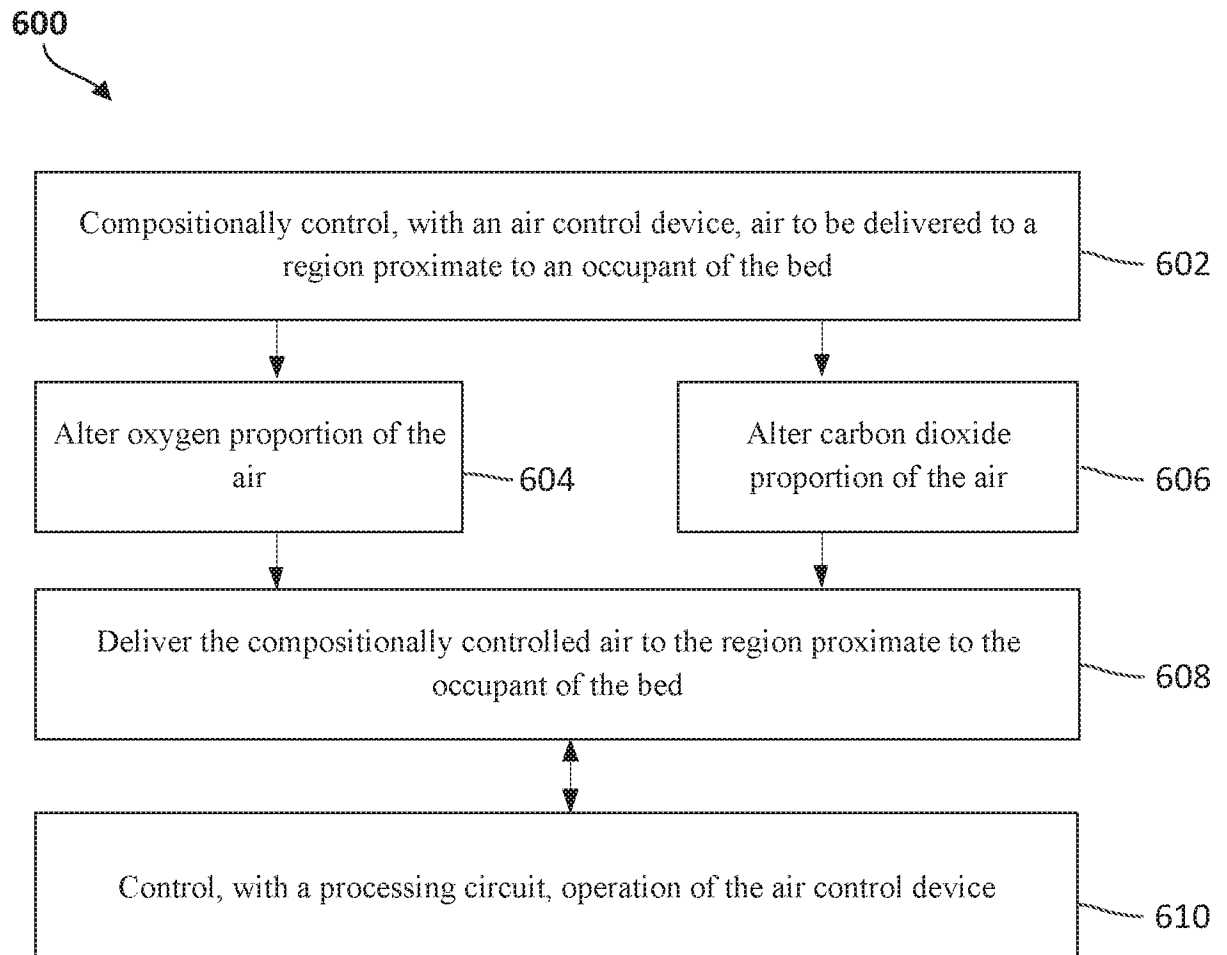


FIG. 6

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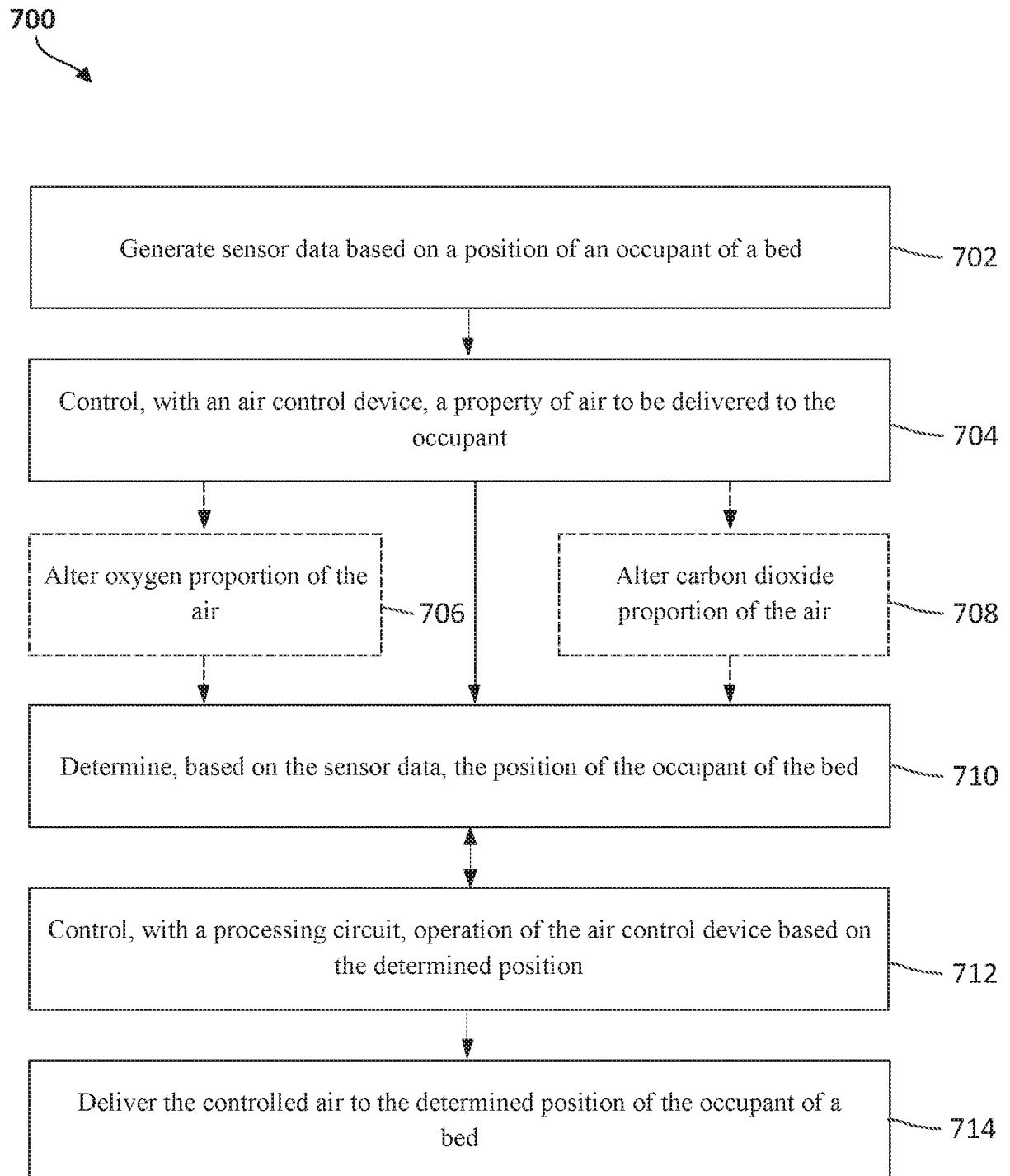


FIG. 7

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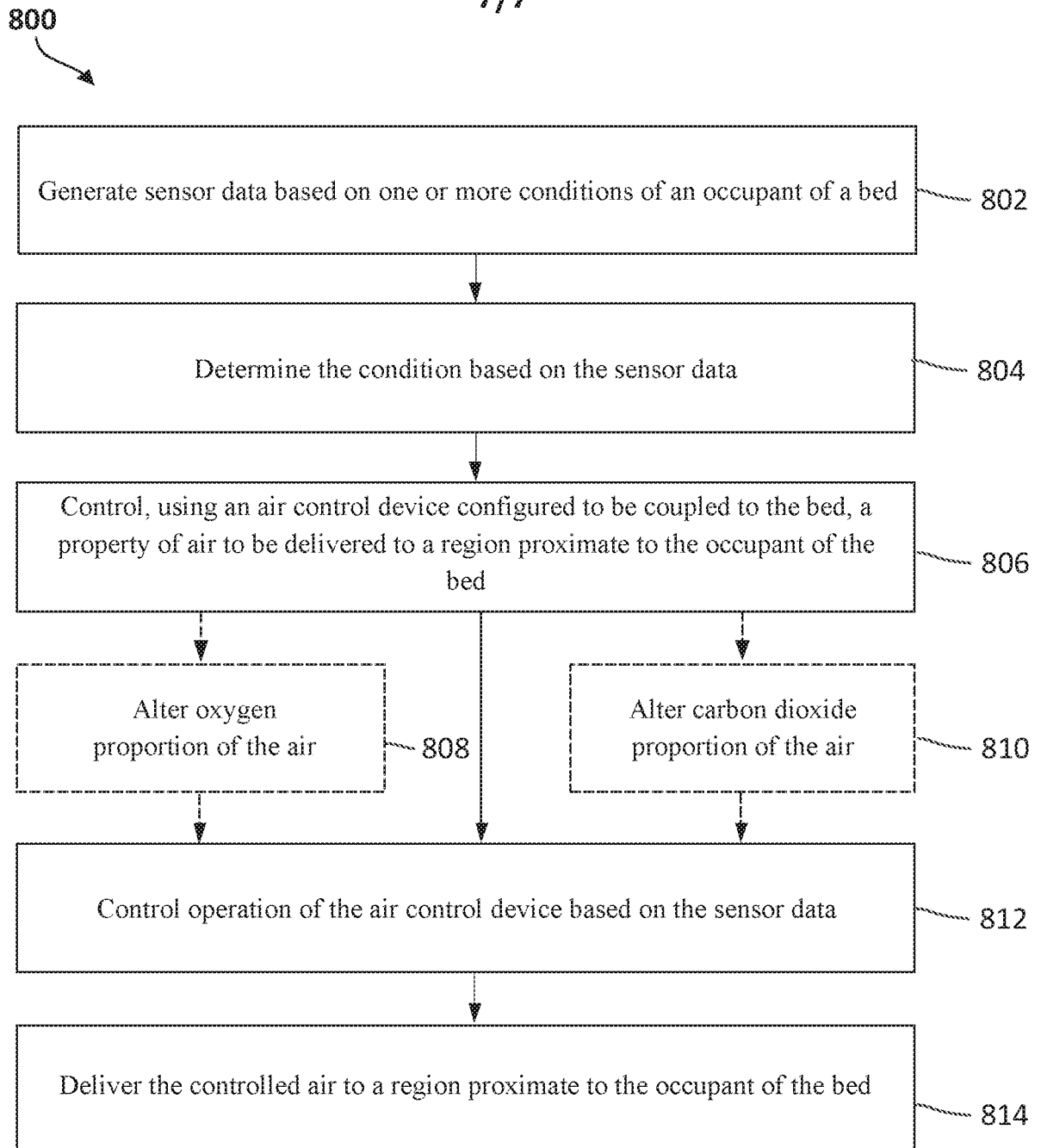


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/065547**A. CLASSIFICATION OF SUBJECT MATTER****A47C 21/04(2006.01)i, A47C 31/00(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47C 21/04; F24F 7/00; A61L 9/22; A61G 7/05; A47C 21/00; A61L 9/01; A47C 31/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords:bed, air treatment system, air control device, processing circuit, and sensor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2011-224029 A (PANASONIC CORP.) 10 November 2011	1,6-19,25-29,32
Y	See paragraphs [0029]-[0030], [0033], [0037], [0041]-[0043] and figures 1-6.	2-5,20-24,30-31,33-35
Y	KR 20-2009-0001156 U (J.C.02, INC.) 02 February 2009	2-5,30-31,34
	See paragraphs [0038], [0040], [0042], [0047]-[0049] and figure 4.	
Y	KR 10-2001-0108853 A (KANG, HYUN KOO) 08 December 2001	20-24,33-35
	See claim 1 and figure 1.	
A	JP 2000-171067 A (IMAI, MICHIKO) 23 June 2000	1-35
	See paragraphs [0017]-[0021] and figures 7-8.	
A	KR 10-2005-0109429 A (HANBAT NATIONAL UNIVERSITY INDUSTRY-ACADEMIC COOPERATION FOUNDATION) 21 November 2005	1-35
	See claim 1 and figure 1.	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 March 2016 (15.03.2016)

Date of mailing of the international search report

15 March 2016 (15.03.2016)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea



Facsimile No. +82-42-472-7140

Authorized officer

PARK, Tae Wook

Telephone No. +82-42-481-3405



INTERNATIONAL SEARCH REPORT

Information on patent family members

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