

INTEGRATED FAN ASSEMBLY FOR BEDS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 63/160,041, filed March 12, 2021. The disclosure of the prior application is considered part of (and is incorporated by reference in) the disclosure of this application.

TECHNICAL FIELD

[0002] This document relates to bed systems, and more particularly, to devices, systems, and methods for cooling a temperature of the bed.

BACKGROUND

[0003] In general, a bed is a piece of furniture used for sleeping and relaxing. Many modern beds include a soft mattress on a bed frame. The mattress may include springs, foam material, and/or an air chamber to support the weight of one or more users. Various features and systems have been used in conjunction with beds, including heating and cooling systems to adjust a temperature of the bed.

SUMMARY

[0004] Some embodiments described herein include a bed system with an integrated fan assembly for directing airflow in a mattress to adjust a temperature of the mattress, such as a temperature at or above a top surface of the mattress. The integrated fan assembly can also provide for adjusting a temperature of interior components of the mattress. Enabling built-up heat to be removed from the mattress can provide for reducing heat more quickly from a microclimate at the top of the mattress at a faster rate. Instead of being located at an exterior of the mattress (e.g., attached to an external surface of the mattress or to a bottom of a foundation that supports the mattress), the fan assembly can be enclosed in the mattress and operate to draw air into the fan assembly, thereby circulating air in the mattress and controlling the microclimate(s) (e.g., temperature) at the top of the mattress. Alternatively, the fan assembly that is enclosed in the mattress can control the microclimate at the top surface of the mattress by

removing and/or drawing air therefrom. As another example, the fan assembly can blow air throughout a bottom of the mattress and not just towards head or foot ends of the mattress. The bottom of the mattress can be made of a breathable material to allow for the air to flow through it. As yet another example, the fan assembly can blow air out from and/or through sides of the mattress. At least a portion of each side of the mattress can be made from a breathable material, and the fan assembly is positioned adjacent to the at least a portion of the side of the mattress so that air from the fan assembly can pass through the at least a portion of the each side of the mattress. In addition, a mattress cover enclosing the mattress (or a portion of the mattress cover that is adjacent to the fan assembly) can also be made of a breathable material to allow for the air to flow through the mattress cover to adjust the temperature of the top of the mattress.

[0005] In some implementations, the fan assembly can be received in a foot rail of a rail structure of the mattress. The foot rail can have a thicker width than a head rail and/or opposite sides (e.g., left and right) rails of the rail structure. The thicker width of the foot rail can provide additional support to the rail structure such that the rail structure does not bend out of the shape of the mattress when weight/movement is applied to the mattress. The thicker width of the foot rail can also make it possible to use the mattress without one or more reinforcement straps. Moreover, the thicker width of the foot rail can allow for the fan assembly to be fully received into a recessed portion of the foot rail without compromising support and structure of the mattress. The opposite side rails can have a thicker width than the head rail of the rail structure to provide additional support for the rail structure. Despite the rails having different widths, the rails (e.g., the head, foot, opposite side rails) can be sized to provide the same interior space for accommodating the inner components (e.g., air chambers, air distribution layers, and associated electronics) while providing the same exterior dimensions (e.g., standardized mattress sizes like king, queen, full, and twin sizes). For example, a total width of the opposite rails (e.g., a total width of the foot and head rails, or a total width of the opposite side rails) can be similar or the same as a total width of rails that are equally sized in other rail structures of same or similar mattresses. As a result, the same components used in the other mattresses can also be used with the mattress having the differently sized rails. For example, air chambers of the other mattresses can be placed in the mattress having the differently sized rails since a total amount of space created by the rail structure in the mattress is the same as a total amount of space created by the

equally sized rail structure in the other mattresses. Using the same components for the different mattresses can provide for ease and efficiency of manufacturing, assembling, delivering, and maintaining the mattresses.

[0006] The fan assembly can be oriented to create airflow along one or more directions to draw air from the top of the mattress. For example, the fan assembly can draw air from the top of the mattress and discharge exhaust air into the foot rail of the rail structure and/or towards a side rail of the rail structure (e.g., a right side rail or a left side rail). The fan assembly can be fully received in a recessed portion of the foot rail. The foot rail and/or other rails in the rail structure can be made of a foam or other materials that allow the exhaust air to pass through and finally discharge to the surroundings of the mattress.

[0007] Moreover, the mattress can include a base pad (e.g., bottom layer) that attaches to the rail structure and encloses components of the mattress therein. The base pad can be split longitudinally down a midpoint of the base pad, thereby creating two flaps of the base pad that can be opened and closed. The edges of the base pad can be adhered to side rails of the rail structure to facilitate the opening and closing of the base pad flaps from the midpoint of the base pad. This configuration of the base pad can provide for ease of access to components of the mattress.

[0008] In some implementations, the fan assembly can be received at a side of an interior of the mattress, and oriented to create airflow along one or more directions that may effectively draw the air from the top of the mattress. The fan assembly can be arranged to draw air from the top of the mattress and discharge it along the side of the interior of the mattress at the bottom of the mattress. For example, the fan assembly can be disposed (e.g., positioned) at a side or foot of the mattress interior. In another example, the fan assembly can be positioned at the head of the mattress interior. An air inlet of the fan assembly is oriented toward the top surface of the mattress, and an air outlet of the fan assembly is oriented towards a head end or a foot end of the mattress such that the fan assembly can draw air from the top of the mattress and discharge the air toward the head end or the foot end along the side of the mattress. In some implementations, the fan assembly may be oriented such that it can discharge the air towards the side of the mattress (e.g., the side (e.g., a foot side) at which the fan assembly is positioned, or its adjacent side (e.g., either or both of lateral sides extending between the foot and head sides)) and/or along

the inside of the mattress. The fan assembly can include a duct that defines the air inlet positioned close to one or more layers that may constitute the mattress top. The duct can extend vertically or horizontally along the side of the mattress toward the bottom or side of the mattress such that the air drawn at the mattress top can be routed through the duct and discharged at the mattress side or bottom. The fan assembly can be positioned within recessed portions defined at one or more layers of the mattress, such as a rail structure that at least partially defines the side of the mattress. As a result, the fan assembly can be integrated into the mattress without obstructing one or more components of the mattress, such as inflatable air chambers, air chamber hoses, and/or other components.

[0009] In some implementations, the fan assembly is configured in a relatively small form factor that is suitable to be fully received within the mattress without interfering with other components such as pneumatic and electrical elements in the mattress. For example, the fan assembly can be configured in a compact case and only be operated to provide a simple functionality, such as drawing ambient air into the case and discharging it out of the case. In some implementation, the fan assembly does not include other microclimate functionalities, such as heating air, cooling air, etc. which would otherwise require more spacing in the case and thus increase the size of the fan assembly.

[0010] Particular embodiments described herein include a mattress including a first layer having a first layer top and a first layer bottom; a head rail attached to the first layer bottom; a foot rail attached to the first layer bottom and defining a first recessed portion; and a first air module configured to create airflow between the first layer top and the first layer bottom, the first air module being positioned in the first recessed portion of the foot rail.

[0011] In some implementations, the system can optionally include one or more of the following features. For example, the mattress can further include a first side rail extending longitudinally and connecting a first edge of the head rail with a first edge of the foot rail; a second side rail opposite the first side rail, extending longitudinally, and connecting a second edge of the head rail with a second edge of the foot rail; and one or more additional layers positioned under the first layer bottom between the first side rail and the second side rail. The one or more additional layers can include a core, and a second layer positioned under the core and covering the core between the first side rail and the second side rail. The mattress can

include a thermal layer attached to the first layer bottom. The thermal layer (i) is configured to extend a first distance longitudinally between the head rail and the foot rail and (ii) is offset a second distance from at least one of the first side rail and the second side rail. The thermal layer can be positioned closer to the foot rail than the head rail of the mattress. The mattress can include an air duct hose configured to fluidly connect the first air module to the thermal layer. The first air module is configured to draw air from the thermal layer through the air duct hose, and discharge the drawn air out into the foot rail. The first air module is configured to draw air from the first layer and direct exhaust air into the foot rail and towards the first side rail of the mattress. The first air module is configured to draw air from the first layer and direct exhaust air into the foot rail and towards the second side rail of the mattress. The first air module is configured to draw air from the first layer and direct exhaust air into the foot rail of the mattress. The first recessed portion is configured to at least partially receive the first air module. The first air module can include a housing that defines an air inlet and an air outlet; and a fan assembly enclosed in the housing and configured to suction air through the air inlet and supply exhaust air through the air outlet. The first air module can include wiring that is electrically connected to the fan assembly and extending from the housing, the wiring configured to electrically connect to a power source external to the mattress and supply electrical power to the fan assembly. The mattress can include a second recessed portion defined in the foot rail proximate the first recessed portion; and a second air module configured to create airflow and positioned inside the second recessed portion of the foot rail. The second air module is configured to draw air from the first layer and direct exhaust air in a same direction in the foot rail as exhaust air that is directed by the first air module. The second air module is configured to draw air from the first layer and direct exhaust air in a different direction in the foot rail as exhaust air that is directed by the first air module. The first air module can define an air outlet that is configured to discharge air into the foot rail of the mattress. The first air module is configured to draw air from the first layer and direct exhaust air into the foot rail towards an interior of the mattress. The mattress can include a bottom layer positioned under the first layer. The bottom layer can extend from the head rail to the foot rail of the mattress. The bottom layer can include first and second portions that extend laterally between the head rail and the foot rail along a predetermined axis of the bottom layer. The first and second portions of the bottom layer can be laminated to respective first and second

side rails of the mattress. The first and second portions are configured to be opened from the predetermined axis of the bottom layer to expose at least a portion of the first layer, the head rail, the foot rail, and the first air module in the recessed portion of the foot rail of the mattress. The bottom layer can include first and second openings in the respective first and second portions of the bottom layer. The first and second openings are configured to route wires from at least the first air module along at least one side of the mattress.

[0012] Particular implementations of the present disclosure provide a mattress that includes a first foam layer having a top surface and an opposite bottom surface; an inflatable chamber positioned below the bottom surface of the first foam layer; a foam rail structure including a head portion, a foot portion, and first and second side portions, the foam rail structure extending from a periphery of the first foam layer around a perimeter of the mattress and configured to surround the inflatable chamber; a mattress bottom that covers the inflatable chamber, and an air source configured to create airflow and positioned under the inflatable chamber, above the mattress bottom, and in the foot portion of the foam rail structure.

[0013] In some implementations, the system can optionally include one or more of the following features. For example, the air source is a first air module. The mattress can include a second foam layer positioned under the inflatable chamber and covering at least a portion of the inflatable chamber between the head portion, the foot portion, and the first and second side portions of the foam rail structure. The air source is configured to draw air from the second foam layer and direct exhaust air into the foot portion of the foam rail structure. The air source is configured to draw air from the first foam layer and direct exhaust air into the foot portion of the foam rail structure and towards the first side portion or the second side portion of the foam rail structure. The foot portion of the foam rail structure can define a first rail recessed portion configured to receive the air source. The foot portion of the foam rail structure has a first width, the head portion of the foam rail structure has a second width, the first and second portions of the foam rail structure have a third width, and the first width can be greater than the second and third widths, and the second width can be less than the third width. The air source can include a housing that defines an air inlet and an air outlet; a fan assembly enclosed in the housing and configured to suction air through the air inlet and supply exhaust air through the air outlet; one or more sensors configured to generate signals representative of at least one of temperature,

humidity, and flame; a controller included in the housing that is configured to control operations of the fan assembly and receive the signals from the one or more sensors; and wiring that is electrically connected to the controller and the fan assembly. The wiring extends from the housing and is configured to electrically connect to a power source external to the mattress and supply electrical power to the controller and the fan assembly. The inflatable chamber can be a mattress core.

[0014] Particular embodiments described herein include a mattress having a first layer with a first layer top and a first layer bottom and extending from a first edge to a second edge, a first side rail proximate the first edge, a second side rail proximate the second edge, one or more additional layers positioned under the first layer bottom between the first side rail and the second side rail, and a first air module configured to create airflow and positioned between the first side rail and at least one of the one or more additional layers.

[0015] In some implementations, the system can optionally include one or more of the following features. For example, the one or more additional layers can include a core, and a second layer positioned under the core and covering the core between the first side rail and the second side rail. The first air module can be configured to draw air from the first layer and direct exhaust air between the first side rail and the second layer. The mattress can define a first channel between the first side rail and the second layer, the first channel can be configured to permit flow of the exhaust air between the first side rail and the second layer. The second layer can define a layer recessed portion at a side of the second layer that can be adjacent to the first side rail, the layer recessed portion can define the first channel between the first side rail and the second layer. The layer recessed portion can extend at least partially along a length of the second layer.

[0016] As another example, the first air module can be configured to draw air from the first layer and direct exhaust air along the first side rail toward a foot side of the mattress. The first air module can be configured to draw air from the first layer and direct exhaust air along the first side rail toward a head side of the mattress. The first side rail can define a first rail recessed portion that can be configured to at least partially receive the first air module. The mattress system can also include a first strap connected to the first side rail and the second side rail at a

connection location such that the first strap can extend under the one or more additional layers from a bottom of the first side rail to a bottom of the second side rail.

[0017] As another example, the first air module can include a housing that can define an air inlet and an air outlet, and a fan assembly that can be enclosed in the housing and can be configured to suction air through the air inlet and supply exhaust air through the air outlet. The first air module can include wiring that can be electrically connected to the fan assembly and extending from the housing, the wiring can be configured to electrically connect to a power source external to the mattress and supply electrical power to the fan assembly. The first layer, the first side rail, and the second side rail can include one or more foam materials. The one or more additional layers can include an inflatable air chamber. The first layer, the first side rail, and the second side rail can be part of an upside-down foam tub, wherein the upside-down foam tub further can include a foot rail and a head rail.

[0018] As yet another example, the mattress system can include a second air module that can be configured to create airflow and positioned between the second side rail and the one or more additional layers under the first layer bottom. The second air module can be configured to draw air from the first layer and direct exhaust air in a same direction as exhaust air that can be directed by the first air module. The second air module can be configured to draw air from the first layer and direct exhaust air in a different direction of exhaust air that can be directed by the first air module.

[0019] As another example, the mattress can define a second channel between the second side rail and the second layer, the second channel can be configured to direct exhaust air between the second side rail and the second layer. The second layer can define a layer recessed portion at a side of the second layer that can be adjacent to the second side rail, the layer recessed portion defining the second channel between the second side rail and the second layer. A second air module can be configured to draw air from the second layer and can direct exhaust air through the second channel between the second side rail and the second layer. The first rail recessed portion can be offset from a first duct that can be configured to inflate a first air chamber of the one or more additional layers.

[0020] Particular embodiments described herein can also include a mattress including a first foam layer having a top surface and an opposite bottom surface, an inflatable chamber positioned

below the bottom surface of the first foam layer, a foam rail structure including a rail top, a rail bottom, a rail inner side, and a rail outer side, the foam rail structure extending from a periphery of the first foam layer and configured to surround the inflatable chamber, a mattress bottom that covers the inflatable chamber, and an air source that can create airflow and positioned under the inflatable chamber, above the mattress bottom, and interior of and adjacent to the rail inner side.

[0021] In some implementations, the system can optionally include one or more of the following features. For example, the air source can be a first air module. The mattress can also include a second foam layer positioned under the inflatable chamber and covering the inflatable chamber between the rail inner side and the rail outer side. The air source can be configured to draw air from the second foam layer and direct exhaust air between the rail inner side and the second foam layer. The mattress can define a first channel between the rail inner side and the second foam layer, the first channel can be configured to direct exhaust air between one of side foam rails of the foam rail structure and the second foam layer. The second foam layer can define a layer recessed portion at a side of the second foam layer that can be adjacent to the rail inner side, the layer recessed portion can define the first channel between the rail inner side and the second layer. The layer recessed portion can extend at least partially along a length of the second foam layer. The air source can be configured to draw air from the first foam layer and direct exhaust air toward a foot side of the mattress. The air source can be configured to draw air from the first foam layer and direct exhaust air toward a head side of the mattress. The rail inner side can define a first rail recessed portion that can be configured to at least partially receive the air source.

[0022] As another example, the mattress system can also include a first strap that can be connected to the rail inner side and the rail outer side at connection locations such that the first strap can extend under the inflatable chamber from a bottom of the rail inner side to a bottom of the rail outer side. The air source can include a housing that can define an air inlet and an air outlet, and a fan assembly enclosed in the housing and configured to suction air through the air inlet and supply exhaust air through the air outlet. The air source can include wiring that can be electrically connected to the fan assembly and extending from the housing, the wiring can be configured to electrically connect to a power source external to the mattress and supply electrical power to the fan assembly.

[0023] As another example, the first foam layer, the rail inner side, the rail outer side, the rail top, and the rail bottom can include one or more foam materials. The inflatable chamber can be a mattress core. The first foam layer, the rail inner side, and the rail outer side can be part of an upside-down foam tub, wherein the upside-down foam tub further can include a foot rail and a head rail. The mattress can also include a second air source that can be configured to create airflow and can be positioned under the inflatable chamber, above the mattress bottom, and interior of and adjacent to the rail outer side. The air source can be configured to draw air from the first foam layer and direct exhaust air in a first direction and the second air source can be configured to draw air from the first foam layer and direct exhaust air in a second direction. The first direction can be same as the second direction. The first direction can be different than the second direction. The layer recessed portion can extend from a middle axis of the second layer and can taper towards a first corner of the second layer. The layer recessed portion further can extend from the middle axis of the second layer and can taper towards a second corner of the second layer, wherein the second corner can be opposite the first corner along a same side of the second layer. The first corner can be proximate to a head portion of the mattress and the second corner can be proximate to a foot portion of the mattress.

[0024] As yet another example, the first side rail can be attached to the first layer bottom at the first edge of the first layer, and the second side rail can be attached to the first layer bottom at the second edge of the first layer. The mattress can define a first flow path configured for the airflow created by the first air module, the first flow path being bound by a side surface of the first side rail and a corresponding side surface of the at least one additional layer. The at least one additional layer can be a bottom layer that covers a core between the first and second side rails. The mattress can also include a mattress cover including a top panel, a bottom panel, and opposing side panels, wherein the first flow path can further be bound by a bottom surface of the core and a top surface of the bottom panel of the mattress cover. The core can include an air chamber.

[0025] As another example, a width of the first flow path between the side surface of the first side rail and the corresponding side surface of the bottom layer can vary in a longitudinal direction along the first side rail. The corresponding side surface of the bottom layer can include a tapered surface that can be angled relative to the side surface of the first side rail that can face

the corresponding side surface of the bottom layer. The width of the first flow path can decrease from a location at which the first air module is positioned, toward either of a head side of the mattress or a foot side of the mattress. The width of the first flow path can vary along an entire length of the bottom layer. The first flow path can extend to a corner of the bottom layer. The first flow path can extend vertically along at least part of the sides of the mattress. The first flow path can be defined along at least one foam layer between a mattress top and a mattress bottom. The mattress top can include a mattress cover, and the mattress bottom can include a bottom layer.

[0026] As another example, the first air module can include an air duct that can define an air inlet exposed toward the first layer and configured to draw air from the first layer. The first air module can define an air outlet that can be configured to discharge air toward a channel defined between the first side rail and at least one of the one or more additional layers. The first air module can be configured to draw air from the first layer and direct exhaust air out a side of the mattress towards the first side rail. The first air module can be configured to draw air from the first layer and direct exhaust air towards an interior of the mattress.

[0027] The devices, system, and techniques described herein may provide one or more of the following advantages. First, some embodiments described herein provide for non-obtrusive arrangement of components of the mattress. The fan assembly can be small and integrated into a recessed portion of a rail structure of the mattress. The fan assembly may not be positioned outside of the mattress system. Thus, the fan assembly can be hidden from view. Since the fan assembly is located and enclosed within the recessed portion inside the mattress, the fan assembly also may not obstruct configuration and/or operation of other components of the mattress. For example, the positioning of the fan assembly may not create a bump in any layers of the mattress or create an uneven surface of the mattress. A user laying on top of the mattress, therefore, may not notice that the fan assembly is positioned within the mattress. As another example, the positioning of the fan assembly may not interfere with positioning and operation of other components, such as hoses, cables, housing components, ports, and/or air chambers. The fan assembly, inside the recessed portion, can be offset from a middle axis of the mattress or another portion of the mattress where hoses and/or ports are already integrated into the mattress. The hoses and/or ports may be configured to provide airflow to one or more inflatable air

chambers in a core of the mattress. The fan assembly can be positioned proximate to such hoses and/or ports so as to not interfere with configuration and operation of such hoses and/or ports. This offset positioning can be advantageous when manufacturing the mattress. This is because configuration of traditional hoses and/or ports does not have to be modified to accommodate for the fan assembly, which is also being integrated into the mattress during mattress production. Instead of changing configuration of any existing components of the mattress, recessed portions in the rail structure can merely be made offset from the existing components and the fan assembly can be positioned therewithin. The fan assembly can still operate to provide airflow to cool a temperature of the mattress regardless of placement or orientation of the fan assembly in the rail structure.

[0028] Second, some embodiments described herein provide for less expensive production and maintenance of the mattress and/or the integrated fan assembly. For example, the fan assembly may not require coupling or connection with a foundation. Thus, should the fan assembly require servicing, the fan assembly can be accessed from just the mattress. Servicing may not require accessing to the foundation that supports the mattress. Moreover, as described above, integrating the fan assembly into the mattress during mattress production can be a simple and less expensive process. For example, integrating the fan assembly can be less expensive because integration may only require defining a recessed portion in one or more components of the mattress, such as the rail structure and/or a bottom layer of the mattress. Once the recessed portion is defined, the fan assembly can be fastened therewithin. As another example, integration can be a simple process because the recessed portions can be defined in the mattress based on where other components (e.g., hoses, air chamber ports, etc.) are traditionally positioned in the mattress. Location of the recessed portions does not affect ability of the fan assembly to direct airflow to one or more portions of the mattress. Thus, integrating the fan assembly into any portion of the mattress along the rail structure while accommodating for integration of additional mattress components can be a simple, quick, and easier manufacturing process. Further, when the bed is installed at a customer's site, there is no need of additional procedures to assemble the fan assembly to a designated location external to the mattress, such as a bottom of the foundation that supports the mattress. Moreover, the mattress that fully encloses the fan assembly does not need to provide a dedicated feature to fluidly connect the fan assembly to the mattress.

[0029] Third, some embodiments described herein can provide for continued operation of existing, traditional, and/or other components of the mattress. For example, offsetting the recessed portions and fan assemblies placed therewithin can provide for continued and unobstructed operation of air chamber hoses and/or ports. Thus, air chambers of the mattress can be inflated and/or deflated using known or conventional techniques while the fan assemblies can provide nonobtrusive airflow through and around components of the mattress system. As another example, wires of the fan assembly can be routed out of the mattress so that the wires do not conflict with components of the mattress or a foundation. As a result, the mattress can be placed on any type of foundation. The wires of the fan assembly may not require passing through or being configured to any components inside the foundation, such as control modules. Not only does this configuration provide for continued operation of existing components of the mattress and the foundation, it also provides for easier and less expensive production and maintenance of the mattress and/or the fan assembly therewithin.

[0030] Fourth, some embodiments described herein can provide for directing targeted airflow from a top surface of the mattress. This direction of airflow is advantageous to reduce or lower a temperature of the top surface of the mattress. Airflow can be directed toward and into the fan assembly at or adjacent to the mattress top and discharged along a predetermined direction at the mattress bottom so that the air at the mattress top can be drawn out without being circulated or distributed through or around other components of the mattress that would hinder effective air circulation from/toward the mattress top. As a result, a temperature of the top surface of the mattress can be reduced or lowered more efficiently and/or quickly.

[0031] Alternatively, the fan assembly can be used to provide targeted airflow toward the mattress top through and around components of the mattress, such as air chambers and various layers. Although air directed through such components can provide a cooling effect, the cooling effect can be minimal because such components can be made from non-air-permeable or less air-permeable materials (e.g., foam). With the disclosed fan assembly, air can be directed along air channels created by the recessed portions such that the air flows more directly towards the top surface of the mattress and around one or more layers (e.g., non-air-permeable layers) or components of the mattress. As a result, a temperature of the top surface of the mattress can be reduced or lowered more efficiently and/or quickly. With the disclosed fan assembly, some air

can still be directed through one or more layers (e.g., non-air-permeable layers) or components of the mattress to provide for an additional cooling effect to reduce an overall temperature of the mattress. By providing airflow around layers and/or components of the mattress as well as through such layers and/or components, the fan assembly can be more effective and faster in cooling or lowering a temperature of the mattress.

[0032] Fifth, some embodiments described herein provide for airflow to be directed in any orientation of the fan assembly. Therefore, the airflow that is drawn from the mattress top can be directed in one or more different areas or portions of the mattress that allow the air to be effectively discharged out of the mattress. For example, the fan assembly can be oriented in the recessed portion of the rail structure so as to discharge the drawn air towards a side or head portion of the mattress. The discharged air can then be directed through the channel created by the recessed portion towards the side or head portion of the mattress. The channel created by the recessed portion along the side of the mattress provides an air exhaust path of the least resistance and escape out of the mattress. In some implementations, such airflow may additionally provide a cooling effect in that area of the mattress. As another example, the fan assembly can be oriented towards a foot portion or another side portion of the mattress such that airflow can be directed through the channel created by the recessed portion towards the foot portion of the mattress. The channel created by the recessed portion along the foot or side of the mattress provides an air exhaust path of the least resistance and escape out of the mattress. In some implementations, this may additionally provide a cooling effect that targets the foot portion of the mattress. The air can flow through the channel defined by the recessed portion of the rail structure to provide a more direct cooling effect on the top surface of the mattress. The air can also flow through one or more layers and/or components of the mattress by being expelled from the air outlets of the fan assembly, where such air outlets are directed towards the layers and/or components of the mattress. This configuration can be advantageous to reduce an amount of time it takes to lower an overall temperature of the mattress. In some implementations, the recessed portion and associated channel can be symmetrically sized and/or configured such that the fan assembly can be oriented in any desired direction (e.g., towards either side portion of the mattress, the head portion, or the foot portion of the mattress) to provide airflow in the desired direction.

[0033] Seventh, some embodiments described herein can provide for a small and compact fan assembly. As described above, the fan assembly can have a simple and small configuration so as to not be intrusive with operation and configuration of other components of the mattress. Moreover, since the fan assembly can be used to provide a cooling option to portions of the mattress without other options available such as heating and cooling, the fan assembly can be smaller and simpler than an assembly that provides heating and cooling. The fan assembly can have a simple configuration because the fan assembly can circulate ambient air to naturally lower a temperature at the top of the mattress. The fan assembly may not require additional components to generate conditioned air to then provide to portions of the mattress. This simple configuration provides for a smaller size, which makes integration of the fan assembly into the rail structure of the mattress easier and less obtrusive. Moreover, such a simple configuration, makes servicing or repairing of the fan assembly simpler as well.

[0034] The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] FIG. 1 illustrates an example bed system having an integrated fan assembly as described herein.

[0036] FIG. 2 is a bottom perspective view of a mattress system, illustrating the mattress system upside down.

[0037] FIG. 3 is a partial exploded view of the mattress system of FIG. 2, illustrating a top layer, an intermediate layer, an example air chamber assembly, and the integrated fan assembly.

[0038] FIG. 4 illustrates a bottom perspective view of the mattress system of FIG. 2 with a set of reinforcement straps removed and the integrated fan assembly in place.

[0039] FIG. 5 is a perspective view of the integrated fan assembly.

[0040] FIG. 6 illustrates a recessed view of airflow through the mattress system.

[0041] FIG. 7 illustrates a side cross sectional view of airflow through the mattress system of FIG. 6.

- [0042] FIG. 8 is a bottom view of an example mattress system having the integrated fan assembly.
- [0043] FIG. 9 is another bottom view of the example mattress system of FIG. 8 having the integrated fan assembly.
- [0044] FIG. 10 is another bottom view of the example mattress system of FIG. 8 having the integrated fan assembly.
- [0045] FIG. 11 is a bottom view of another example mattress system having the integrated fan assembly.
- [0046] FIG. 12 is a bottom view of another example mattress system having the integrated fan assembly.
- [0047] FIG. 13A is a perspective view of the integrated fan assembly in the mattress system.
- [0048] FIG. 13B is a top view of the integrated fan assembly in the mattress system of FIG. 13A.
- [0049] FIG. 13C is a side perspective view of the integrated fan assembly in the mattress system of FIG. 13A.
- [0050] FIG. 14 illustrates an example bed system for providing a quality sleep experience with an example local bed system.
- [0051] FIG. 15 illustrates another fan assembly integrated into another example mattress system.
- [0052] FIG. 16 is a bottom perspective view of the mattress system of FIG. 15, illustrating the mattress system upside down.
- [0053] FIG. 17 is a partial exploded view of the mattress system of FIG. 16.
- [0054] FIG. 18 illustrates a bottom perspective view of the mattress system of FIG. 16.
- [0055] FIG. 19 is a perspective view of the integrated fan assembly of FIG. 15.
- [0056] FIG. 20 illustrates a recessed view of airflow through the mattress system of FIG. 16.
- [0057] FIG. 21 illustrates a side cross sectional view of airflow through the mattress system of FIG. 20.
- [0058] FIG. 22 is a bottom view of an example mattress system having the integrated fan assembly of FIG. 15.

[0059] FIG. 23 is another bottom view of the example mattress system of FIG. 22 having the integrated fan assembly.

[0060] FIGS. 24A-B illustrate a bottom view of a bottom layer of an example mattress system having the integrated fan assembly of FIG. 15.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0061] This document generally pertains to a bed system with an integrated fan assembly for directing airflow around and/or in a mattress to adjust a temperature of the mattress.

[0062] FIG. 1 illustrates an example bed system 100 having an integrated fan assembly 110 as described herein. In this example, the bed system 100 includes a mattress 101 and a foundation 103, which can be configured to be identical or similar to the mattresses and the foundations described herein. The mattress 101 can have a mattress core, which is configured to support a user resting on the mattress 101. In some implementations, the mattress core can have one or more inflatable air chambers. Moreover, in other implementations, the mattress 101 can be configured as a climate-controlled mattress.

[0063] As depicted, the mattress 101 can include a top layer 102, a rail structure 106, a bottom layer 108, and air chambers. The integrated fan assembly 110 depicted and described herein can be attached or configured to a portion of the rail structure 106. For example, the fan assembly 110 can be disposed (e.g., positioned) at opposing left and right sides of the rail structure 106. As described herein, the fan assembly 110 can be received in a recessed portion of each of the opposing left and right sides of the rail structure 106. As a result, the fan assembly 110 may not interfere with other components of the mattress 101, such as the bottom layer 108, the air chambers, and/or the top layer 102. The fan assembly 110 can also be mounted to an air duct hose 111, as shown in FIG. 1. The fan assembly 110 can connect to the air duct hose 111 using one or more different fastening means, such as snaps, zipper, adhesive, and/or buttons. For example, as shown in FIG. 1, the fan assembly 110 can be snap fitted to a top opening of the air duct hose 111. As described herein, the air duct hose 111 can extend from an airflow insert pads 122 in the mattress 101. In some implementations, at least a portion of the hose 111 can be made of a silicon material and configured to be fitted around an air opening (e.g., an air inlet 710 in FIG. 5) of the fan assembly 110. As shown, the fan assembly 110 mounted to the air duct hose

111 can be positioned closer to a head side or a foot side of the mattress 101. The fan assembly 110 and the hose 111 may be offset from a midpoint of the mattress 101.

[0064] The fan assembly 110 can be configured to cool a top surface of the mattress 101 by, for example, drawing air from a top of the mattress and discharging it at a bottom of the mattress. In additional or alternatively, the fan assembly 110 can be configured to circulate ambient air or conditioned air (e.g., heated or cooled air) around or through one or more of the components in the mattress 101 to control a microclimate (e.g., increase or decrease a temperature or humidity) at the top surface of the mattress 101.

[0065] In other words, the mattress 101 can include a first layer (e.g., the top layer 102) having a first layer top (e.g., a top surface) and a first layer bottom (e.g., a bottom surface) and extending from a first edge to a second edge. The mattress 101 can also include a first side rail attached to the first layer bottom proximate the first edge and a second side rail attached to the first layer bottom proximate the second edge (e.g., opposing left and right sides of the rail structure 106). A core (e.g., inflatable air chamber) can be positioned under the first layer bottom between the first side rail and the second side rail. A first air module (e.g., the fan assembly 110, an air conditioning module) can also be included in the mattress 101 and configured to create airflow. The first air module can be disposed between the first side rail and the core under the first layer bottom. A second layer (e.g., the bottom layer 108) can also be disposed under the core and covering the core between the first side rail and the second side rail. The first air module can be configured to draw air from the first layer and direct exhaust air between the first side rail and the second layer. The first air module can also be configured to draw air from the first layer and direct exhaust air towards a head side of the mattress 101 and/or a foot side of the mattress 101.

[0066] In other implementations, the first air module can be configured to direct exhaust air towards an interior of the mattress 101. One or more interior components (e.g., layers) of the mattress 101 can be made of a breathable material allowing for the exhausted air to circulate through the mattress 101. A channel can also be integrated into one or more of the interior components such that the exhausted air can be routed towards a middle portion of the mattress 101 and away from the first air module. In other implementations, the first air module can be configured to direct exhaust air towards a foundation that supports the bottom of the mattress

101. For example, the first air module can pull air from a top surface of the mattress 101 and push the air out an opening that is defined at the foundation that supports the bottom of the mattress 101. In other implementations, the first air module can be configured to direct exhaust air out sides of the mattress 101 (e.g., through the side rails 234, 236 and through a mattress cover 140 of the mattress 101). For example, the exhaust air can be directed towards the side rails. A portion of each side rail can be made of a breathable material through which the exhaust air can pass through. Alternatively or in addition, the side rails can also have holes or openings integrated therein and proximate the first air module. Therefore, the exhaust air can be routed through the holes or openings. As described further below, the first air module can be mounted onto a first duct that is configured to permit air to flow to inflate an air chamber of the core. The first air module and the first duct can be positioned offset from a midpoint of the mattress 101. In other implementations, the first air module can be positioned offset from the first duct.

[0067] Further, the mattress 101 includes a mattress cover 140 having a top surface, a bottom surface, and side surfaces, which are configured to at least partially cover the top layer 102, the rail structure 106, the bottom layer 108, the air chambers 104, and the fan assembly 110. In some implementations, the fan assembly 110 can be configured to draw air from a top of the mattress 101, into the mattress 101 through the mattress cover 140, through the top layer 102, into an inlet of the fan assembly 110, out an outlet of the fan assembly 110, and out through the mattress cover 140 or some other exhaust outlet to a space outside of the mattress 101. In some implementations, the fan assembly can be configured to blow air from the fan assembly 110 through the top layer 102 and out through the mattress cover 140 to a location at a top of the mattress 101. As a result, a temperature of a top surface of the mattress 101 can be cooled quicker and more efficiently.

[0068] One or more of the top layer 102, the rail structure 106, and the bottom layer 108 can be made of foam materials. Alternatively or in addition, the top layer 102 can be surface-treated with one or more gel materials that have different heat capacities to provide prolonged coolness through the mattress when the bed is in a cooled air supply mode. In some implementations, one or more gel materials can be incorporated into the top layer 102 by surface-infusion. Moreover, in some implementations, the top layer 102 and the rail structure 106 can be part of an

upside-down foam tub. The upside-down foam tub can further include a foot rail and a head rail, in addition to first and second side rails.

[0069] FIG. 2 is a bottom perspective view of a mattress system 200, illustrating the mattress system 200 upside down. The mattress system 200 can be the mattress as depicted and described throughout this disclosure (e.g., refer to the mattress 101 in FIG. 1). The mattress system 200 can include a top layer (e.g., a first layer) 202, an intermediate layer (e.g., a second layer) 204, a rail structure 206, and a bottom layer (e.g., a third layer) 208. The mattress system 200 also has a top surface 212 (e.g., a top surface of the top layer 202). The intermediate layer 204 can include one or more airflow insert pads 122, as shown in FIG. 1.

[0070] In some implementations, the top layer 202, the intermediate layer 204, and the bottom layer 208 are arranged in order from the top to the bottom of the mattress system 200. The rail structure 206 is arranged around a periphery of the mattress system 200 and configured to at least partially surround an air chamber assembly or mattress core. For example, the air chamber assembly can include one or more inflatable air chambers (e.g., refer to FIG. 3). As illustrated in FIG. 2, the bottom layer 208 can be disposed to be at least partially surrounded by the rail structure 206. The bottom layer 208 can be configured to close a space 211 (e.g., refer to FIG. 3) defined by the rail structure 206. In other implementations, the bottom layer 208 can be disposed above the rail structure 206.

[0071] The mattress system 200 can also include fan assemblies 110 as described throughout this disclosure (e.g., refer to FIG. 1). As depicted, the mattress system 200 can have two fan assemblies 110 disposed in opposing left and right sides of the rail structure 206, and configured and operable to control microclimates of two separate zones (left and right sides) at the top of the mattress. In some implementations, the fan assembly 110 can be disposed in a head side of the rail structure 206 and/or a foot side of the rail structure 206. In yet other implementations, the mattress system 200 can have fewer or more integrated fan assemblies.

[0072] FIG. 3 is a partial exploded view of the mattress system 200 of FIG. 2, illustrating the top layer 202, the intermediate layer 204, an example air chamber assembly 220, and the integrated fan assemblies 110. The top layer 202 can have the top surface 212 on which a user's body can be rested either directly, or indirectly through a mattress cover and/or one or more additional layers disposed on the top surface. The intermediate layer 204 can be disposed

opposite to the top surface 212 of the top layer 202. The intermediate layer 204 can be attached to the top layer 202 in various ways. For example, the intermediate layer 204 can be glued to the top layer 202, or attached to the top layer 202 using fasteners, such as hook-and-loop fasteners (e.g., VELCRO®), zippers, clips, pins, buttons, straps, ties, snap fasteners, and other suitable types of fasteners.

[0073] Moreover, the mattress system 200 can include the air chamber assembly 220. In the illustrated example, the air chamber assembly 220 includes a pair of air chambers 222 disposed between the top layer 202 and the bottom layer 208. The air chambers 222 can be inflatable air chambers. The air chamber assembly 220 depicted can be for a king or queen size mattress 200. Other mattresses, such as twin and full size mattresses, can have an air chamber assembly having only one air chamber. In yet other examples (not depicted), the air chamber assembly can be merely a mattress core that is not inflatable or filled with air.

[0074] The air chambers 222 can be arranged to be surrounded by the rail structure 206. The air chamber assembly 220 can further include a pump system configured to inflate and/or deflate the air chambers 222. The pump system can be disposed outside the mattress and fluidly connected to the air chambers 222 via fluid delivery components. For example, the mattress 200 further includes an air chamber hose 226 connected to the air chambers 222 for inflating or deflating the air chambers 222. For example, one end of the air chamber hose 226 can be connected to the air chamber 222 to be in fluid communication with the interior of the air chamber 222, and the other end of the air chamber hose 226 can be fluidly connected to the pump system. In the illustrated implementations, the air chamber hoses 226 are routed at the side locations of the mattress system 200, at a middle axis of the mattress system 200. In alternative implementations, the air chamber hoses 226 can be routed at different locations of the mattress system 200, such as the head or foot of the mattress system 200, or other suitable locations of the mattress system 200.

[0075] As depicted, the rail structure 206 can be disposed on the intermediate layer 204, or on the top layer 202 where there is no intermediate layer, to define the space 211 for at least partially receiving the air chamber assembly 220. The bottom layer 208 can be disposed at least partially within the space 211 to at least partially cover the space 211 and the air chamber assembly 220 within the space 211. The space 211 can be a single, integral solid layer. The

space 211 can be made of a same or different material as the top layer 202, the intermediate layer 204, and/or the rail structure 206.

[0076] The mattress system 200 can also include an airflow insert pad 122 (e.g., thermal insert) that can be included in the mattress 200 and configured to circulate ambient or conditioned air through the mattress 200 under the user at rest. The airflow insert pad 122 can be positioned under the top layer 202. In some implementations, the intermediate layer 204 defines a cutout section or recess to receive the airflow insert pad 122 therein. The airflow insert pad 122 can include a material having a higher air permeability than the top layer 202, the intermediate layer 204 and/or other adjacent layers, thereby promoting airflow through the airflow insert pad 122 as opposed to its adjacent layer(s) such as the top layer 202 and the intermediate layer 204. In the illustrated example, the mattress includes two airflow insert pads 122. A single airflow insert pad, or more than two airflow insert pads can be included in other implementations of the mattress. The airflow insert pad 122 can be arranged at various locations in the mattress 200. In the illustrated example, the airflow insert pad 122 is disposed between the head and foot of the mattress 200 (e.g., in the middle of the mattress). The pad 122 can also be disposed closer to the head of the mattress 200 or the foot of the mattress 200 to optimize positioning without needing to rely on a foundation hole pass-through. In some implementations, the pad 122 can be laminated in place using adhesive. The pad 122 can also be held in place using one or more other attaching means, such as hook and loop fasteners and/or zippers.

[0077] The fan assemblies 110 can be connected to or mounted on the air duct hose 111. The fan assemblies 110 can also be disposed at least partially in the rail structure 206. As depicted, the fan assemblies 110 are offset from a middle axis of the mattress system 200. The middle axis can extend along a center between the head end and the foot end of the mattress. The fan assemblies 110 can be positioned closer to a head side of the rail structure 206 or a foot side of the rail structure 206. Positioning the fan assemblies 110 closer to the head side of the rail structure 206 can be advantageous to exhaust or provide more airflow to a head portion of the top surface 212 of the mattress system 200 than other portions of the mattress system. Positioning the fan assemblies 110 closer to the foot side of the rail structure 206 can be advantageous to provide or exhaust more airflow to a foot portion of the top surface 212 of the mattress system 200 than other portions of the mattress system. Offsetting the fan assemblies 110

from the middle axis of the mattress system 200 can be beneficial so that the fan assemblies 110 do not interfere with configuration and operation of the air chamber hoses 111 that are located at or around the middle axis of the mattress system 200. Moreover, the fan assemblies 110 can be positioned in the rail structure 206 relative to the air chamber hoses 111 based on where the air chamber hoses 111 are disposed in the mattress system 200 (e.g., if the hoses 111 are positioned closer to a head portion of the mattress system 200, then the fan assemblies 110 can be positioned at the middle axis of the mattress system 200 or any other suitable location. In some implementations, where the mattress system 200 does not have the air chamber assembly 220, the fan assemblies 110 can be positioned at the middle axis of the mattress system 200.

[0078] The top layer 202, the intermediate layer 204, the rail structure 206, and the bottom layer 208 can be made of various materials. For example, at least one of the top layer 202, the intermediate layer 204, the rail structure 206, and the bottom layer 208 can be made of foam, which may be closed-cell, open-cell, or a combination thereof. Additionally, the top layer 202, the intermediate layer 204, and/or the rail structure 206 can form a foam tub in which the air chamber assembly 220 is housed. Other materials, such as one or more coil springs, air chambers, spacer materials, and/or other suitable materials, can be used for at least one of the top layer 202, the intermediate layer 204, the rail structure 206, and the bottom layer 208.

[0079] FIG. 4 illustrates a bottom perspective view of the mattress system 200 of FIG. 2 with a set of reinforcement straps 250A-B removed and the integrated fan assembly 110 in place. The reinforcement straps 250A-B can be used to hold the mattress system 200 in place and keep it from bowing outwards when used. For example, the straps 250A-B can be used to keep the bottom layer 208 (e.g., refer to FIGS. 2-3) in place inside the rail structure 206 and over one or more components of the mattress system 200 (e.g., the air chamber assembly 220 in FIG. 3 disposed inside the space 211). Therefore, the one or more components can be retained inside the mattress system 200 when the mattress system 200 is flipped over and positioned on top of a foundation or other mattress support system.

[0080] In some implementations, the mattress system 200 can be configured to include a core of various types, such as one or more inflatable air chambers, foams, and/or spring assemblies, that can be received in the space 211 defined by the rail structure 206 in the same or similar manner as described herein.

[0081] The rail structure 206 can include a foot rail 230, a head rail 232, and opposite side rails 234, 236 extending between the foot rail 230 and the head rail 232. In some implementations, the rail structure 206 can be made of one or more foam materials. In this example, the rail structure 206 is attached to the intermediate layer 204. The rail structure 206 has a top rail side, a bottom rail side, a rail inner side, and a rail outer side. In other words, each of the foot rail 230, the head rail 232, and the opposite side rails 234, 236 has a top rail side, a bottom rail side, a rail inner side, and a rail outer side. In the illustrated example, the top rail side can be attached to the intermediate layer 204, while the bottom rail side that is opposite to the top rail side is exposed and defines a perimeter of the rail structure 206 in the view of FIG. 4. The rail inner side faces an interior of the mattress, while the rail outer side that is opposite to the rail inner side faces outwards and defines a side exterior of the mattress.

[0082] When attached to the intermediate layer 204, the rail structure 206 may be also engaged with, or attached to, the air chamber assembly 220 that is positioned in the space 211 of the mattress and abutted with the intermediate layer 204. For example, the foot rail 230 is attached to a bottom of the intermediate layer 204 at (or proximate) a foot edge of the intermediate layer 204, and the head rail 232 is attached to the bottom of the intermediate layer 204 at (or proximate) a head edge of the intermediate layer 204 (opposite to the foot edge of the intermediate layer 204). The side rails 234, 236 are attached to the bottom of the intermediate layer 204 at (or proximate) opposite sides of the intermediate layer 204. The rail structure 206 also forms an upside-down foam tub, along with the layers (e.g., the intermediate layer 204 and/or the top layer 202). For example, the rail structure 206 defines the space 211 for receiving a mattress core or air chamber assembly 220, such as one or more inflatable air chambers, foams, and/or spring assemblies (e.g., refer to FIG. 3). In implementations where no intermediate layer 204 is provided, the rail structure 206 can be attached to the top layer 202 in a similar manner.

[0083] The first reinforcement strap 250A can be connected to the opposite side rails 234, 236 so as to extend under the mattress core or air chamber assembly 220 between bottoms of the side rails 234, 236. For example, one end of the first strap 250A can be connected to a first connection point 242A located on a bottom of a first side rail (e.g., the side rail 234), and the other end of the first strap 250A can be connected to a second connection point 240A located on a bottom of a second side rail (e.g., the side rail 236). The first strap 250A can be attached to the

opposite side rails 234, 236 at predetermined connection locations 240A, 242A. Thus, the first strap 250A can extend under a core from a bottom of the first side rail to a bottom of the second side rail. Similarly, the second strap 250B can be connected to the opposite side rails 234, 236 so as to extend under the mattress core or air chamber assembly 220 between bottoms of the side rails 234, 236. For example, one end of the second strap 250B can be connected to a third connection point 242B located on a bottom of the first side rail (e.g., the side rail 234), and the other end of the second strap 250B can be connected to a fourth connection point 240B located on a bottom of the second side rail (e.g., the side rail 236). The second strap 250B can be attached to the opposite side rails 234, 236 at predetermined connection locations 240B, 242B.

[0084] The straps 250A-B can be attached to the rail structure 206 using one or more fastening elements 238. The fastening elements 238 can be of various types. For example, the fastening elements 238 include adhesive tapes. Alternatively or in addition, the fastening elements 238 can be hook-and-loop fasteners (e.g., VELCRO®), zippers, clips, pins, buttons, straps, ties, snap fasteners, and other suitable types of fasteners. The fastening elements 238 can be applied at the connection locations 240A-B and/or 242A-B, or at desired locations (e.g., the ends) of the straps 250A-B, so that such desired location of the straps 250A-B are attached to the connection points 240A-B and/or 242A-B of the rail structure 206. For example, adhesive tapes can be applied between the connection locations 240A-B and 242A-B of the rail structure 206 and the ends of the straps 250A-B.

[0085] The reinforcement straps 250A-B can be used with pieces of hook materials (e.g., 3M hook materials) with adhesive backing (e.g., the fastening elements 238). The hook materials can be placed along the bottom side of the perimeter side rails 234 and 236. In some implementations, the reinforcement straps 250A-B can include a scrim material and attach to the hook materials and extend from one side of the mattress system 200 to the other side. The straps 250A-B can be removable to allow other components (e.g., the air chambers, layers, etc.) to be assembled without interference. The straps 250A-B can be adjustable to accommodate for stretch or changes over time, varying tolerances of a foam tub and its cover, or general aesthetic preference impact. The straps 250A-B can also have a width of varying sizes, such as a width ranging between about 1 inch and about 7 inches

[0086] In some implementations, the first strap 250A and the second strap 250B are positioned in a longitudinal middle section of the mattress system 200. The first strap 250A can extend to be parallel with the second strap 250B and spaced at a predetermined distance from the second strap 250B.

[0087] Other configurations of the straps 250A-B can be possible. In some implementations, the straps 250A-B can be routed to cross each other. For example, the first strap 250A and the second strap 250B are connected to the opposite side rails 234, 236 to extend under the mattress core or air chamber assembly 220 between the bottoms of the side rails 234, 236. The first strap 250A can be routed to cross the second strap 250B by connecting one end of the first strap 250A to one of the side rails 234, 236 between the head rail 232 and the second strap 250B, and connecting the other end of the first strap 250A to the other side rail 234, 236 between the foot rail 230 and the second strap 250B.

[0088] In other configurations, one or more of the straps 250A-B can extend to one or both of the foot rail 230 and the head rail 232. In one example, one or more of the straps 250A-B can extend from the foot rail 230 to the head rail 232 rather than extending between the opposite side rails 234, 236. In another example, one or more of the straps 250A-B can extend from the foot rail 230 to the head rail 232 in addition to having one or more of the straps 250A-B extending between the opposite side rails 234 and 236. In yet other configurations, fewer or additional reinforcement straps can be included in the mattress system 200.

[0089] As depicted, the fan assembly 110 can be disposed at least partially in the rail structure 206. The straps 250A-B can be attached to the rail structure 206 on opposite sides of the fan assemblies 110, thereby reinforcing or maintaining the rail structure 206 at or around the fan assemblies 110. For example, in the illustrated example, the fan assemblies 110 are provided in the opposite side rails 234, 236, and the first strap 250A and/or the second strap 250B are connected to the opposite side rails 234, 236 proximate the fan assemblies 110. The rail structure 206 can also include one or more recessed portions proximate to the fan assembly 110 and/or the connection points of the straps 250A-B to receive other components (e.g., air passages, air chamber hoses, electronic wires, etc.) of the mattress system 200. In alternatively implementations, the mattress system 200 does not include the straps 250A-B and their associated elements.

[0090] Other configurations of the fan assemblies 110 are possible. For example, the fan assemblies 110 can be positioned closer to the foot rail 230 and/or closer to the head rail 232. The fan assemblies 110 can also be positioned on outer sides of the connection locations 240A-B and 242A-B. In other words, the fan reinforcement straps 250A-B need not be positioned around the fan assemblies 110. In some implementations, the mattress system 200 may not include the reinforcement straps 250A-B, as depicted and described further in reference to FIG. 18.

[0091] FIG. 5 is a perspective view of the integrated fan assembly 110. As depicted, the fan assembly 110 includes an external housing 700 configured to receive a fan and electronics that can control operation of the fan. The fan assembly 110 can include an air duct 708 (e.g., plenum) that is fluidly connected to the housing 700 and configured for airflow into or from the housing 700. The housing 700 and the air duct 708 can define an air inlets and an air outlets. In embodiments where the fan assembly 110 operates to draw air, the air duct 708 defines an air inlet 710, and the housing 700 defines an air outlet 702. In embodiments where the fan assembly 110 operates to blow air, the air inlet 710 of the air duct 708 works as an air outlet, and the air outlet 702 of the housing 700 works as an air inlet.

[0092] The air inlet 710 of the air duct 708 is positioned toward the top of the mattress to thereby effectively draw air from the top of the mattress. As described herein, the air outlet 702 of the housing 700 is oriented toward the foot side or the head side of the mattress at the bottom of the mattress. For example, the housing 700 can be positioned between a bottom layer (e.g., the bottom layer 208) and a corresponding side rail (e.g., one of the side rails 234, 236) of the mattress, and the air outlet 702 is oriented toward a channel defined between the bottom layer and the corresponding side rail (i.e., a side surface of the bottom layer and a side surface of the side rail that faces the side surface of the bottom layer), as shown and described in reference to FIGS. 2-3.

[0093] In some implementations, the air duct 708 of the fan assembly 110 can also function as a base portion of the fan assembly 110. For example, the air duct 708 can attached to the rail structure of the mattress using one or more fastening elements (e.g., screws, bolts, adhesive, etc.). In some implementations, the air duct 708 is configured to fit the recessed portion (e.g., the recessed portions 306, 406, 506) defined at the rail structure. The air duct 708 can be received into and fit in the recessed portion with or without additional fastening elements (e.g., screws,

bolts, adhesives, etc.). Moreover, when the mattress is manufactured, the fan assembly 110 can be integrated into or attached to the mattress during production. In some implementations, the air duct 708 (together with the housing 700) can be removed from the mattress when the fan assembly 110 needs to be serviced and/or replaced. Therefore, fastening the air duct 708 to the rail structure can provide for easier servicing of the fan assembly 110.

[0094] FIG. 6 illustrates a cross sectional view of the mattress system 200, taken along a cross sectional line shown in FIG. 8. FIG. 6 illustrates an example airflow 800 (e.g., exhaust air) through the mattress system 200. As depicted, the mattress 200 includes the mattress cover 140, the top layer 202, the intermediate layer 204, the rail structure 206, air chambers 222, an optional airflow layer 223, airflow insert pad 122 (e.g., thermal insert), and the bottom layer 208 (e.g., refer to FIGS. 1-3). The airflow insert pad 122 can be stitched together or attached together as one piece. The view of FIG. 6 depicts the opposite side rails 234 and 236 of the rail structure 206. The fan assemblies 110 are positioned within the opposing side rails 234 and 236 of the rail structure 206. In some implementations, the optional airflow layer 223 can be positioned to be flushed with the intermediate layer 204 and configured to promote air circulation and distribution toward and from the top layer 202. The airflow layer 223 can include a material that provides a higher airflow rate than the intermediate layer 204 and/or the top layer 202. The airflow layer 223 can promote and guide the airflow 800 from the mattress top into the air ducts 708 of the fan assemblies 110.

[0095] The fan assemblies 110 are positioned such that the air duct 708 is fluidly connected to the air duct hose 111 that is fluidly connected to the airflow layer 223 in the intermediate layer 204, and such that an air opening (e.g., the air outlet 702 shown and described in FIG. 5) of the housing 700 is oriented towards the head portion or the foot portion of the mattress 200. As depicted in FIG. 6, the airflow 800 is directed from the top of the mattress, through the air duct hose 111, into the air duct 708 of the fan assembly 110 and routed into the housing 700 of the fan assembly 110. The airflow 800 can also flow through one or more layers of the mattress 200 to provide for air circulation at the top layer 202. In addition, the airflow 800 can be directed through the intermediate layer 204, the airflow layer 223, and/or through the top layer 202 of the mattress 200. As a result, the fan assemblies 110 can cause the airflow 800 at the top surface of the mattress cover 140 to lower or moderate a temperature of the mattress 200.

[0096] FIG. 7 illustrates a side cross sectional view of the mattress 200, taken along a cross sectional line shown in FIG. 8. FIG. 7 depicts the airflow 800 that is drawn into the fan assembly 110 and further depicts exhaust air 801 from the fan assembly 110. This side cross sectional view of the mattress 200 depicts a longer side of the mattress 200, such as a left or right side. The mattress 200 includes the rail structure 206 having the head rail 232, the foot rail 230, and one side rail 234. Moreover, the fan assembly 110 is disposed in the side rail 234 of the rail structure 206, closer to the head rail 232 or the head portion of the mattress 200. As depicted, the fan assembly 110 is offset from a middle axis of the mattress 200. In the illustrated example, the fan assembly 110 is oriented towards the head rail 232. As a result, the airflow 801 is discharged from the fan assembly 110 towards the head portion of the mattress 200 to thereby lower a temperature of a top surface of the mattress 200. Alternatively, the fan assembly 110 is oriented towards the foot rail 230.

[0097] As described herein, the exhaust air 801 can be directed through a channel or recessed portion (e.g., the channel or recessed portion 308, 408, 508, 604) that is defined between a side of the bottom layer 208 and an adjacent side rail of the rail structure (e.g., the rail structure 206). The channel or recessed portion can extend toward the head portion or the foot portion of the mattress 200. This provides for more direct and efficient exhaust of air from the fan assembly 110 to thereby quickly lower the temperature of the top surface of the mattress 200. Moreover, the airflow 800 can be drawn from a top surface of the mattress 200 through the airflow insert pad 122 (e.g., thermal insert), where the airflow 800 can be collected, and then directed through the air duct hose 111 into the air duct 708 and the fan assembly 110.

[0098] FIG. 8 is a bottom view of an example mattress system 300 having the integrated fan assembly 110. As depicted, the mattress system 300 is flipped upside down so that a top surface of the mattress system 300 is facing down. The depicted mattress system 300 has a rail structure 302 and a bottom layer 304, as described throughout this disclosure (e.g., refer to the rail structure 206 and the bottom layer 208 in FIG. 2). The mattress system 300 can have one or more additional components described herein, such as a top layer, an intermediate layer, and/or an air chamber assembly. Moreover, in some implementations, the bottom layer 304 disposed inside the rail structure 302 can be retained or held in place using one or more reinforcement straps, as described in reference to FIG. 4.

[0099] The rail structure 302 has recessed portions 306. The recessed portions 306 are configured to receive the fan assemblies 110. In other words, a first side rail (e.g., a left or right side rail of the rail structure 302) can define a first rail recessed portion (e.g., the recessed portion 306) configured to at least partially receive a first air module (e.g., the fan assembly 110). The recessed portions 306 can be any appropriate size to fit a size of the fan assemblies 110. Therefore, the fan assemblies 110 can be disposed inside the rail structure 302 so that the fan assemblies 110 do not interfere with one or more other components of the mattress system 300. Additionally, as depicted, the recessed portions 306 can be offset from a middle axis 310 of the mattress system 300. This configuration can also be beneficial to prevent interference of the fan assemblies 110 placement with one or more other components of the mattress system 300 that are disposed at or around the middle axis 310. The middle axis 310 can be an axis that extends between the opposite side rails and divides the mattress system 300 into two halves. Alternatively, the middle axis 310 can be offset from the axis that divides the mattress system 300 into two halves.

[0100] The recessed portions 306 can have a predetermined width W1 that is suitable for receiving at least part of the fan assemblies 110. The predetermined width W1 can be big enough to maintain sufficient air flow and room for installation of the fan assembly 110 while also being minimal in size to minimize discomfort that may occur from an opening that is too wide. Too large of an opening may be felt by the user laying on top of the mattress system 300, thereby reducing comfortability. By way of example, the width W1 can be 9.5 inches. This width can be advantageous to provide sufficient air flow without compromising comfortability of the mattress system 300 to users. In other implementations, the width W1 of the recessed portion 306 can range from 4 inches to 10 inches. Other ranges of the width W1 are also possible for various configurations of the mattress.

[0101] Moreover, the bottom layer 304 can have recessed portions 308. The recessed portions 308 can have various dimensions (widths, lengths, and depths). In some implementations, a width W2 of the recessed portion 308 can be smaller than 1 inch. In other example implementations, the width W2 can range from 1 inches to 6 inches. In some implementations, as illustrated in FIG. 8, a length L2 of the recessed portion 308 can extend between opposite head and foot rail portions 314 and 316. As illustrated in FIG. 8, the length L2

of the recessed portion 308 can extend an entire distance between the opposite head and foot rail portions 314 and 316. The distance L2 of the recessed portion 308 can range in size depending on the size of the mattress system 300. In other implementations, the length L2 of the recessed portion 308 can be smaller than the distance between the opposite head and foot rail portions 314 and 316, as further described in more detail with respect to FIG. 12. Various other sizes of the recessed portions 308 can be realized (e.g., refer to FIGS. 9-12). The various different sizes of the recessed portions 308 can be advantageous to ensure that the bottom layer 304 remains positioned in a center of the mattress system 300 without shifting to one of the sides of the system 300 and eliminating or compromising airflow 312A-B through the recessed portions 308. For example, the bottom layer 304 can have the recessed portions 308 positioned at the head portion 314 and/or the foot portion 316 of the mattress system 300. Moreover, as described herein, instead of having the recessed portion 308, the bottom layer 304 can be made of a breathable material to allow air to flow directly through the bottom layer 304.

[0102] The recessed portions 308 can be configured to facilitate or direct airflows 312A-B (e.g., exhaust air) from the fan assemblies 110. For example, the recessed portions 308 can create one or more different flow paths to direct exhaust air from the fan assemblies 110. A first flow path can be bound by a side surface of a first side rail (e.g., the side rails 302) and a corresponding side surface of at least one additional layer (e.g., the bottom layer 304). The bottom layer 304 can cover a core between the first and second side rails 302. The mattress 300 can also include a mattress cover having a top panel, a bottom panel, and opposing side panels. The first flow path can further be bound by a bottom surface of the core and a top surface of the bottom panel of the mattress cover. In some implementations, the core can include an air chamber. A width of the first flow path between the side surface of the first side rail 302 and the corresponding side surface of the bottom layer 304 can vary in a longitudinal direction along the first side rail. The corresponding side surface of the bottom layer 304 can include a tapered surface 305 that is angled relative to the side surface 303 of the first side rail 302 that faces the corresponding side surface of the bottom layer 304. The width of the first flow path can decrease from a location at which the fan assembly 110 is positioned, toward either a head side of the mattress 300 or a foot side of the mattress 300. The width of the first flow path can also vary along an entire length of the bottom layer 304. The first flow path can extend to a corner of the

bottom layer 304. The first flow path can also extend vertically along at least part of the sides of the mattress 300. The first flow path can be defined at least through the air duct 708 of the fan assembly 110. The first flow path can be defined along at least one foam layer between a mattress top and a mattress bottom. The mattress top can include a mattress cover and the mattress bottom can include a bottom layer.

[0103] The recessed portions 308 can also be angled (e.g., tapering) so as to better direct and exhaust the airflows 312A-B towards either the head portion 314 or the foot portion 316 of the mattress system 300. As depicted in FIG. 8, the recessed portions 308 of the bottom layer 304 are symmetrical from the middle axis 310 of the mattress system 300. Therefore, it does not matter how the bottom layer 304 is oriented or directed when assembled to other parts of the mattress system 300 (e.g., when disposed in the rail structure 302). In other words, the symmetrical recessed portions 308 of the bottom layer 304 allow easy assembling of the bottom layer 304 to other parts of the mattress system 200 because the bottom layer 304 provides the same configuration of the mattress system 200 regardless of the orientation of the bottom layer 304 attaching to the rest of the mattress system 200. In one example, an angle A of the tapered recessed portion 308 with respect to the middle axis 310 can range from 60 degrees to 85 degrees. Another example of the angle A can range from 65 degrees to 80 degrees. Yet another example of the angle A can range from 70 degrees to 75 degrees. Other ranges of the angle A are also possible.

[0104] In one example, the fan assemblies 110 in the mattress system 300 are oriented towards the head portion 314 of the mattress system 300. In another example, the fan assemblies 110 can also be oriented towards the foot portion 316 of the mattress system 300. Regardless of whether the fan assemblies 110 are oriented towards the head portion 314 or the foot portion 316, the symmetrical recessed portions 308 provide for uniform airflow in whichever direction that the fan assemblies 110 are oriented.

[0105] The recessed portions 308 create air ducts or channels for which the airflows 312A-B are exhausted out of the fan assembly 110.

[0106] For example, the mattress 300 can define a first channel (e.g., the recessed portion 308) between the first side rail (e.g., the rail structure 302) and a second layer (e.g., a layer, such as the inflatable air chamber, above the bottom layer 304). The first channel is configured to

permit for airflow between the first side rail and the second layer. The second layer can also define a layer recessed portion (e.g., the recessed portion 308) defining the first channel between the first side rail and the second layer. The layer recessed portion can extend at least partially along a length of the second layer.

[0107] Directing the airflows 312A-B around components of the mattress system 300, such as along edges or sides of the components, can provide for a more effective cooling effect of a top surface of the mattress system 300. For example, the airflows 312A-B promote air draw from the mattress top through the fan assemblies 110, thereby causing more effective cooling effect at the mattress top.

[0108] The recessed portions 306 and/or 308 can prevent the fan assemblies 110 from interfering with one or more other components integrated in the mattress system 300. For example, electric wires and/or air chamber hoses can be disposed along sides of the bottom layer 304 and/or the rail structure 302. Placing the fan assemblies 110 in the recessed portions 306 and/or 308 can keep the fan assemblies 110 separate from these additional components and prevent interference of configuration or operation of such components.

[0109] In some implementations, the mattress system 300 can have fewer or additional fan assemblies 110. For example, the mattress system 300 can have one fan assembly 110 along a longer side of the rail structure 302. In another example, the bed system 300 can have one fan assembly 110 along the head portion 314 or the foot portion 316. As yet another example, the mattress system 300 can have two fan assemblies 110 on each of the longer sides of the rail structure 302. In yet another example, the mattress system 300 can have a fan assembly 110 disposed on each of the longer sides of the rail structure 302 and the head portion 314 and the foot portion 316. As described herein, each of the fan assemblies 110 can be oriented in any direction when disposed in the recessed portions 306 and 308.

[0110] FIG. 9 is another bottom view of the example mattress system 300 of FIG. 8 having the integrated fan assembly 110. In comparison to FIG. 8, FIG. 9 depicts the airflows 312A-B (e.g., exhaust air) directed towards the foot portion 316 of the mattress system 300. Thus, the fan assemblies 110 are disposed and oriented towards the foot portion 316 of the mattress system 300. In this example, the fan assemblies 110 are arranged on the left side of the middle axis 310 so that the fan assemblies 110 are disposed closer to the head portion 314 than the foot portion

316. Alternatively, the fan assemblies 110 can be arranged the right side of the middle axis 310 so that the fan assemblies 110 are disposed closer to the foot portion 316 than the head portion 314, and thus increase airflow toward the foot portion 316 compared to the head portion 314.

[0111] The recessed portions 308 of the bottom layer 304 are symmetrical and proportional along the length of the mattress system 300. Therefore, orientation of the bottom layer 304 does not matter when assembled with other parts of the mattress system 300, thereby improving convenience of assembling and servicing the mattress system 300. The airflows 312A-B can be directed along the channels created by the recessed portions 308 such that air can flow along sides of the components of the mattress system 300 and cool the top surface of the mattress system 300.

[0112] Similarly to those of FIG. 8, the recessed portions 306 can have a predetermined width W3 that is suitable for receiving at least part of the fan assemblies 110. The width W3 of the recessed portion 306 can range from 2 inches to 10 inches. In other implementations, the width W3 of the recessed portions 306 can range from 3 inches to 9 inches. In other implementations, the width W3 of the recessed portions 306 can range from 4 inches to 8 inches. Moreover, the recessed portions 308 can have various dimensions (widths, lengths, and depths). In some implementations, a width W4 of the recessed portion 308 can be smaller than 1 inch. In other implementations, the width W4 can range from 1 inches to 6 inches. In other implementations, the width W4 of the recessed portions 308 can range from 2 inches to 5 inches. In other implementations, the width W4 of the recessed portions 308 can range from 3 inches to 4 inches. In some implementations, as illustrated in FIG. 8, a length L3 of the recessed portion 308 can extend between opposite head and foot rail portions 314 and 316. The length L3 of the recessed portion 308 can extend an entire distance between the opposite head and foot rail portions 314 and 316. The distance L3 of the recessed portion 308 can range in size depending on the size of the mattress system 300, as described above.

[0113] FIG. 10 is another bottom view of the example mattress system 300 of FIG. 8 having the integrated fan assembly 110. In comparison to FIGS. 8 and 9, FIG. 10 depicts the airflows 312A-B (e.g., exhaust air) going in different or opposite directions. For example, the airflow 312A is directed towards the head portion 314 of the mattress system 300. The airflow 312B is directed towards the foot portion 316 of the mattress system 300. Directing air towards both the

head portion 314 and the foot portion 316 of the mattress system 300 can be advantageous to cool or lower temperatures of two different zones at a top surface of the mattress system 300 at different rates. Directing air towards both the head portion 314 and the foot portion 316 of the mattress system 300 can also be advantageous to allow for a common fan assembly 110 to be used, regardless of whether the fan assembly is positioned on a right side or a left side of the mattress system 300. Regardless of fan assembly orientation, the airflows 312A-B can be directed along the channels created by the recessed portions 308 such that air can flow along sides of the components of the mattress system 300 and cool the top surface of the mattress system 300.

[0114] Similarly to those of FIGS. 8-9, the recessed portions 306 can have a predetermined width W5 that is suitable for receiving at least part of the fan assemblies 110. Moreover, the recessed portions 308 can have various dimensions (widths, lengths, and depths). For example, the recessed portions 308 can have a width W6, as described in reference to FIGS. 8-9. In some implementations, as illustrated in FIGS. 8-9, a length L4 of the recessed portion 308 can extend between opposite head and foot rail portions 314 and 316.

[0115] FIG. 11 is a bottom view of another example mattress system 400 having the integrated fan assembly 110. The mattress system 400 can be similar to the mattress system 300 depicted and described in reference to FIGS. 8-10. For example, the mattress system 400 is flipped upside down so that a top surface of the mattress system 400 is facing down. The depicted mattress system 400 has a rail structure 402 and a bottom layer 404, as described throughout this disclosure. The bottom layer 404 disposed inside the rail structure 402 can be retained or held in place using one or more reinforcement straps, as described in reference to FIG. 4. For example, a reinforcement strap can be placed across a middle axis 410 of the mattress system 400, thereby connected to opposing longer sides of the rail structure 402.

[0116] The rail structure 402 has recessed portions 406, as described in reference to FIGS. 8-10. The fan assemblies 110 are disposed at least partially in the recessed portions 406 of the rail structure 402. As depicted, the recessed portions 406 are offset from the middle axis 410 of the mattress system 400. This configuration can be beneficial to prevent interference of the fan assemblies 110 placement with one or more other components of the mattress system 400.

[0117] Moreover, the bottom layer 404 has recessed portions 408 to facilitate or direct airflows 412A-B (e.g., exhaust air) from the fan assemblies 110. The recessed portions 408 can also be angled so as to better direct the airflows 412A-B. In comparison to the recessed portions 308 in FIGS. 8-10, the recessed portions 408 in FIG. 11 begin at the middle axis 410 of the mattress system 400 and taper towards a head portion 414 of the mattress system 400. In other implementations, the recessed portions 408 can begin at the middle axis 410 and taper towards a foot portion 416 of the mattress system 400.

[0118] The configuration of the recessed portions 408 in FIG. 4 provides for the fan assemblies 110 to be oriented towards the head portion 414 of the mattress system 400. As a result, the airflows 412A-B can be directed towards one or more layers of the mattress system 400 proximate to the head portion 414 of the mattress system 400. This configuration can be advantageous to exhaust the air and direct it toward the head portion 414 of the mattress system 400. In other implementations where the recessed portions 408 are disposed towards the foot portion 416, the fan assemblies 110 can be oriented towards the foot portion 416 such that the airflows 412A-B are exhausted and directed towards the foot portion 416 of the mattress system 400.

[0119] The configuration of the recessed portions 406 and/or 408 are also advantageous to prevent the fan assemblies 110 from interfering with one or more other components integrated in the mattress system 400. For example, electric wires and/or air chamber hoses can be disposed along sides of the bottom layer 404 and/or the rail structure 402, such as at the middle axis 410. Placing the fan assemblies 110 in the recessed portions 406 and/or 408 can keep the fan assemblies 110 separate from these additional components and prevent interference of configuration or operation of such components.

[0120] Similarly to those of FIGS. 8-10, the recessed portions 406 can have a predetermined width W7 that is suitable for receiving at least part of the fan assemblies 110. The width W7 of the recessed portion 406 can range from 2 inches to 10 inches. One or more other ranges can be used for the width W7. Moreover, the recessed portions 408 can have various dimensions (widths, lengths, and depths). In some implementations, a width W8 of the recessed portion 408 can be smaller than 1 inch. In other implementations, the width W8 can range from 1 inches to 6 inches. One or more other ranges can be used for the width W8. In some implementations, a

length L5 of the recessed portion 408 can extend between the head portion 414 and the middle axis 410. In other implementations, the length L5 can extend between the foot portion 416 and the middle axis 410. The distance L5 of the recessed portion 408 can range in size depending on the size of the mattress system 400.

[0121] FIG. 12 is a bottom view of another example mattress system 500 having the integrated fan assembly 110. The mattress system 500 can be similar to the mattress systems 300 and 400 depicted and described in reference to FIGS. 8-11. For example, the mattress system 500 is flipped upside down so that a top surface of the mattress system 500 is facing down. The depicted mattress system 500 has a rail structure 502 and a bottom layer 504, as described throughout this disclosure. The bottom layer 504 disposed inside the rail structure 502 can be retained or held in place using one or more reinforcement straps, as described in reference to FIG. 4. For example, a reinforcement strap can be placed across a middle axis 510 of the mattress system 500, thereby connected to opposing longer sides of the rail structure 502.

[0122] The rail structure 502 has recessed portions 506, as described in reference to FIGS. 8-11. The fan assemblies 110 are disposed in the recessed portions 506 of the rail structure 502. As depicted, the recessed portions 506 are offset from the middle axis 510 of the mattress system 500. This configuration can be beneficial to prevent interference of the fan assemblies 110 placement with one or more other components of the mattress system 500 that are disposed at or around the middle axis 510 of the mattress system 500.

[0123] Moreover, the bottom layer 504 has recessed portions 508 to facilitate or direct airflows 512A-B (e.g., exhaust air) from the fan assemblies 110. The recessed portions 508 can also be angled or tapered so as to better direct the airflows 512A-B. Like the recessed portions 308 in FIGS. 8-11, the recessed portions 508 in FIG. 12 are symmetrical from the middle axis 510 of the mattress 500. The recessed portions 508 taper symmetrically from the middle axis 510 to corners of a head portion 514 and a foot portion 516 of the mattress system 500. The recessed portions 508 are also narrower in width (e.g., refer to width W10) than the recessed portions 308 in FIGS. 8-11. The width of the recessed portions 508 and 308 can be different based on a configuration of a mattress system. In some implementations, a larger width may enable better air flow, thereby circulating air more efficiently and/or quickly throughout the mattress 500. In

some implementations, a smaller width can maintain comfortability of a user on the mattress 500. The smaller width can also maintain surface stability of the mattress 500.

[0124] As depicted in FIG. 12, the airflows 512A-B (e.g., exhaust air) are directed through the channels of the recessed portions 508 towards the head portion 514 of the mattress system 500. In other implementations, one or more of the airflows 512A-B can be directed through the channels of the recessed portions 508 towards the foot portion 516 of the mattress system 500. Because the recessed portions 508 are symmetrical from the middle axis 510, the fan assemblies 110 can be oriented in either direction towards the head portion 514 or the foot portion 516 of the mattress system 500 without compromising on an effectiveness of cooling the top surface of the mattress system 500. Moreover, the symmetrical recessed portions 508 of the bottom layer 504 allow easy assembling of the bottom layer 504 to other parts of the mattress system 500 because the bottom layer 504 provides the same configuration of the mattress system 500 regardless of the orientation of the bottom layer 504 attaching to the rest of the mattress system 500. In one example, an angle B of the tapered recessed portion 508 with respect to the middle axis 510 can range from 60 degrees to 85 degrees. Another example of the angle B can range from 50-65 degrees. Other ranges of the angle B are also possible.

[0125] Additionally, as described throughout this disclosure, the configuration of the recessed portions 506 and/or 508 are advantageous to prevent the fan assemblies 110 from interfering with one or more other components integrated in the mattress system 500. For example, electric wires and/or air chamber hoses can be disposed along sides of the bottom layer 504 and/or the rail structure 502, such as at the middle axis 510. Placing the fan assemblies 110 in the recessed portions 506 and/or 508 can keep the fan assemblies 110 separate from these additional components and prevent interference of configuration or operation of such components.

[0126] Similarly and as described in reference to those of FIGS. 8-11, the recessed portions 506 can have a predetermined width W9 that is suitable for receiving at least part of the fan assemblies 110. The recessed portions 508 can also have various dimensions (widths, lengths, and depths), such as a width W10 and a length L6 of the recessed portion 508 that can extend between opposite head and foot rail portions 514 and 516.

[0127] FIG. 13A is a perspective view of the integrated fan assembly 110 in the mattress system 600. As depicted, the fan assembly 110 is placed inside/positioned within a recessed portion 601 of the rail structure 206. The positioning of the fan assembly 110 inside the recessed portion 601 is advantageous because it keeps the fan assembly 110 hidden from view. Moreover, this configuration prevents the fan assembly 110 from obstructing access or functioning of other components of the mattress system 600.

[0128] The recessed portion 601 is offset from a middle axis 602 of the mattress system 600. This configuration is advantageous because it allows existing ports in the mattress system 600 to function normally. For example, the recessed portion 601 may not intrude with functioning or placement of a ports that are used for inflating and deflating inflatable air chambers of the mattress system 600.

[0129] The fan assembly 110 protrudes out from the recessed portion 601 and into a recessed portion 604 of the bottom layer 208 of the mattress system 600. As depicted, the recessed portion 604 is angled such that it has a bigger width closer to the middle axis 602 and a smaller or narrower width closer to corners of the rail structure 206. For example, as depicted in FIG. 13A, the fan assembly 110 is positioned such that an airflow 606 (e.g., exhaust air) is directed towards a foot end of the mattress 600. In other implementations, the fan assembly 110 can be positioned such that the airflow 606 is directed towards a head end of the mattress 600.

[0130] FIG. 13B is a top view of the integrated fan assembly 110 in the mattress system 600 of FIG. 13A. The fan assembly 110 includes wires 608. The wires 608 can connect the fan assembly 110 to a power source in the mattress system 600. The wires 608 can also provide a connection of the fan assembly 110 to a power source external to the mattress system 600. Thus, the wires 608 can supply electrical power to the fan assembly 110. As depicted in FIG. 13B, the wires 608 can be positioned inside the recessed portion 601 of the rail structure 206. Therefore, the wires 608 can be kept out of sight. This placement of the wires 608 can also be beneficial because it may not obstruct other components of the mattress system 600, such as the bottom layer 208, the fan assembly 110 itself, and/or other layers of the mattress system 600 as depicted and described herein. In some implementations, the fan assembly 110 can be placed inside of an enclosure that has a fan guard, a printed circuit board (PCB) to help with controlling the fan

assembly 110, and indicator lights. The wires 608 can be organized inside the enclosure and routed out, as described herein.

[0131] FIG. 13C is a side perspective view of the integrated fan assembly 110 in the mattress system 600 of FIG. 13A. Fan assemblies 110 are positioned within recessed portions 601 on opposing sides of the rail structure 206 (e.g., left and right sides). Both sides of the bottom layer 208 can also have symmetrical recessed portions 604 to facilitate for airflow in whatever direction the fan assemblies are oriented. Moreover, the fan assemblies 110 are offset from the middle axis 602 such that additional components of the mattress system 600, such as air chamber ports, can still function as they normally would. For example, placement of the fan assemblies 110 that is offset from the middle axis 602 does not require reconfiguring or moving inflatable air chamber ports that are positioned at the middle axis 602 of the mattress system 600. In some implementations, where the mattress system 600 does not include air chamber ports or inflatable air chambers, the fan assembly 110 can positioned at the middle axis 602 of the mattress system 600.

[0132] FIG. 14 illustrates an example bed system 900 for providing a quality sleep experience with an example local bed system 901. The local bed system 901 can include a bed 902 and a bed control system 910 used in conjunction with the bed 902 and configured to control one or more user comfort features of the bed 902. The local bed system 901 can be any one of the bed systems described throughout this disclosure.

[0133] The bed 902 can include a mattress 904 and a foundation 906. In some embodiments, the mattress 904 can be an air mattress having an inflatable air chamber and a controller for controlling inflation of the inflatable air chamber, as described herein. In other embodiments, the mattress 904 does not include an air chamber. For example, the mattress 904 may include foam and/or springs instead of or in addition to an inflatable air chamber. The mattress 904 can be sized and shaped as a twin mattress, full mattress, queen mattress, king mattress, California king mattress, split king mattresses, partially split mattress (e.g. a mattress that is split at the head and/or foot ends and joined in the middle), and/or other mattress as suitable for the application. The foundation 906 is positioned under the mattress 904 to support the mattress 904. In some embodiments, the foundation 906 can be an adjustable foundation with one or more articulable

sections, such as for raising the head and foot of the foundation 906 and the mattress 904. In other embodiments, the foundation 906 can be a stationary foundation.

[0134] The bed 902 can be configured to provide a microclimate control of the mattress 904. In some implementations, as described herein, the bed 902 can be configured to provide a cooling function. For example, the bed 902 can include a fan assembly 905 (e.g., refer to the fan assembly 110 described throughout this disclosure) that can be included in the mattress 904. The fan assembly 905 can be configured to circulate ambient air through the mattress 904 to reduce a top surface temperature of the mattress 904.

[0135] In addition or alternatively, the bed 902 provides a foot warming function. For example, the bed 902 can include a foot warming device 920 which is disposed on the mattress 904 or incorporated in the mattress 904 and at a foot side of the bed 902. The foot warming device 920 can be disposed on a top of the mattress 904, included in the mattress 904, or disposed at other locations of the bed 902 and/or in other configurations. The foot warming device 920 can include an electronic heating element in some implementations. The foot warming device 920 can include an air circulation element through which heating air is circulated in other implementations. Other configurations are also possible.

[0136] In addition or alternatively, the bed 902 can include an airflow insert pad 922 that can be included in the mattress 904 and configured to circulate ambient or conditioned air through the mattress under the user at rest. The airflow insert pad 922 can be arranged at various locations in the mattress 904. In the illustrated example, the airflow insert pad 922 is disposed between the head and foot of the mattress 904 (e.g., in the middle of the mattress 904).

[0137] The bed control system 910 operates to control features available for the bed 902. In some implementations, the bed control system 910 includes a bed articulation system 912, an air chamber control system 914, a foot warming control system 916, an airflow insert pad control system 918, and a fan control system 919.

[0138] The bed articulation system 912 operates to articulate the foundation 906 and/or the mattress 904. For example, the bed articulation system 912 can adjust one or more articulable sections of the foundation 906 to raise the head and foot of the foundation 906 and/or the mattress 904. The bed articulation system 912 can include a controller and an actuator (e.g., a motor) operated by the controller and coupled to the articulable sections of the foundation 906 so

that the sections of the foundation 906 are automatically adjusted to desired positions.

Alternatively or in addition, the articulable sections of the foundation 906 can be manually adjusted.

[0139] The air chamber control system 914 operates to control the air chamber of the mattress 904. The air chamber control system 914 can include a controller and an actuator (e.g., a pump) operated by the controller and fluidly connected to the air chamber. The actuator is controlled to inflate or deflate the air chamber to provide and maintain a desired pressure in the air chamber, thereby providing a desired firmness of the air chamber.

[0140] The foot warming control system 916 operates to control the foot warming device 920 disposed in the mattress 904. The foot warming control system 916 can include a controller configured to activate a heating element of the foot warming device 920 and maintain a desired temperature of the heating element.

[0141] The airflow insert pad control system 918 operates to control the airflow insert pad 922 disposed in the mattress 904. The airflow insert pad control system 918 can include an air controller configured to cause ambient or conditioned air to flow into or out of the airflow insert pad 922 so that a top layer of the mattress above or adjacent the airflow insert pad 922 have a desired temperature and/or humidity. The airflow insert pad control system 918 can determine an airflow based on one or more temperature and/or humidity sensor readings at the top layer of the mattress 904 and/or of the user's body.

[0142] The fan control system 919 operates to control the fan assembly 905. The fan control system 919 can include an air controller configured to cause ambient air to be expelled from the fan assembly 905 so that the top layer of the mattress can reach a desired, cooled temperature and/or humidity level. The fan control system 919 can determine an airflow based on one or more temperature and/or humidity sensor readings at the top layer of the mattress 904 and/or the user's body. In other implementations, the fan control system 919 can operate the fan assembly 905 to circulate air through the mattress by drawing ambient air into the fan assembly 905.

[0143] In some implementations, the bed articulation system 912, the air chamber control system 914, the foot warming control system 916, the airflow insert pad control system 918, and the fan control system 919 can be independently configured and operated. In other implementations, some or all of the bed articulation system 912, the air chamber control system

914, the foot warming control system 916, the airflow insert pad control system 918, and the fan control system 919 are at least partially combined so that they share at least part of their components such as actuators (e.g., motors, pumps, etc.) and/or controllers (e.g., control circuits, processors, memory, network interfaces, etc.).

[0144] The bed control system 910 can be accessed by a user via one or more control devices 930, such as a bed-side controller 932 and a mobile computing device 934. The bed-side controller 932 is wired to, or wirelessly connected to, the bed control system 910 to enable the user to at least partially control the bed control system 910. The bed-side controller 932 includes an input device (e.g., a keypad, buttons, switches, etc.) for receiving a user input of controlling various settings of the bed control system 910, such as articulation positions, temperature settings, air chamber pressure settings, etc. The bed-side controller 932 can further include an output device (e.g., a display, a speaker, etc.) for outputting the statuses and conditions of the bed control system 910 and other information useful to the user, such as articulation positions, temperature settings, air chamber pressure settings, sleep analysis results, etc. The same or similar functionalities can be implemented with the mobile computing device 934, such as a mobile device running a dedicated software application. For example, the user can use a mobile device as an input device to control various settings of the bed control system 910, such as articulation positions, temperature settings, air chamber pressure settings, etc., and further use the mobile device as an output device to see the statuses and conditions of the bed control system 910 and other useful information, such as articulation positions, temperature settings, air chamber pressure settings, sleep analysis results, etc.

[0145] Referring still to FIG. 14, the system 900 can include a server system 940 connected to the local bed system 901 and configured to provide one or more services associated with the bed 902. The server system 940 can be connected to the local bed system 901, such as the bed 902, the bed control system 910, and/or the control devices 930, via a network 942. The server system 940 can be of various forms, such as a local server system with one or more computing devices dedicated to one or more beds, or a cloud server. The network 942 is an electronic communication network that facilitates communication between the local bed system 901 and the server system 940. An electronic communication network is a set of computing devices and links between the computing devices. The computing devices in the network use the links to

enable communication among the computing devices in the network. The network 942 can include routers, switches, mobile access points, bridges, hubs, intrusion detection devices, storage devices, standalone server devices, blade server devices, sensors, desktop computers, firewall devices, laptop computers, handheld computers, mobile telephones, and other types of computing devices. In various embodiments, the network 942 includes various types of links. For example, the network 942 includes wired and/or wireless links. Furthermore, in various embodiments, the network 942 is implemented at various scales. For example, the network 942 can be implemented as one or more local area networks (LANs), metropolitan area networks, subnets, wide area networks (such as the Internet), or can be implemented at another scale.

[0146] In some implementations, the server system 940 can provide a bed data service that can be used in a data processing system associated with the local bed system 901. The server system 940 can be configured to collect sensor data and sleep data from a particular bed, and match the sensor and sleep data with one or more users that use the bed when the sensor and sleep data were generated. The sensor and sleep data, and the matching data, can be stored as bed data 950 in a database. The bed data 950 can include user identification data usable to identify users of beds. The users can include customers, owners, or other users registered with the server system 940 or another service. Each user can have, for example, a unique identifier, user credentials, contact information, billing information, demographic information, or any other technologically appropriate information. The bed data 950 can include management data usable to identify data related to beds or other products associated with data processing systems. For example, the beds can include products sold or registered with a system associated with the server system 940. Each bed can have, for example, a unique identifier, model and/or serial number, sales information, geographic information, delivery information, a listing of associated sensors and control peripherals, etc. Additionally, an index or indexes stored in the bed data 950 can identify users that are associated with beds. For example, this index can record sales of a bed to a user, users that sleep in a bed, etc.

[0147] The bed data 950 can include sensor data that record raw or condensed sensor data recorded by beds with associated data processing systems. For example, a bed's data processing system can have a temperature sensor, humidity sensor, pressure sensor, and light sensor. Readings from these sensors, either in raw form or in a format generated from the raw data (e.g.

sleep metrics) of the sensors, can be communicated by the bed's data processing system to the server system 940 for storage in the bed data 950. Additionally, an index or indexes stored by the server system 940 can identify users and/or beds that are associated with the sensor data. In some implementations, the server system 940 can use any of its available data to generate advanced sleep data. The advanced sleep data includes sleep metrics and other data generated from sensor readings.

[0148] For example, the advanced sleep data can include sensed mattress surface temperature values and/or sensed mattress surface humidity values. Using these values, the server system 940 can determine an amount of ambient and/or conditioned air to deliver through the mattress 904 to maintain an optimal or desired temperature for the mattress 904 (e.g., the desired temperature can be determined by the user, by the server system 940, and/or by any one of the other systems described in reference to FIG. 14). The server system 940 can also determine/estimate a body temperature of the user based on sensed mattress surface temperature values and/or humidity values. One or more of these calculations can be performed locally on the bed's data processing system. Performing such calculations in the server system 940, however, can be advantageous because the calculations can be computationally complex or requiring a large amount of memory space or processor power that is not available on the bed's data processing system. This can help allow a bed system to operate with a relatively simple controller and still be part of a system that performs relatively complex tasks and computations.

[0149] The sensed temperature values and/or airflow adjustment determinations can also be transmitted to the bed-side controller 932 and/or the mobile computing device 934. Based on these values and airflow adjustment determinations, the user can selectively moderate, adjust, and/or change an airflow through the mattress 904 or a desired temperature.

[0150] In addition or alternatively, the server system 940 can provide a sleep data service that can be used in a data processing system that can be associated with the local bed system 901. In this example, the server system 940 is configured to record data related to users' sleep experience and store the data as sleep data 952. The sleep data 952 can include pressure sensor data related to the configuration and operation of pressure sensors in beds. For example, the pressure sensor data can include an identifier of the types of sensors in a particular bed, their settings and calibration data, etc. The sleep data 952 can include pressure based sleep data which

can be calculated based on raw pressure sensor data and represent sleep metrics specifically tied to the pressure sensor data. For example, user presence, movements, weight change, heart rate, and breathing rate can be determined from raw pressure sensor data. Additionally, an index or indexes stored by the server system 940 can identify users that are associated with pressure sensors, raw pressure sensor data, and/or pressure based sleep data. The sleep data 952 can include non-pressure sleep data which can be calculated based on other sources of data and represent sleep metrics obtained from such other sources of data. For example, user entered preferences, light sensor readings, and sound sensor readings can all be used to track sleep data 952. Additionally, an index or indexes stored by the server system 940 can identify users that are associated with other sensors and/or non-pressure sleep data 952.

[0151] In addition or alternatively, the server system 940 can provide a user account service that can be used in a data processing system associated with the local bed system 901. For example, the server system 940 can record a list of users and to identify other data related to those users, and store such data as user account data 954. The user account data 954 are related to users of beds with associated data processing systems. For example, the users can include customers, owners, or other users registered with the server system 940 or another service. Each user can have, for example, a unique identifier, user credentials, demographic information, or any other technologically appropriate information. The user account data 954 can include engagement data usable to track user interactions with the manufacturer, vendor, and/or manager of the bed and/or cloud services. This engagement data can include communications (e.g., emails, service calls), data from sales (e.g., sales receipts, configuration logs), and social network interactions. The user account data 954 can include usage history data related to user interactions with one or more applications and/or remote controls of a bed. For example, a monitoring and configuration application can be distributed to run on, for example, the control devices 930. This application can log and report user interactions for storage. Additionally, an index or indexes stored by the server system 940 can identify users that are associated with each log entry.

[0152] In addition or alternatively, the server system 940 can provide an environment service that can be used in a data processing system associated with the local bed system 901. For example, the server system 940 can record data related to users' home environment, and store

such data as environment data 956. The environment data 956 can be obtained using one or more sensors installed in or around the bed. Such sensors can be of various types that can detect environmental variables, such as light sensors, noise sensors, vibration sensors, thermostats, etc. The environment data 956 can include historical readings or reports from those sensors. By way of example, a light sensor is used to collect data indicative of the frequency and duration of instances of increased lighting when the user is asleep.

[0153] FIG. 15 illustrates another fan assembly 1110 integrated into another example mattress system 1500. The mattress system 1500 can be part of the bed system 100 described in reference to FIG. 1. For example, components 1106, 1122, and 1110 can replace components 106, 110, and 122 in the mattress 101 in FIG. 1. The mattress system 1500 can be similarly configured as other examples of the mattress system described herein. Further, the fan assembly 1110 can be similarly configured as other examples of the fan assembly described herein. More particularly, the mattress system 1500 can include the top layer 102, rail structure 1106, the bottom layer 108, and air chambers. In this example, the integrated fan assembly 1110 can be disposed (e.g., positioned) at a foot end of the rail structure 1106. As described herein, the fan assembly 1110 can be received in a recessed portion of the foot end of the rail structure 1106. As a result, the fan assembly 1110 may not interfere with other components of the mattress system 1500, such as the bottom layer 108, the air chambers, and/or the top layer 102. The fan assembly 1110 can also be mounted to the air duct hose 111 (e.g., FIG. 16). As described herein, the air duct hose 111 can extend from airflow insert pads 1122 in the mattress system 1500. In some implementations, at least a portion of the hose 111 can be made of a silicon material and configured to be fitted around an air opening (e.g., an air inlet 1710 in FIG. 19) of the fan assembly 1110. The fan assembly 1110 can then draw air out of the airflow insert pads 1122 and exhaust the drawn air into the foot end of the rail structure 1106.

[0154] The fan assembly 1110 can be similar (e.g., in terms of functionality) to the fan assembly 110 described throughout this disclosure. For example, the fan assembly 1110 can be configured to pull or draw air from the mattress system 1500. In other examples, the fan assembly 1110 can also be configured to push air into the mattress system 1500 (such as ambient air or cooled/conditioned air), which can be beneficial to cool a top surface of the mattress system 1500. In yet other examples, the fan assembly 1110 can be configured to push heated air

into the mattress system 1500 to warm a top surface of the mattress system 1500. Therefore, the fan assembly 1110 can be arranged to draw air into the mattress system 1500 and circulate the air therein to help control a microclimate at the top surface of the mattress 1500.

[0155] FIG. 16 is a bottom perspective view of a mattress system 1600, illustrating the mattress system 1600 upside down. The mattress system 1600 can be the mattress system 1500 as depicted and described in reference to FIG. 15. The mattress system 1600 can also include some similar or same components as the mattress system 200 depicted and described in FIG. 2. For example, the mattress system 1600 can include the top layer (e.g., a first layer) 202, the intermediate layer (e.g., a second layer) 204, and the bottom layer (e.g., a third layer) 208, which is not shown in FIG. 16. The intermediate layer 204 can include the airflow insert pads 1122, as shown in FIG. 15. The airflow insert pads 1122 can each extend some length from a foot end 1207 of the rail structure 1206 towards a head end 1209 of the rail structure 1206. The airflow insert pads 1122 can be inset some distance from the foot end 1207 of the rail structure 1206 as well as respective right and left sides of the rail structure 1206.

[0156] A bottom layer (e.g., the bottom layer 108 as shown in FIG. 15) can cover an entire bottom of the mattress system 1600, from one rail edge to another rail edge (e.g., from a head end edge to a foot end edge of the rail structure 1206 and from a right side edge to a left side edge of the rail structure 1206). In some implementations, the bottom layer can also cover the rail structure. In other implementations, the bottom layer is inserted into a space defined (surrounded) by the rail structure.

[0157] The mattress system 1600 can also include the rail structure 1206, as shown in FIG. 15. The rail structure 1206 is arranged around a periphery of the mattress system 1600 and configured to at least partially surround an air chamber assembly or mattress core. For example, the air chamber assembly can include one or more inflatable air chambers (e.g., refer to FIG. 17). The foot end 1207 of the rail structure 1206 can have a wider width than the head end 1209 opposite the foot end and left and right sides of the rail structure 1206. In some implementations, the combined width of the foot end 1207 and head end 1209 of the rail structure 1206 is the same as the combined width of the foot end 230 and the head end 232 of the mattress 200 (FIG. 4). The foot end 1207 can be wider in order to accommodate placement of the fan assemblies 1110 thereto. As described in reference to FIG. 15, the fan assemblies 1110 can be disposed inside the

foot end 1207 of the rail structure 1206 and configured to draw air through the air duct hoses 111 from the airflow insert pads 1122 and out along the inside of the rail structure 1206 (e.g., along the foot end 1207 of the rail structure 1206). For example, the foot end 1207 defines a cavity 1306 configured to receive the fan assembly 1110. Referring also to FIG. 19, the cavity 1306 is configured to entirely receive an external housing 1700 of the fan assembly 1110. The cavity 1306 is open toward the interior of the mattress so that an air duct 1708 of the fan assembly 1110 extends therethrough. An air inlet 1710 at the end of the air duct 1708 is exposed out of the cavity 1306 in the foot end 1207 and configured to couple to the air duct hose 111. The fan assemblies 1110 can be positioned at the foot end 1207 of the rail structure 1206 to prevent the fan assemblies 1110 from protruding out from the mattress system 1600 due to connection to the air duct hoses 111. Moreover, the fan assemblies 1110 are positioned farther away from a head of a user of the mattress system 1600 so that the fan assemblies 1110 are quieter when operating. As a result, sounds from the fan assemblies 1110 may not disturb the user's sleep.

[0158] As depicted, the mattress system 1600 can have two fan assemblies 1110 disposed in the foot end 1207 of the rail structure 1206, and configured and operable to control microclimates of two separate zones (left and right sides) at the top of the mattress system 1500. In yet other implementations, the mattress system 1500 can have fewer or more integrated fan assemblies.

[0159] FIG. 17 is a partial exploded view of the mattress system 1600 of FIG. 16, illustrating the top layer 202, the intermediate layer 204, the example air chambers 222, and the integrated fan assemblies 1110. The air chambers 222 can be arranged to be surrounded by the rail structure 1206.

[0160] As depicted, the rail structure 1206 can be disposed on the intermediate layer 204, or on the top layer 202 where there is no intermediate layer, to define the space 211 for at least partially receiving the air chambers 222. As described in reference to FIG. 16, the bottom layer 208 can be disposed within the space 211 to cover the entire space 211 and the air chambers 222 within the space 211.

[0161] The mattress system 1600 can also include the airflow insert pads 1122 (e.g., thermal insert), which can be positioned under the top layer 202. In some implementations, the intermediate layer 204 can define a cutout section or recess to receive the airflow insert pads

1122 therein. The airflow insert pads 1122 can be similar to the airflow insert pad 122 described throughout this disclosure. In the illustrated example, the airflow insert pads 1122 are disposed between the head and foot of the mattress 1600, partially along a length of the mattress 1600 from the head to the foot. The pads 1122 are disposed closer to the foot of the mattress 1600 than the head of the mattress 1600 to optimize positioning without needing to rely on a foundation hole pass-through. For example, as described herein, the fan assembly can be embedded in the foam. The fan assembly can operate to draw air from the top of the mattress, and the fan assembly is designed to have enough power to expel the air out of the rail structure of the mattress. This design allows the mattress assembly to not rely on a single foundation and to be used with any type of foundation. In one example, a portion of the rail structure can be thickened in order to accept the fan assembly and maintain structural integrity of the foam mattress assembly. In some implementations, the fan assembly is placed in the foot of the bed (e.g., in the foot rail of the mattress), and the air chamber is shifted up towards the head of the bed, reducing the thickness of the head rail. By placing the fan assembly in the foot rail as opposed to the head rail can provide additional benefits. For example, the sound of the fan is further away from the head reducing perceived sound levels. The chamber is shifted to the more comfort sensitive areas of the body (core, head) rather than the feet. In addition, where the fan assembly is a cooling-only module, the fan assembly can have a relatively small form factor so as to fit within the bounds of the mattress.

[0162] The airflow insert pads 1122 can be attached to a surface of the space 211 using one or more attachment mechanisms. For example, each corner of the airflow insert pad 1122 can include a hook or loop configured to mate with a respective loop or hook on the space 211. Such hook and loop fasteners can provide for easy and secure attachment of the airflow insert pad 1122 in the space 211. One or more other attachment mechanisms can be used, including but not limited to adhesives. In other examples, the airflow insert pads 1122 can be interference fit to the cutout section or recess in the intermediate layer 204, or received within the cutout section or recess in the intermediate layer 204 without attachment mechanisms. In some implementations, the airflow insert pads 1122 can be positioned to be flush with the intermediate layer 204.

[0163] The fan assemblies 1110 can be connected to or mounted on the air duct hoses 111. The fan assemblies 1110 can also be disposed at least partially in the rail structure 1206 at the

foot end, as described in reference to FIGS. 15-16. In some implementations, the intermediate layer 1122 defines a cutout section or recess configured to receive the air duct hoses 111. The air duct hoses 111 can be received in the cutout section or recess to be flush with the intermediate layer 1122.

[0164] FIG. 18 illustrates a bottom perspective view of the mattress system 1600 of FIG. 16. Unlike the mattress system 200 depicted and described in FIG. 4, the mattress system 1600 depicted and described in FIG. 18 does not include reinforcement straps (e.g., the reinforcement straps 250A-B in FIG. 4). Instead, a foot rail 1230 of the rail structure 1206 is thicker than a head rail 1232 and the opposite side rails 234 and 236. The thicker foot rail 1230 can provide additional support for the rail structure 1206 to hold a shape of the mattress system 1600. The thicker foot rail 1230 can also provide additional support for maintaining the fan assemblies 1110 in place so that the rail structure 1206 does not bend and/or the fan assemblies 1110 do not protrude from a general shape of the mattress system 1600. By thickening the foot rail 1230, the head rail 1232 and the opposite side rails 234 and 236 can be adjusted in width such that an existing air chamber assembly can be positioned in the mattress system 1600. For example, the head rail 1232 may be thinned/thinner in width. Therefore, an air chamber assembly may not have to be modified in size and/or shape in order to fit within a space (e.g., the space 211 in FIG. 17) defined by and between the foot rail 1230, the head rail 1232, and the opposite side rails 234 and 236 of the rail structure 1206. For example, the air chamber assembly 220 described in FIG. 3 can be used with both the mattress system 200 and the mattress system 1600, even though the rail structure 206 of the mattress system 200 has rails of equal width and the rail structure 1206 of the mattress system 1600 has rails of different widths. In one example, the width of the foot rail can range between 4 inches and 7 inches, and the head rail can range between 1 inches and 4 inches, so that the total width of the foot and head rails can be around 8 inches. In this example, each of the side rails can be maintained at 4 inches of width.

[0165] In some implementations, the foot rail 1230 can have a largest width, the head rail 1232 can have a smallest width, and the opposite side rails 324 and 236 can have a same width that is less than the width of the foot rail 1230 and greater than the width of the head rail 1232. As mentioned above, the rail structure 1206 can be sized in such a way that still allows an existing air chamber assembly to be positioned in the mattress system 1600 without having to be

replaced by a differently sized air chamber assembly. In some implementations, the opposite side rails 234 and 236 can be increased in width to provide additional support and maintain the rail structure 1206 in the shape of the mattress system 1600.

[0166] FIG. 19 is a perspective view of the integrated fan assembly 1110 of FIG. 15. As depicted, the fan assembly 1110 includes an external housing 1700 configured to receive a fan and electronics that can control operation of the fan. The fan can be positioned in the external housing 1700. The electronics can include a printed circuit board positioned proximate the fan and/or near an air outlet 1702 of the fan assembly 1110. The electronics can connect (e.g., wired and/or wireless) to a controller of a bed system (e.g., the bed system 100 in FIG. 1) and can be configured to control operation of the fan assembly 1110. In some implementations, the electronics can include one or more sensors for measuring temperature, humidity, and/or smoke detection in the fan assembly 1110 and/or near the fan assembly 1110 when positioned in the mattress system 1500 and/or 1600.

[0167] The fan assembly 1110 can include an air duct 1708 (e.g., plenum) that is fluidly connected to the housing 1700 and configured for airflow into or from the housing 1700. The housing 1700 and the air duct 1708 can define air inlets and air outlets. For example, where the fan assembly 110 operates to draw air, the air duct 1708 defines an air inlet 1710, and the housing 1700 defines an air outlet 1702. In embodiments where the fan assembly 1110 operates to blow air, the air inlet 1710 of the air duct 1708 work as an air outlet, and the air outlet 1702 of the housing 1700 works as an air inlet. One or more components of the fan assembly 1110 depicted and described in FIG. 19 can be similar to one or more components of the fan assembly 110 depicted and described in FIG. 5.

[0168] FIG. 20 illustrates a cross sectional view of airflow through the mattress system 1600 of FIG. 16, taken along a cross sectional line shown in FIG. 22. FIG. 20 illustrates an example airflow 1800 (e.g., exhaust air) through the mattress system 1600. The mattress system 1600 can be similar to the mattress system 200 depicted and described in reference to FIG. 6. The view of FIG. 20 depicts the head rail 1232 and the foot rail 1230 of the rail structure 1206. The fan assemblies 1110 are positioned within the foot rail 1230 of the rail structure 1206, as described throughout FIGS. 15-19.

[0169] As shown in FIG. 20, the airflow 1800 is directed from the top surface of the mattress system 1600, through the airflow insert pad 1122, and into the fan assembly 1110 via the air duct 1708. The airflow 1800 can then be routed into the housing 1700 of the fan assembly 1110. In some implementations, the airflow 1800 can also flow through one or more layers of the mattress 1600 to provide for air circulation at the top layer 202. By circulating the airflow 1800, the fan assembly 1110 can cause the airflow 1800 at the top surface of the mattress cover 140 to lower or moderate a temperature of the mattress 1600.

[0170] FIG. 21 illustrates a side cross sectional view of the mattress system 1600, taken along a cross sectional line shown in FIG. 22. FIG. 21 depicts the airflow 1800 that is drawn into the fan assembly 1110 and further depicts exhaust air 1801 from the fan assembly 1110. This side cross sectional view of the mattress 1600 depicts a shorter foot side of the mattress 1600. The mattress 1600 includes the rail structure 1206 having the side rails 234 and 236. The fan assemblies 1110 are disposed in the foot rail 1230 of the rail structure 1206 (not shown). In the illustrated example, the fan assemblies 1110 are oriented towards the side rail 234 of the rail structure 1206. As a result, the airflow 1801 is discharged from the fan assemblies 1110 towards the same side portion of the mattress 1600 to thereby lower a temperature of a top surface of the mattress 1600. Alternatively, the fan assemblies 1110 can be oriented towards the side rail 236 of the rail structure 1206.

[0171] As shown in FIG. 21, the fan assemblies 1110 can exhaust the airflow 1801 in the same direction. In some implementations, the fan assemblies 1110 can exhaust the airflow 1801 in different directions (e.g., the fan assembly 1110 closest to the side rail 234 can exhaust the airflow 1801 towards the side rail 234 and the fan assembly 1110 closest to the side rail 236 can exhaust the airflow 1801 towards the opposite side rail 236). Regardless of an orientation/direction of the fan assemblies 1110, the airflow 1801 can be directed into and/or around the rail structure 1206 to effectively adjust a microclimate of a top surface of the mattress 1600 as described throughout this disclosure.

[0172] FIG. 22 is a bottom view of the example mattress system 1600 having the integrated fan assembly 1110 of FIG. 15. As depicted, the mattress system 1600 is flipped upside down so that a top surface of the mattress system 1600 is facing down. The depicted mattress system 1600 has a rail structure 1302 and the bottom layer 304, as described throughout this disclosure (e.g.,

refer to the rail structure 1206 in FIG. 16 and the bottom layer 208 in FIG. 2). In some implementations, as described in reference to FIGS. 24A-B, the mattress system 1600 can have a bottom layer 1900.

[0173] FIG. 23 is another bottom view of the example mattress system 1600 of FIG. 22 having the integrated fan assembly 1110. In FIG. 23, the bottom layer 304 is removed to show detail of the rail structure 1302. The rail structure 1302 has recessed portions 1306. The recessed portions 1306 are configured to receive the fan assemblies 1110. A foot rail 1304 can include recessed portions 1306 configured to at least partially receive each of the fan assemblies 1110. The recessed portions 1306 can be any appropriate size to fit a size of the fan assemblies 1110. Therefore, the fan assemblies 1110 can be disposed inside the rail structure 1302 so that the fan assemblies 1110 do not interfere with one or more other components of the mattress system 1600. This configuration can also be beneficial to prevent interference of the fan assemblies 1110 placement with one or more other components of the mattress system 1600 that are disposed at or around a middle axis of the mattress system 1600 (e.g., refer to the middle axis 310 described in reference to FIGs. 8-10).

[0174] The recessed portions 1306 can have a predetermined width W1 that is suitable for receiving at least part of the fan assemblies 1110. The predetermined width W1 can be big enough to maintain sufficient airflow and room for installation of the fan assembly 1110 while also being minimal in size to minimize discomfort that may occur from an opening that is too wide. The width W1 can depend on the length of the thermal module. For example, the width W1 can be greater (e.g., by 1 inch or more) than the length of the thermal module. In some implementations, where the length of the thermal module is 8.5 inches, the width W1 can be 9.5 inches or larger.

[0175] In some implementations, the recessed portions 1306 can be arranged in one or more different configurations to facilitate or direct airflow (e.g., exhaust air) from the fan assemblies 1110. As shown in FIG. 23, the recessed portions 1306 can be arranged such that the fan assemblies 1110 can direct air towards a same side rail of the rail structure 1302. As another example, the recessed portions 1306 can be arranged in an opposite direction such that both fan assemblies 1110 direct air towards the opposite side rail of the rail structure 1302. In some implementations, each of the recessed portions 1306 can be arranged in opposite configurations

such that the fan assembly 1110 on a right side of the mattress system 1600 can direct air towards a right side rail of the rail structure 1302 and the fan assembly 1110 on a left side of the mattress system 1600 can direct air towards a left side rail of the rail structure 1302. In some implementations, each of the recessed portions 1306 can be arranged towards each other such that both fan assemblies 1110 direct air inwards towards a midpoint of the foot rail 1304 of the rail structure 1302. In yet some implementations, at least one of the recessed portions 1306 can be arranged inwards, towards the midpoint of the foot rail 1304 of the rail structure 1302. Moreover, in some implementations, an air duct of the fan assemblies 1110 (e.g., the air duct 1708 in FIG. 19) can extend out from the foot rail 1304 of the rail structure 1302.

[0176] FIGS. 24A-B illustrate a bottom view of a bottom layer 1900 of an example mattress system 1901 having the integrated fan assembly of FIG. 15. The mattress system 1901 can be the same as or similar to the mattress systems 1500 and 1600. In some implementations, the bottom layer 1900 can be part of the mattress system 200 described herein.

[0177] Referring to both FIGS. 24A-B, the bottom layer 1900 (e.g., base pad) can cover an entire bottom of the mattress system 1901, including a top layer (e.g., a first layer, such as the layer 202) 1902, an intermediate layer (e.g., a second layer, such as the layer 204) 1904, a rail structure 1906 (e.g., such as the rail structure 206 and/or 1206). The bottom layer 1900 can be made of a material that has some permeability to provide a sufficient airflow rate for adjusting a microclimate at a top surface of the mattress system 1901. The fan assemblies described herein (e.g., the fan assembly 110 and the fan assembly 1110) can also route airflow throughout the mattress system 1901 sufficiently to overcome features of the bottom layer 1900 that may otherwise impede ability to adjust the microclimate and achieve a desired cooling at the top surface of the mattress system 1901. The foot of the bed is configured to be permeable enough to discharge the air through the foot rail without a need for any permeability of the base. Therefore, for example, the bottom layer 1900 can be made of various types of material (e.g., not breathable, having minimum breathability, etc.) In some implementations, the bottom layer is made to little breathability so that the air exits the vertical surface at the foot of the bed. Moreover, the fan assemblies described herein can sufficiently route airflow through/around the rail structure 1906 and the bottom layer 1900 without requiring exhaust openings (e.g., the

recessed portions 1306) to extend out from the rail structure 1906 and into a surrounding environment.

[0178] Still referring to both FIGS. 24A-B, the bottom layer 1900 can be formed with multiple pieces. For example, the bottom layer 1900 can be split longitudinally down a midpoint of the bottom layer 1900, thereby having first and second flaps 1900A and 1900B, respectively. Each of the flaps 1900A and 1900B can be individually opened/folded back from a midpoint of the mattress system 1901 to access components of the mattress system 1901 described throughout this disclosure. This construction can be beneficial to allow for opening the mattress system 1901 for assembly, maintenance, and/or fixing/replacing one or more components of the mattress system 1901. Each of the flaps 1900A and 1900B can also be attached (e.g., laminated, adhered) to respective side rails of the rail structure 1906. In some implementations, the flaps are attached to the rails using foam lamination. For example, for laminating to the head and foot rails, glue (e.g., 3-4 inches) would be present following the glue path created by the side rails. This makes the head/foot rails have a partial lamination with the base pads. The flaps 1900A and 1900B of the bottom layer 1900 may not be laminated or otherwise attached to head and foot rails of the rail structure 1906 to ensure that the flaps 1900A and 1900B can be individually opened or closed.

[0179] In some implementations, the bottom layer 1900 can also include openings 1908A and 1908B (e.g., cutouts, chamber ports, etc.) on respective flaps 1900A and 1900B. The openings 1908A and 1908B can be positioned towards a midpoint of the mattress system 1901 (e.g., a hip of the bed). The openings 1908A and 1908B can be offset some predetermined distance from the midpoint of the mattress system 1901, in some implementations. Moreover, the openings 1908A and 1908B can be positioned at locations where air duct hoses may attach to air chambers of the mattress system 1901 such that all or some wiring/cables can be maintained together in a centralized location and routed therefrom to a power source and/or a controller for the mattress system 1901 and/or the bed system. The openings 1908A and 1908B can therefore be configured to receive wires/cables that are routed to and from components (e.g., the fan assemblies, air chambers, etc.) in the bed system 1901. For example, wiring/cables connected to an external housing of a fan assembly can be routed (e.g., in a wire harness or without a harness) from the foot rail of the rail structure 1906 to the midpoint of the mattress system 1901

(e.g., the hip of the bed) along the foot rail and at least one of the side rails of the rail structure 1906.

[0180] The wiring can be routed, as an illustrative example, along the foot rail to a location where the flap 1900B folds back from the respective side rail of the rail structure 1906. The wiring can be secured along one or more portions of the rail structure 1906 using one or more wire management loops. The loops can keep the wiring from shifting out of its intended location inside the mattress system 1901 when the mattress system 1901 is transported (e.g., to a user's home), when a user sits on edges of the mattress system 1901, and/or when the mattress system 1901 is lifted off a base/foundation of a bed system. The loops can be secured to the respective side rails of the rail structure 1906 (and/or portions of the foot rail of the rail structure 1906) using adhesive (e.g., foam glue between the bottom layer 1900 and the respective side rail of the rail structure 1906) and/or hook and loop fasteners (e.g., micro-hooks adhered to the respective side rail and fabric attached to the micro-hooks). One or more other attachment mechanisms may also be used to attach the wire management loops to the mattress system 1901.

[0181] One or more wire management loops can be attached to each side of the mattress system 1901. For example, a loop can be configured at a corner where the foot rail means a right side rail (and where the foot rail meets a left side rail) of the rail structure 1906. This location can be beneficial to ensure the wiring does not shift or move towards a center of the mattress system 1901 and thus interfere with other components therein. Moreover, this location can be beneficial to ensure stress experienced on the fan assembly from using and/or moving the mattress system 1901 may be relieved. One or more additional wire management loops can be placed along a length of the side rail up to the respective opening 1908A or 1908B. In some implementations, wire management loops may not be used. Instead, the wiring can be attached directly to the mattress system 1901 with adhesives, hook and loop fasteners, and/or one or more other types of attachment mechanisms.

[0182] The wiring can then be tucked between the respective side rail of the rail structure 1906 and the flap 1900B of the bottom layer 1900 up to the respective opening 1908B. The wiring can then be routed through the respective opening 1908B. As a result, the wiring may be consolidated and maintained in one location, thereby providing an aesthetically pleasing look and also ease to a user of the mattress system 1901 and/or a technician when setting up and

maintaining the mattress system 1901. In other words, when the mattress system 1901 is manufactured and before it is delivered to a user, wires from the fan assemblies can be routed along side rails of the rail structure 1906 and out through the respective openings 1908A and 1908B. Maintaining the wires in one location can be beneficial to ensure ease of setting up the mattress system 1901 in a home of the user. A delivery technician or the user may not be required to connect wiring between/amongst one or more components of the mattress system 1901. Instead, the wires may already be connected to the components and thus maintained in a centralized location (e.g., at the openings 1908A and 1908B). The wires can also be maintained at the openings 1908A and 1908B such that they do not protrude through a cover of the mattress system 1901 or otherwise interfere with comfortability of the user of the mattress system 1901 or an aesthetic appearance of the mattress system 1901 when it is in use in the user's home.

[0183] The features of the integrated fan assemblies described herein can be applied to various types of mattress systems. In some implementations, the fan assemblies described herein can be integrated into a mattress that does not have air chambers. For example, the fan assemblies can be integrated into a mattress including spring assemblies, foam materials, or any suitable supporting materials, instead of inflatable air chambers. The fan assemblies can be installed inside such mattress the same or similar ways described herein (e.g., by inserting the fan assemblies at least partially in cutout sections of the rail structure). In other implementations, the fan assemblies can be mounted to any suitable locations within a mattress other than the rail structure of the mattress. In some cases, a mattress system may not include a rail structure. Instead, the mattress system can include a material, such as springs, foam, or another supporting material that makes up a majority composition of the mattress. In such mattress systems, a fan assembly, such as the fan assembly 110 and/or the fan assembly 1110, can be integrated into or otherwise housed in a recessed portion of the material of the mattress system. For example, a mattress system can be composed of foam materials. A recessed portion, such as an opening, can be cut into a foot end of the foam materials of the mattress system, near an edge of the foot end. The fan assembly can then be placed thereto to provide similar or same functionality to the mattress system as the fan assemblies described herein. As another example, a mattress system can be composed of springs. A recessed portion can be formed near a foot end of the mattress system in which a fan assembly can be placed to provide similar or same functionality to the

mattress system as the fan assemblies described throughout this disclosure. One or more other configurations and/or placements of the fan assembly can be used to incorporate the fan assembly into mattress systems that do not include rail structures and/or air chambers.

[0184] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of the disclosed technology or of what may be claimed, but rather as descriptions of features that may be specific to particular embodiments of particular disclosed technologies. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment in part or in whole. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described herein as acting in certain combinations and/or initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination. Similarly, while operations may be described in a particular order, this should not be understood as requiring that such operations be performed in the particular order or in sequential order, or that all operations be performed, to achieve desirable results. Particular embodiments of the subject matter have been described. Other embodiments are within the scope of the following claims.

CLAIMS

WHAT IS CLAIMED IS:

1. A mattress comprising:
 - a first layer having a first layer top and a first layer bottom;
 - a head rail attached to the first layer bottom;
 - a foot rail attached to the first layer bottom and defining a first recessed portion; and
 - a first air module configured to create airflow between the first layer top and the first layer bottom, the first air module being positioned in the first recessed portion of the foot rail.
2. The mattress of claim 1, further comprising:
 - a first side rail extending longitudinally and connecting a first edge of the head rail with a first edge of the foot rail;
 - a second side rail opposite the first side rail, extending longitudinally, and connecting a second edge of the head rail with a second edge of the foot rail; and
 - one or more additional layers positioned under the first layer bottom between the first side rail and the second side rail, wherein the one or more additional layers comprises:
 - a core, and
 - a second layer positioned under the core and covering the core between the first side rail and the second side rail.
3. The mattress of claim 2, further comprising a thermal layer attached to the first layer bottom, wherein the thermal layer (i) is configured to extend a first distance longitudinally between the head rail and the foot rail and (ii) is offset a second distance from at least one of the first side rail and the second side rail.
4. The mattress of claim 3, wherein the thermal layer is positioned closer to the foot rail than the head rail of the mattress.
5. The mattress of claim 3, further comprising an air duct hose configured to fluidly connect the first air module to the thermal layer.

6. The mattress of claim 5, wherein the first air module is configured to draw air from the thermal layer through the air duct hose, and discharge the drawn air out into the foot rail.
7. The mattress of claim 2, wherein the first air module is configured to draw air from the first layer and direct exhaust air into the foot rail and towards the first side rail of the mattress.
8. The mattress of claim 2, wherein the first air module is configured to draw air from the first layer and direct exhaust air into the foot rail and towards the second side rail of the mattress.
9. The mattress of claim 1, wherein the first air module is configured to draw air from the first layer and direct exhaust air into the foot rail of the mattress.
10. The mattress of claim 1, wherein the first recessed portion is configured to at least partially receive the first air module.
11. The mattress of claim 1, wherein the first air module includes:
 - a housing that defines an air inlet and an air outlet; and
 - a fan assembly enclosed in the housing and configured to suction air through the air inlet and supply exhaust air through the air outlet.
12. The mattress of claim 11, wherein the first air module includes:
 - wiring that is electrically connected to the fan assembly and extending from the housing, the wiring configured to electrically connect to a power source external to the mattress and supply electrical power to the fan assembly.
13. The mattress of claim 1, further comprising:
 - a second recessed portion defined in the foot rail proximate the first recessed portion; and

a second air module configured to create airflow and positioned inside the second recessed portion of the foot rail.

14. The mattress of claim 13, wherein the second air module is configured to draw air from the first layer and direct exhaust air in a same direction in the foot rail as exhaust air that is directed by the first air module.

15. The mattress of claim 13, wherein the second air module is configured to draw air from the first layer and direct exhaust air in a different direction in the foot rail as exhaust air that is directed by the first air module.

16. The mattress of claim 1, wherein the first air module defines an air outlet that is configured to discharge air into the foot rail of the mattress.

17. The mattress of claim 1, wherein the first air module is configured to draw air from the first layer and direct exhaust air into the foot rail towards an interior of the mattress.

18. The mattress of claim 1, further comprising a bottom layer positioned under the first layer, wherein the bottom layer extends from the head rail to the foot rail of the mattress, the bottom layer including first and second portions that extend laterally between the head rail and the foot rail along a predetermined axis of the bottom layer.

19. The mattress of claim 18, wherein the first and second portions of the bottom layer are laminated to respective first and second side rails of the mattress, and the first and second portions being configured to be opened from the predetermined axis of the bottom layer to expose at least a portion of the first layer, the head rail, the foot rail, and the first air module in the recessed portion of the foot rail of the mattress.

20. The mattress of claim 18, wherein the bottom layer comprises first and second openings in the respective first and second portions of the bottom layer, the first and second openings

being configured to route wires from at least the first air module along at least one side of the mattress.

21. A mattress comprising:
 - a first foam layer having a top surface and an opposite bottom surface;
 - an inflatable chamber positioned below the bottom surface of the first foam layer;
 - a foam rail structure including a head portion, a foot portion, and first and second side portions, the foam rail structure extending from a periphery of the first foam layer around a perimeter of the mattress and configured to surround the inflatable chamber;
 - a mattress bottom that covers the inflatable chamber, and
 - an air source configured to create airflow and positioned under the inflatable chamber, above the mattress bottom, and in the foot portion of the foam rail structure.
22. The mattress of claim 21, wherein the air source is a first air module.
23. The mattress of claim 22, further comprising:
 - a second foam layer positioned under the inflatable chamber and covering at least a portion of the inflatable chamber between the head portion, the foot portion, and the first and second side portions of the foam rail structure,
 - wherein the air source is configured to draw air from the second foam layer and direct exhaust air into the foot portion of the foam rail structure.
24. The mattress of claim 21, wherein the air source is configured to draw air from the first foam layer and direct exhaust air into the foot portion of the foam rail structure and towards the first side portion or the second side portion of the foam rail structure.
25. The mattress of claim 21, wherein the foot portion of the foam rail structure defines a first rail recessed portion configured to receive the air source.
26. The mattress of claim 21, wherein:

the foot portion of the foam rail structure has a first width,
the head portion of the foam rail structure has a second width,
the first and second portions of the foam rail structure have a third width, and
the first width is greater than the second and third widths, and the second width is less than the third width.

27. The mattress of claim 21, wherein the air source includes:
- a housing that defines an air inlet and an air outlet;
 - a fan assembly enclosed in the housing and configured to suction air through the air inlet and supply exhaust air through the air outlet;
 - one or more sensors configured to generate signals representative of at least one of temperature, humidity, and flame;
 - a controller included in the housing that is configured to control operations of the fan assembly and receive the signals from the one or more sensors; and
 - wiring that is electrically connected to the controller and the fan assembly, wherein the wiring extends from the housing and is configured to electrically connect to a power source external to the mattress and supply electrical power to the controller and the fan assembly.
28. The mattress of claim 21, wherein the inflatable chamber is a mattress core.