US 20250263921A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2025/0263921 A1
(43) Pub. Date: Aug. 21, 2025
Crane et al.

(54) **LOW-COST SHEET-BASED INSULATION WITH SWITCHABLE THERMAL PROPERTIES FOR USE IN RADIATION DOMINATED ENVIRONMENTS**

(71) Applicant: **BRIGHAM YOUNG UNIVERSITY**, Provo, UT (US)

(72) Inventors: **Nathan Crane**, Vineyard, UT (US); **Tyler Stevens**, Salem, UT (US); **Rydge Mulford**, Bellbrook, OH (US)

(73) Assignee: **BRIGHAM YOUNG UNIVERSITY**, Provo, UT (US)

(21) Appl. No.: **19/060,576**

(22) Filed: **Feb. 21, 2025**

Related U.S. Application Data

(60) Provisional application No. 63/556,112, filed on Feb. 21, 2024.

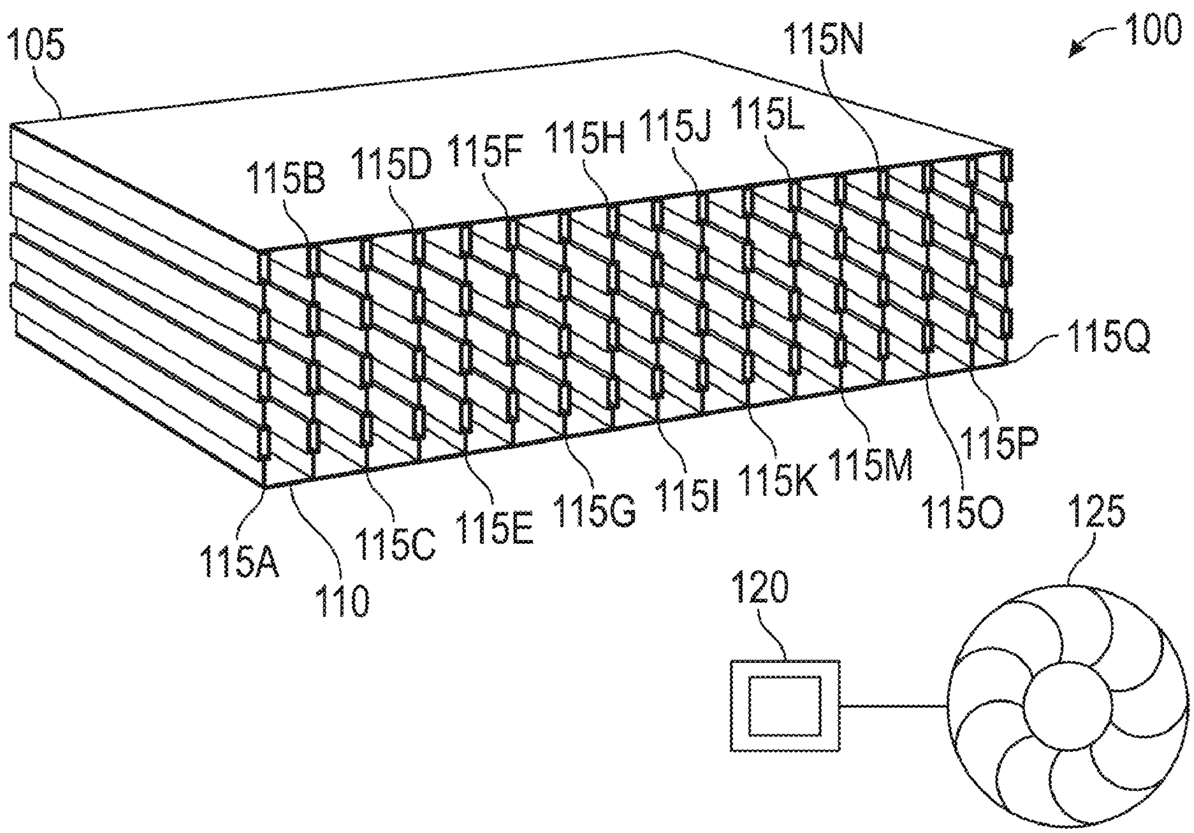
Publication Classification

(51) **Int. Cl.**
E04B 1/76 (2006.01)

(52) **U.S. Cl.**
CPC ***E04B 1/76*** (2013.01)

(57) **ABSTRACT**

Disclosed is A dynamic insulation system that includes a base, one or more slats, a cap, and an inflator. The base is attached to one end of the one or more slats. The cap is attached to the second end of the one or more slats.



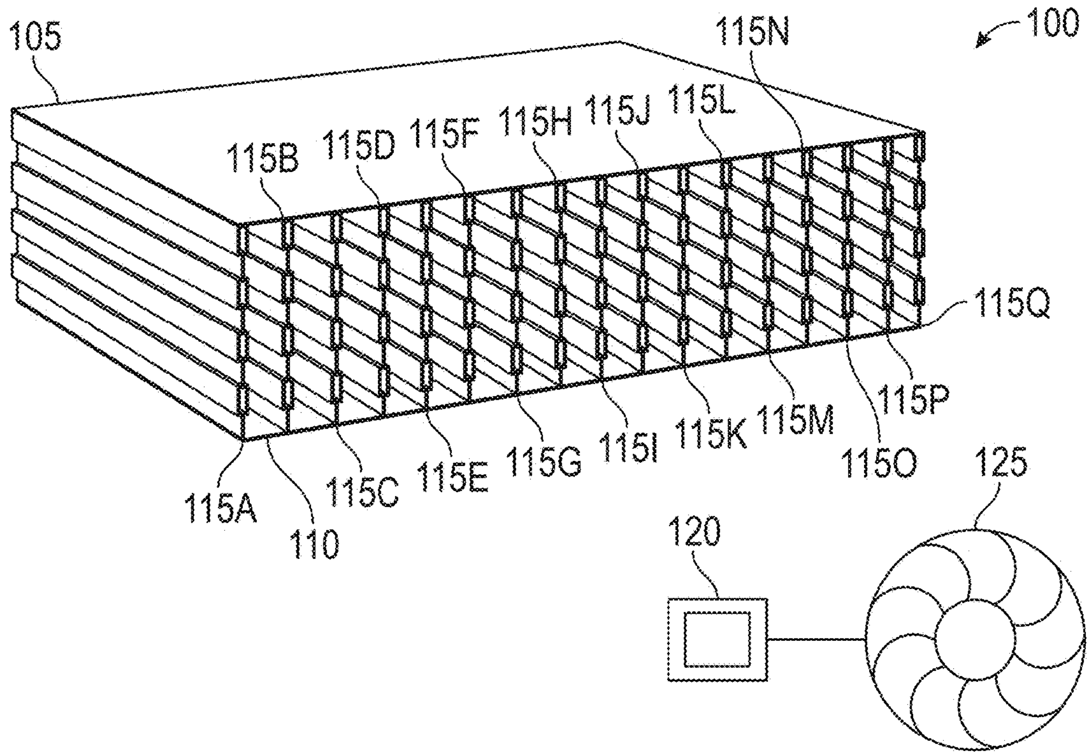

100
105
115N
115B
115D
115F
115H
115J
115L
115Q
115P
115A
110
115C
115E
115G
115I
115K
115M
115O
125
120

FIG. 1

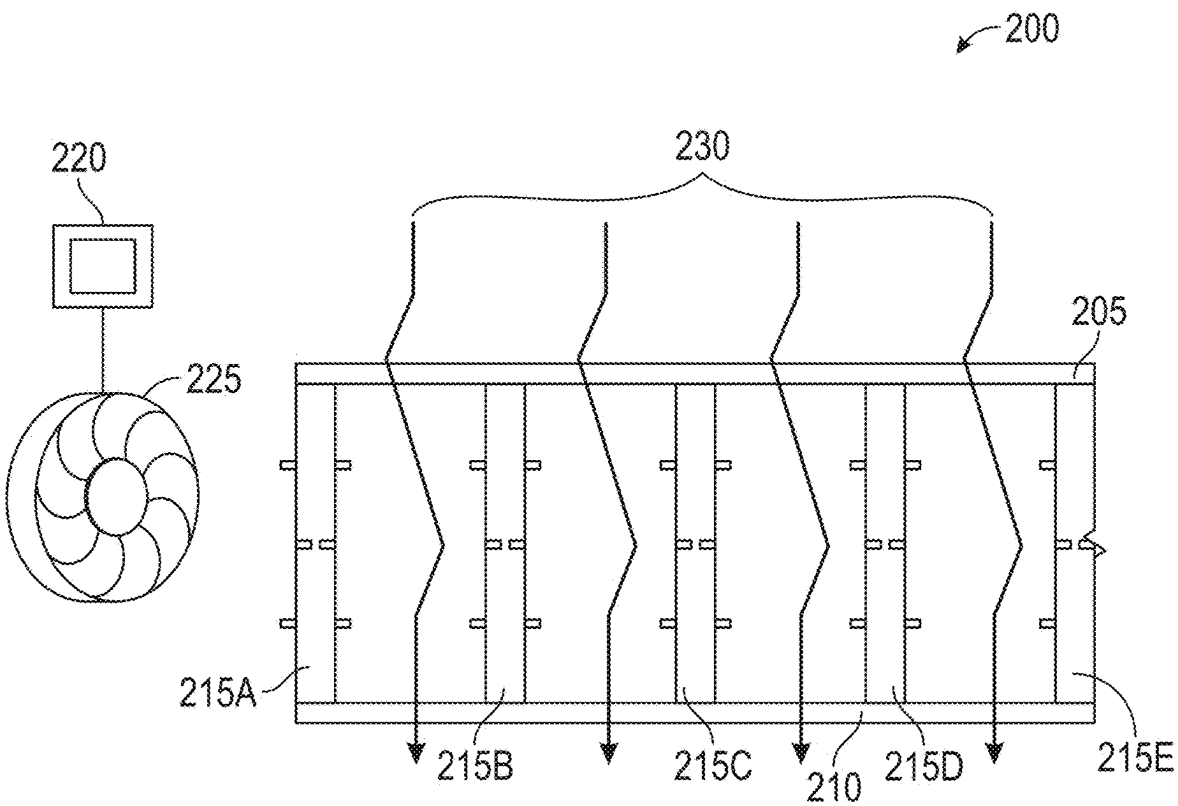

200
230
220
205
225
215A
215B
215C
210
215D
215E

FIG. 2

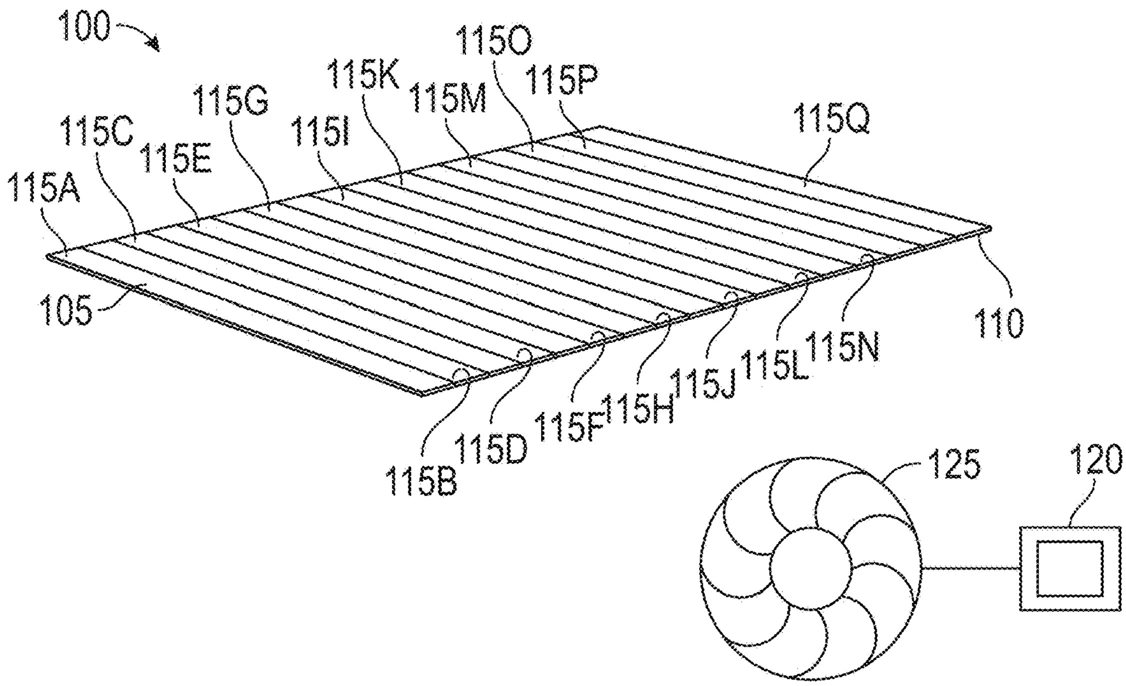

100
115O
115K
115P
115G
115M
115Q
115C
115I
115E
115A
105
110
115N
115L
115J
115H
115F
115D
115B
125
120

FIG. 3

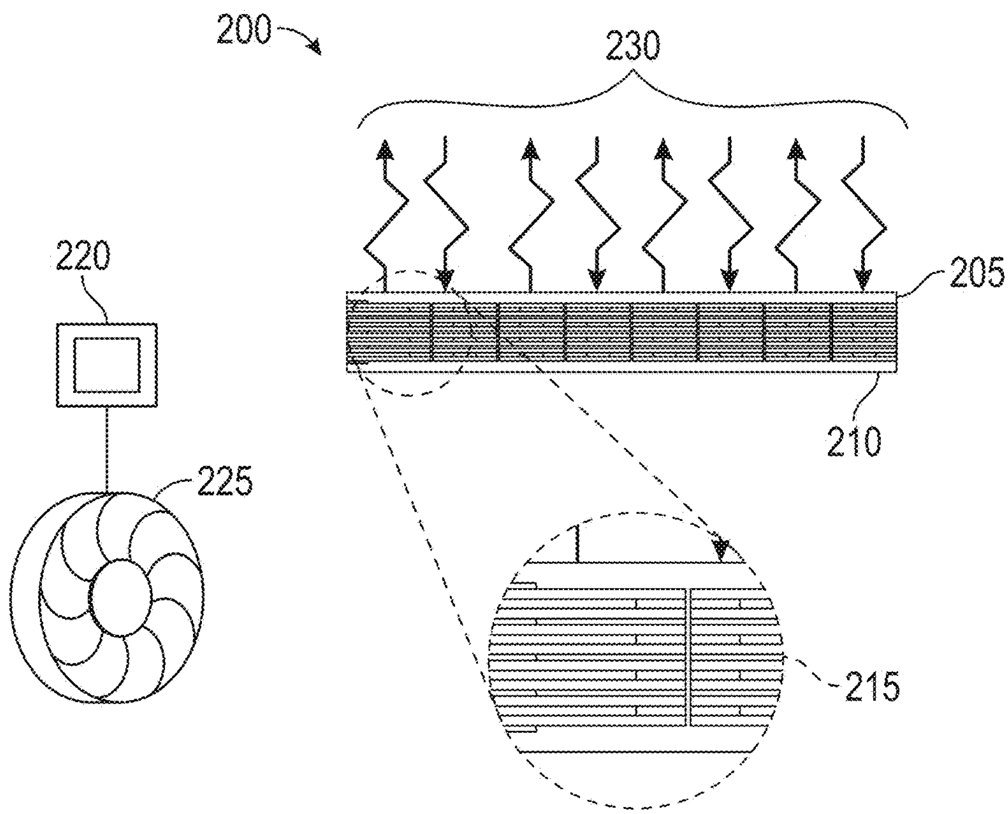

200
230
220
205
210
225
215

FIG. 4

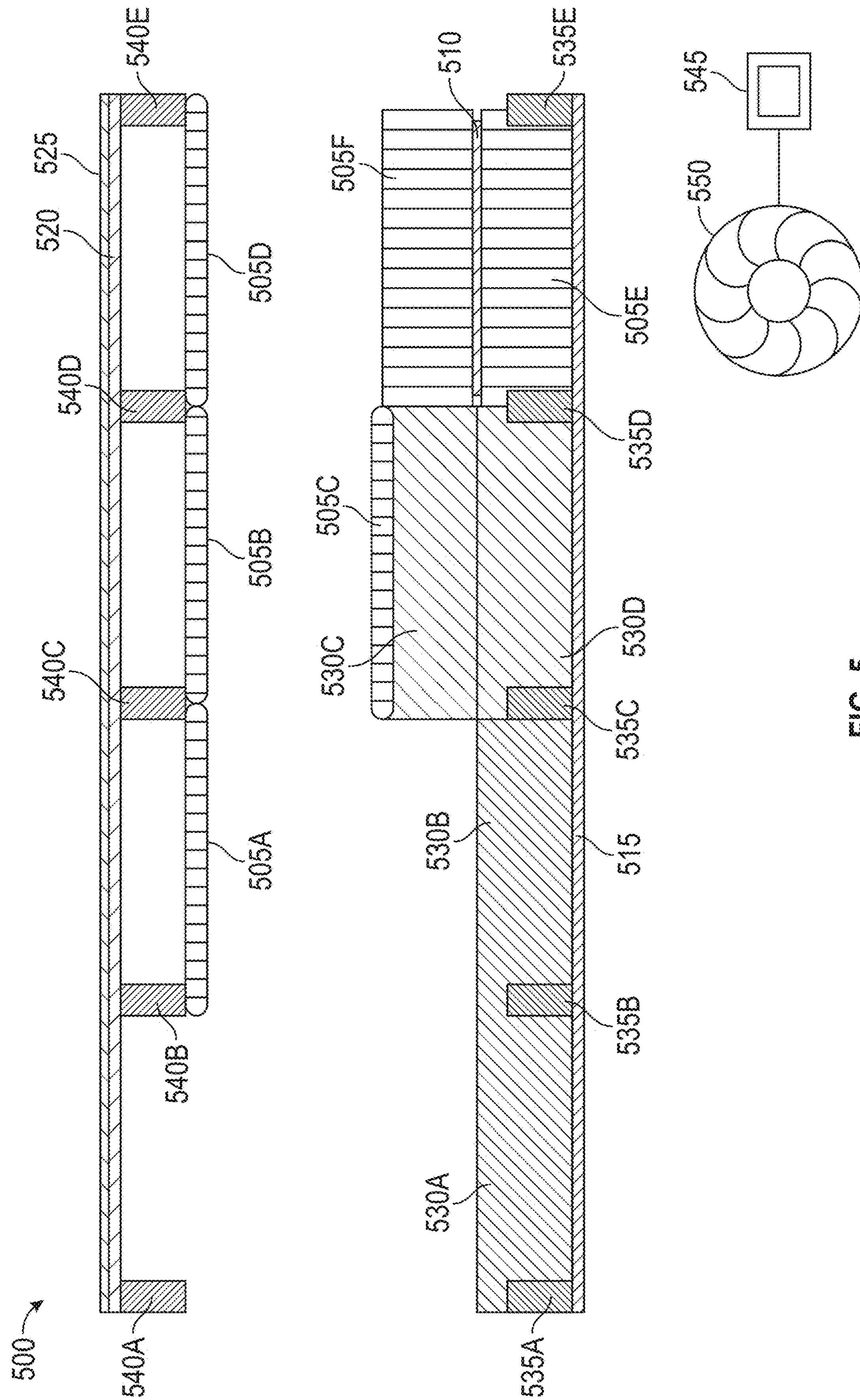

500
540A
540B
540C
540D
540E
525
520
505A
505B
505D
505C
505F
510
535E
505E
535D
530C
530D
535C
530B
515
535B
530A
535A
545
550

FIG. 5

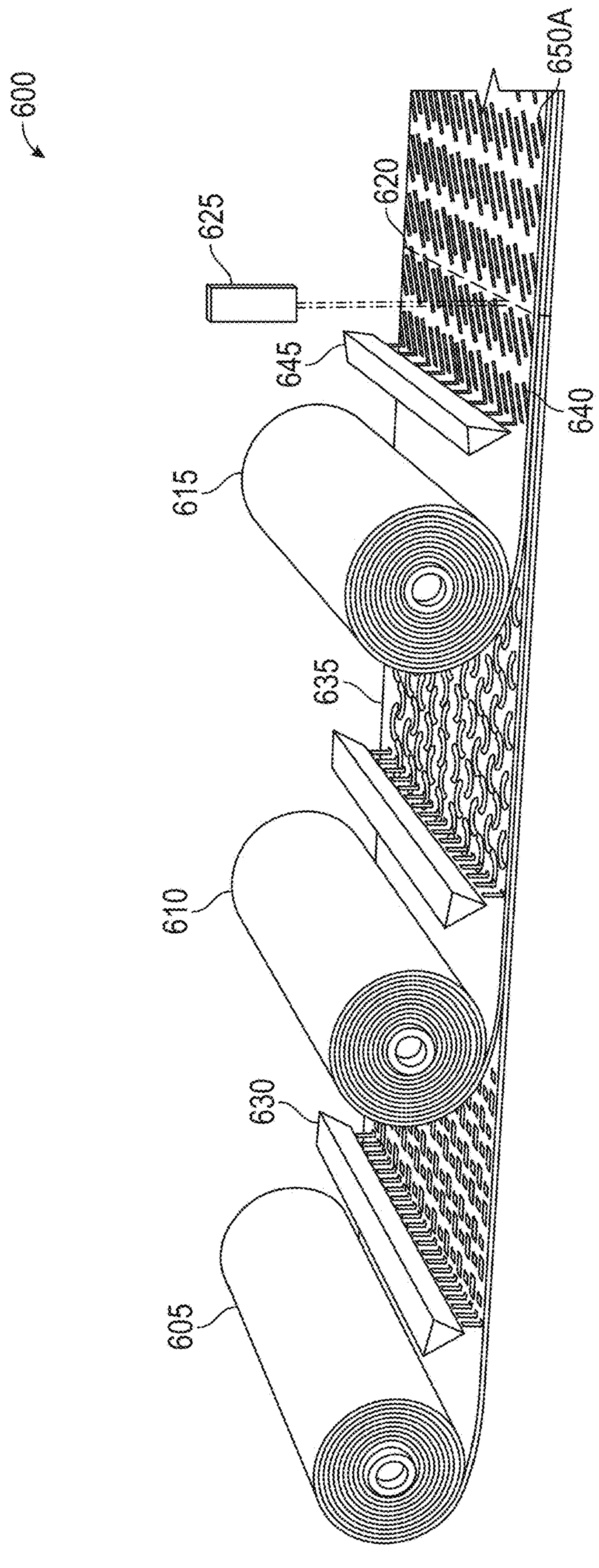


FIG. 6

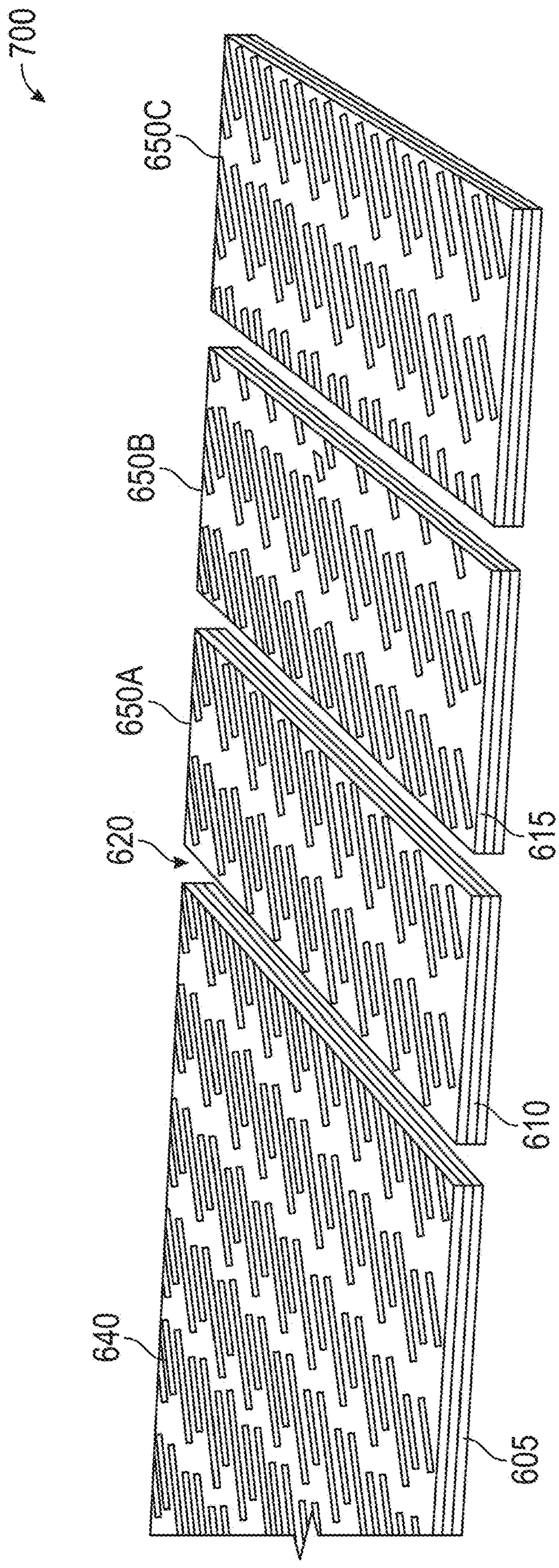


FIG. 7

LOW-COST SHEET-BASED INSULATION WITH SWITCHABLE THERMAL PROPERTIES FOR USE IN RADIATION DOMINATED ENVIRONMENTS

[0001] This application claims the priority and benefit of U.S. Provisional Patent Application No. 63/556,112 filed on Feb. 21, 2024, which is incorporated by reference in its entirety.

BACKGROUND

[0002] Home insulation has evolved significantly over the centuries as societies have sought to improve indoor comfort and energy efficiency. Early forms of insulation were rudimentary, relying on natural materials such as mud, straw, and animal hides to reduce heat loss in dwellings. In colder climates, thick stone walls or thatched roofs provided some thermal protection, though these methods were largely ineffective at preventing drafts and heat escape.

[0003] With the advent of modern construction techniques in the 19th and 20th centuries, insulation materials became more sophisticated. The development of fiberglass insulation in the 1930s marked a turning point in home energy efficiency, as it provided a lightweight and effective means of thermal resistance. By the mid-20th century, additional materials such as cellulose, foam board, and spray-applied polyurethane foam were introduced, further enhancing insulation performance.

[0004] While traditional insulation materials significantly reduced heat transfer, they remained largely passive systems, providing a static level of thermal resistance without the ability to adjust to changing environmental conditions. Additionally, traditional insulation often suffers from several drawbacks. Over time, materials such as fiberglass and cellulose could degrade, settle, or become less effective due to moisture infiltration. Poorly installed insulation could leave gaps, allowing drafts and thermal bridging, which reduced efficiency.

[0005] As energy efficiency standards increased and homeowners sought more adaptive solutions, the concept of dynamic insulation emerged. Dynamic insulation systems represent an advancement in thermal management by actively responding to external and internal temperature variations. Unlike traditional insulation, which maintains a fixed R-value, dynamic insulation systems can enhance heat retention in cold conditions and promote heat dissipation in warm environments, ultimately reducing energy consumption and improving overall home comfort. However, dynamic insulation also presents certain challenges. These systems often require more complex installation processes, increasing initial costs and labor requirements. Additionally, reliance on moving components or automated controls introduces potential points of failure, necessitating regular maintenance and potential repair costs. Furthermore, improper calibration of dynamic insulation systems can lead to inefficiencies, negating potential energy savings and even causing indoor discomfort.

[0006] The present invention builds upon these advancements by offering a novel dynamic insulation system that intelligently adapts to environmental conditions by using a low-cost sheet-based insulation with switchable thermal properties for use in radiation dominated environments, increasing efficiency and sustainability in residential and commercial buildings.

SUMMARY OF THE DISCLOSURE

[0007] Disclosed herein is a low-cost sheet-based insulation with switchable thermal properties for use in radiation dominated environments

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Non-limiting and non-exhaustive implementations of the disclosure are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified. The advantages of the disclosure will become better understood with regard to the following description and accompanying drawings where:

[0009] FIG. **1** illustrates an inflated dynamic insulation system.

[0010] FIG. **2** illustrates a diagram of an inflated dynamic insulation system.

[0011] FIG. **3** illustrates an uninflated dynamic insulation system.

[0012] FIG. **4** illustrates a diagram of an uninflated dynamic insulation system.

[0013] FIG. **5** illustrates a cross section of an attic with an installed dynamic insulation system.

[0014] FIG. **6** illustrates a manufacturing system to manufacture slats for a dynamic insulation system.

[0015] FIG. **7** illustrates an outcome of a manufacturing system to manufacture slats for a dynamic insulation system.

DETAILED DESCRIPTION

[0016] In the following description of the disclosure, reference is made to the accompanying drawings, which form a part hereof, and which are shown by way of illustration-specific implementations in which the disclosure may be practiced. It is understood that other implementations may be utilized, and structural changes may be made without departing from the scope of the disclosure.

[0017] In the following description, for purposes of explanation and not limitation, specific techniques and embodiments are set forth, such as particular techniques and configurations, in order to provide a thorough understanding of the device disclosed herein. While the techniques and embodiments will primarily be described in context with the accompanying drawings, those skilled in the art will further appreciate that the techniques and embodiments may also be practiced in other similar devices.

[0018] Reference will now be made in detail to the exemplary embodiments, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used throughout the drawings to refer to the same or like parts. It is further noted that elements disclosed with respect to particular embodiments are not restricted to only those embodiments in which they are described. For example, an element described in reference to one embodiment or figure may be alternatively included in another embodiment or figure regardless of whether or not those elements are shown or described in another embodiment or figure. In other words, elements in the figures may be interchangeable between various embodiments disclosed herein, whether shown or not.

[0019] FIG. **1** illustrates inflated dynamic insulation system **100**. Insulation system **100** may include cap **105** that attaches to one or more slats **115**A-**115**Q in a way that may allow slats **115**A-**115**Q to articulate. Cap **105** may be composed of material that allows heat to flow with minimal to no obstruction. Slats **115**A-**115**Q may be composed of insulative material. The insulative properties of slats **115**A-**115**Q may be magnified by the overlapping of the slats **115**A-**115**Q when in an uninflated position as seen in FIGS. **3**-**4**. Further, slats **115**A-**115**Q may include grooves tunnels, and slits to increase the ease of manufacturing and/or increase the insulative capabilities as seen in FIGS. **6**-**7**. Slats **115**A-**115**Q may also attach to base **110**. The attachment between base **110** and slats **115**A-**115**Q may allow slats **115**A-**115**Q to articulate. Base **110** may be composed of material that allows heat to flow with minimal to no obstruction. This may allow slats **115**A-**115**Q to have two main positions inflated and uninflated. Alternatively, slats **115**A-**115**Q may have more than two main positions. When slats **115**A-**115**Q are attached to cap **105** and base **110** they may be positioned to form a panel that may later be installed in an attic or other locations requiring insulation. Further, these panels may be positioned in a series and function together as a series of panels. See FIG. **5** for more detailed use of panels.

[0020] When system **100** is inflated slats **115**A-**115**Q may be positioned substantially perpendicular to cap **105** and base **110**. Substantially in this context means plus or minus 10 degrees. Inflator **125** may be used to inflate system **100** to adjust slats **115**A-**115**Q from being substantially parallel to base **110** and cap **105** to being substantially perpendicular to base **110** and cap **105**. Substantially in this context means plus or minus 10 degrees. This may be accomplished through the use of a fan, compressed air, or other types of inflators **125**. Alternatively, inflator **125** may be cable, rope, strap, or some other connector attached to one or more of cap **105** or base **110** that may be pulled in a direction to inflate system **200**, creating a greater separation between cap **105** and base **110**. Inflator **125** may be actuated by indicator **120**. Indicator **120** may be a processor that connects to one or more temperature sensors. One temperature sensor may be positioned outside and another temperature sensor may be positioned near system **100**. Processors may monitor the difference in the temperature sensors and based on the difference actuate inflator **125** to inflate system **100**. Alternatively, indicator **120** may be a temperature sensor to actuate the inflator **125** at a preprogrammed temperature. When system **100** is activated air movement from inflator **125** blows in between the uninflated slats **115**A-**115**Q and may cause slats **115**A-**115**Q to stand on end such that slats **115**A-**115**Q are positioned substantially perpendicular to base **110** and cap **105**. Standing slats **115**A-**115**Q on their ends may allow heat to flow between slats **115**A-**115**Q and through cap **105** and base **110**.

[0021] In system **100**, as described above cap **105** may be attached to a first of end one or more slats **115**A-**115**Q, and base **110** may be attached to a second end of the one or more slats **115**A-**115**Q. Movements, relative to cap **105** and base **110** may occur along a horizontal plane (a plane that runs parallel to the length of cap **105** and base **110**) and a vertical plane (a plane that runs perpendicular to the length of cap **105** and base **110**). When indicator **120** actuates inflator **125** cap **105** and base **110** may move relative to each other such that the space between cap **105** and base **110** increases. This can be accomplished in various methods. For example, cap **105** may move up along the vertical plane away from base **110** while base does not move along the vertical plane up or down. Alternatively, base **110** may move down along the vertical plane away from cap **105** while cap **105** does not move along the vertical plane up or down. Also, both base **110** and cap **105** move away from each other along the vertical plane.

[0022] Movement along the horizontal plane may occur simultaneously with the movement along the vertical plane relative to cap **105** and base **110**. For example, base **110** may move along a horizontal plane while cap **105** remains motionless along the horizontal plain. The alternate may also happen where cap **105** may move along a horizontal plane while base **110** remains motionless along the horizontal plane. Also, both base **110** and cap **105** may move away from each other horizontally.

[0023] Moreover, indicator **120** may store information and monitor how quickly the temperature reaches the optimal level. Indicator **120** may further use artificial intelligence ("AI") such as machine learning ("ML") to adjust at what temperature inflator **125** is actuated. As a failsafe, system **100** may be set up such that the default position of the panels is in an uninflated position. The uninflated position inhibits the flow of heat and acts as traditional non-dynamic insulation, as depicted in FIGS. **2**-**3**. Therefore, if system **100** goes down or system **100** is unable to use power because of a power outage the building may remain insulated.

[0024] FIG. **2** illustrates a diagram of an inflated dynamic insulation system **200**. Insulation system **200** may include cap **205** that attaches to one or more slats **215**A-**215**Q in a way that may allow slats **215**A-**215**Q to articulate. Cap **205** may be composed of material that allows heat **230** to flow with minimal to no obstruction. Slats **215**A-**215**Q may be composed of insulative material. The insulative properties of slats **215**A-**215**Q may be magnified by the overlapping of the slats **215**A-**215**Q when in an uninflated position as seen in FIGS. **3**-**4**. Further, slats **215**A-**215**Q may include grooves tunnels, and slits to increase the ease of manufacturing and/or increase the insulative capabilities as seen in FIGS. **6**-**7**. Slats **215**A-**215**Q may also attach to base **210**. The attachment between base **210** and slats **215**A-**215**Q may allow slats **215**A-**215**Q to articulate. Base **210** may be composed of material that allows heat **230** to flow with minimal to no obstruction. This may allow slats **215**A-**215**Q to have two main positions inflated and uninflated. Alternatively, slats **215**A-**215**Q may have more than two main positions. When slats **215**A-**215**Q are attached to cap **205** and base **210** they may be positioned to form a panel that may later be installed in an attic or other locations requiring insulation. Further, these panels may be positioned in a series and function together as a series of panels. See FIG. **5** for more detailed use of panels.

[0025] When system **200** is inflated slats **215**A-**215**Q may be positioned substantially perpendicular to cap **205** and base **210**. Substantially in this context means plus or minus 10 degrees. Inflator **250** may be used to inflate system **200** to adjust slats **215**A-**215**Q from being substantially parallel to base **210** and cap **205** to being substantially perpendicular to base **210** and cap **205**. Substantially in this context means plus or minus 10 degrees. This may be accomplished through the use of a fan, compressed air, or other types of inflators **225**. Alternatively, inflator **225** may be cable, rope, strap, or some other connector attached to one or more of cap **205** or base **210** that may be pulled in a direction to inflate system **200**, creating a greater separation between cap **205** and base **210**.

[0026] Indicator **220** may be a processor that connects to one or more temperature sensors. One temperature sensor may be positioned outside and another temperature sensor may be positioned near system **200**. Processors may monitor the difference in the temperature sensors and based on the difference actuate inflator **225** to inflate system **200**. Alternatively, indicator **220** may be a temperature sensor to actuate the inflator **225** at a preprogrammed temperature. When system **200** is activated air movement from inflator **225** that blows in between the uninflated slats **215**A-**215**Q may cause slats **215**A-**215**Q to stand on end such that slats **215**A-**215**Q are positioned substantially perpendicular to base **210** and cap **204**. By standing slats **215**A-**215**Q, having insulative properties, on end, this may allow heat **230** to flow between slats **215**A-**215**Q and through cap **205** and base **210**.

[0027] In system **200**, as described above cap **205** may be attached to a first of end one or more slats **215**A-**215**Q, and base **210** may be attached to a second end of the one or more slats **215**A-**215**Q. Movements, relative to cap **205** and base **210** may occur along a horizontal plane (a plane that runs parallel to the length of cap **205** and base **210**) and a vertical plane (a plane that runs perpendicular to the length of cap **205** and base **210**). When indicator **220** actuates inflator **225** cap **205** and base **210** may move relative to each other such that the space between cap **205** and base **210** increases. This can be accomplished in various methods. For example, cap **205** may move up along the vertical plane away from base **210** while base does not move along the vertical plane up or down. Alternatively, base **210** may move down along the vertical plane away from cap **205** while cap **205** does not move along the vertical plane up or down. Also, both base **210** and cap **205** move away from each other along the vertical plane.

[0028] Movement along the horizontal plane may occur simultaneously with the movement along the vertical plane relative to cap **205** and base **210**. For example, base **210** may move along a horizontal plane while cap **205** remains motionless along the horizontal plain. The alternate may also happen where cap **205** may move along a horizontal plane while base **210** remains motionless along the horizontal plane. Also, both base **210** and cap **205** may move away from each other horizontally.

[0029] Moreover, indicator **220** may store information and monitor how quickly the temperature reaches the optimal level. Indicator **220** may further use artificial intelligence ("AI") such as machine learning ("ML") to adjust at what temperature inflator **225** is actuated. As a failsafe, system **200** may be set up such that the default position of the panels is in an uninflated position. The uninflated position inhibits the flow of heat **230** and acts as traditional non-dynamic insulation, as depicted in FIGS. **2-3**. Therefore, if system **200** goes down or system **200** is unable to use power because of a power outage the building may remain insulated.

[0030] FIG. **3** illustrates uninflated dynamic insulation system **100**. Insulation system **100** may include cap **105** that attaches to one or more slats **115**A-**115**Q in a way that may allow slats **115**A-**115**Q to articulate. Cap **105** may be composed of material that allows heat to flow with minimal to no obstruction. Slats **115**A-**115**Q may be composed of insulative material. The insulative properties of slats **115**A-**115**Q may be magnified by the overlapping of the slats **115**A-**115**Q when in an uninflated position. Further, slats **115**A-**115**Q may include grooves tunnels, and slits to increase the ease of manufacturing and/or increase the insulative capabilities as seen in FIGS. **6-7**. Slats **115**A-**115**Q may also attach to base **110**. The attachment between base **110** and slats **115**A-**115**Q may allow slats **115**A-**115**Q to articulate. Base **110** may be composed of material that allows heat to flow with minimal to no obstruction. This may allow slats **115**A-**115**Q to have two main positions inflated and uninflated. Alternatively, slats **115**A-**115**Q may have more than two main positions. When slats **115**A-**115**Q are attached to cap **105** and base **110** they may be positioned to form a panel that may later be installed in an attic or other locations requiring insulation. Further, these panels may be positioned in a series and function together as a series of panels. See FIG. **5** for more detailed use of panels.

[0031] When system **100** is inflated slats **115**A-**115**Q may be positioned substantially perpendicular to cap **105** and base **110**. Substantially in this context means plus or minus 10 degrees. Inflator **125** may be used to inflate system **100** to adjust slats **115**A-**115**Q from being substantially parallel to base **110** and cap **105** to being substantially perpendicular to base **110** and cap **105**. Substantially in this context means plus or minus 10 degrees. This may be accomplished through the use of a fan, compressed air, or other types of inflators **125**. Alternatively, inflator **125** may be cable, rope, strap, or some other connector attached to one or more of cap **105** or base **110** that may be pulled in a direction to inflate system **200**, creating a greater separation between cap **105** and base **110**. Inflator **125** may be actuated by indicator **120**. Indicator **120** may be a processor that connects to one or more temperature sensors. One temperature sensor may be positioned outside and another temperature sensor may be positioned near system **100**. Processors may monitor the difference in the temperature sensors and based on the difference actuate inflator **125** to inflate system **100**. Alternatively, indicator **120** may be a temperature sensor to actuate the inflator **125** at a preprogrammed temperature. When system **100** is activated air movement from inflator **125** blows in between the uninflated slats **115**A-**115**Q and may cause slats **115**A-**115**Q to stand on end such that slats **115**A-**115**Q are positioned substantially perpendicular to base **110** and cap **105**. Standing slats **115**A-**115**Q, having insulative properties, on end, this may allow heat to flow between slats **115**A-**115**Q and through cap **105** and base **110**.

[0032] In system **100**, as described above cap **105** may be attached to a first of end one or more slats **115**A-**115**Q, and base **110** may be attached to a second end of the one or more slats **115**A-**115**Q. Movements, relative to cap **105** and base **110** may occur along a horizontal plane (a plane that runs parallel to the length of cap **105** and base **110**) and a vertical plane (a plane that runs perpendicular to the length of cap **105** and base **110**). When indicator **120** actuates inflator **125** cap **105** and base **110** may move relative to each other such that the space between cap **105** and base **110** increases. This can be accomplished in various methods. For example, cap **105** may move up along the vertical plane away from base **110** while base does not move along the vertical plane up or down. Alternatively, base **110** may move down along the vertical plane away from cap **105** while cap **105** does not move along the vertical plane up or down. Also, both base **110** and cap **105** move away from each other along the vertical plane.

[0033] Movement along the horizontal plane may occur simultaneously with the movement along the vertical plane relative to cap **105** and base **110**. For example, base **110** may move along a horizontal plane while cap **105** remains motionless along the horizontal plain. The alternate may also happen where cap **105** may move along a horizontal plane while base **110** remains motionless along the horizontal plane. Also, both base **110** and cap **105** may move away from each other horizontally.

[0034] Moreover, indicator **120** may store information and monitor how quickly the temperature reaches the optimal level. The indicator may further use artificial intelligence ("AI") such as machine learning ("ML") to adjust at what temperature inflator **125** is actuated. As a failsafe, system **100** may be set up such that the default position of the panels is in an uninflated position. The uninflated position inhibits the flow of heat and acts as traditional non-dynamic insulation, as depicted in FIGS. **2**-**3**. Therefore, if system **100** goes down or system **100** is unable to use power because of a power outage the building may remain insulated.

[0035] FIG. **4** illustrates a diagram of an uninflated dynamic insulation system **200**. Insulation system **200** may include cap **205** that attaches to one or more slats **215**A-**215**Q in a way that may allow slats **215**A-**215**Q to articulate. Cap **205** may be composed of material that allows heat **230** to flow with minimal to no obstruction. Slats **215**A-**215**Q may be composed of insulative material. The insulative properties of slats **215**A-**215**Q may be magnified by the overlapping of the slats **215**A-**215**Q when in an uninflated position as seen in FIGS. **3**-**4**. Further, slats **215**A-**215**Q may include grooves tunnels, and slits to increase the ease of manufacturing and/or increase the insulative capabilities as seen in FIGS. **6**-**7**. Slats **215**A-**215**Q may also attach to base **210**. The attachment between base **210** and slats **215**A-**215**Q may allow slats **215**A-**215**Q to articulate. Base **210** may be composed of material that allows heat **230** to flow with minimal to no obstruction. This may allow slats **215**A-**215**Q to have two main positions inflated and uninflated. Alternatively, slats **215**A-**215**Q may have more than two main positions. When slats **215**A-**215**Q are attached to cap **205** and base **210** they may be positioned to form a panel that may later be installed in an attic or other locations requiring insulation. Further, these panels may be positioned in a series and function together as a series of panels. See FIG. **5** for more detailed use of panels.

[0036] When system **200** is inflated slats **215**A-**215**Q may be positioned substantially perpendicular to cap **205** and base **210**. Substantially in this context means plus or minus 10 degrees. Inflator **250** may be used to inflate system **200** to adjust slats **215**A-**215**Q from being substantially parallel to base **210** and cap **205** to being substantially perpendicular to base **210** and cap **205**. Substantially in this context means plus or minus 10 degrees. This may be accomplished through the use of a fan, compressed air, or other types of inflators **225**. Alternatively, inflator **225** may be cable, rope, strap, or some other connector attached to one or more of cap **205** or base **210** that may be pulled in a direction to inflate system **200**, creating a greater separation between cap **205** and base **210**. Inflator **225** may be actuated by indicator **220**. Indicator **220** may be a processor that connects to one or more temperature sensors. One temperature sensor may be positioned outside and another temperature sensor may be positioned near system **200**. Processors may monitor the difference in the temperature sensors and based on the difference actuate inflator **225** to inflate system **200**. Alternatively, indicator **220** may be a temperature sensor to actuate the inflator **225** at a preprogrammed temperature. When system **200** is activated air movement from inflator **225** that blows in between the uninflated slats **215**A-**215**Q may cause slats **215**A-**215**Q to stand on end such that slats **215**A-**215**Q are positioned substantially perpendicular to base **210** and cap **204**. By standing slats **215**A-**215**Q, having insulative properties, on end, this may allow heat **230** to flow between slats **215**A-**215**Q and through cap **205** and base **210**.

[0037] In system **200**, as described above cap **205** may be attached to a first of end one or more slats **215**A-**215**Q, and base **210** may be attached to a second end of the one or more slats **215**A-**215**Q. Movements, relative to cap **205** and base **210** may occur along a horizontal plane (a plane that runs parallel to the length of cap **205** and base **210**) and a vertical plane (a plane that runs perpendicular to the length of cap **205** and base **210**). When indicator **220** actuates inflator **225** cap **205** and base **210** may move relative to each other such that the space between cap **205** and base **210** increases. This can be accomplished in various methods. For example, cap **205** may move up along the vertical plane away from base **210** while base does not move along the vertical plane up or down. Alternatively, base **210** may move down along the vertical plane away from cap **205** while cap **205** does not move along the vertical plane up or down. Also, both base **210** and cap **205** move away from each other along the vertical plane.

[0038] Movement along the horizontal plane may occur simultaneously with the movement along the vertical plane relative to cap **205** and base **210**. For example, base **210** may move along a horizontal plane while cap **205** remains motionless along the horizontal plain. The alternate may also happen where cap **205** may move along a horizontal plane while base **210** remains motionless along the horizontal plane. Also, both base **210** and cap **205** may move away from each other horizontally.

[0039] Moreover, indicator **220** may store information and monitor how quickly the temperature reaches the optimal level. Indicator may further use artificial intelligence ("AI") such as machine learning ("ML") to adjust at what temperature inflator **225** is actuated. As a failsafe, system **200** may be set up such that the default position of the panels is in an uninflated position. The uninflated position inhibits the flow of heat **230** and acts as traditional non-dynamic insulation, as depicted in FIGS. **2**-**3**. Therefore, if system **200** goes down or system **200** is unable to use power because of a power outage the building may remain insulated.

[0040] FIG. **5** illustrates a cross section of an attic with an installed dynamic insulation system **500**. The exemplary attic may include exterior trusses **540**A-**540**F and interior trusses **535**A-**535**F. Trusses **540**A-**540**F and **535**A-**535**F may alternatively be rafters instead of trusses. Furthermore, this is a depiction of insulations system **500** being installed in an attic. Similar methods may be used to install in walls, floors, and other parts of a building. Also, dynamic insulation system **500** may be used to dynamically dampen the sound in soundproofing endeavors.

[0041] Roof sheathing **520** may be positioned on top of exterior trusses **540**A-F. Roofing material **525** such as asphalt shingles, shakes, tiles, etc. may be positioned on top of the roof sheathing **520**. The type of material used for sheathing **520** and roofing **525** have different insulation properties and may ultimately affect when system **500** is activated. Also, attached to the bottom of the interior portion of the trusses are wall cover **515**. Wall cover **515** may be drywall, oriented strand board ("OSB"), wood paneling, beadboard, etc. In the attic, there also may be traditional insulation **530**A-**530**C such as fiberglass, cellulose, foam, etc. Dynamic insulation system **500** may be retrofitted to buildings with existing insulation.

[0042] System **500** may include panels **505**A-**505**F sized to fit on and/or in between exterior trusses **540**A-**540**F and **535**A-**535**F. Panels **505**A-**505**F may be positioned in a series one after another along trusses **540**A-**540**F and **535**A-**535**F to cover an area similar to how traditional insulation **530**A-**530**C is used not seen due to perspective. Inflation of a panel or a series of panels (that may include panels **505**A-**505**F) may be accomplished by a single inflator **550** or multiple inflators **550**.

[0043] As depicted in FIGS. **1** and **3**, panels **505**A-**505**F of system **500** may include cap **105** that attaches to one or more slats **115**A-**115**Q in a way that may allow slats **115**A-**115**Q to articulate. Cap **105** may be composed of material that allows heat to flow with minimal to no obstruction. Slats **115**A-**115**Q may be composed of insulative material. The insulative properties of slats **115**A-**115**Q may be magnified by the overlapping of the slats **115**A-**115**Q when in an uninflated position as seen in FIGS. **3**-**4**. Further, slats **115**A-**115**Q may include grooves tunnels, and slits to increase the ease of manufacturing and/or increase the insulative capabilities as seen in FIGS. **6**-**7**. Slats **115**A-**115**Q may also attach to base **110**. The attachment between base **110** and slats **115**A-**115**Q may allow slats **115**A-**115**Q to articulate. Base **110** may be composed of material that allows heat to flow with minimal to no obstruction. This may allow slats **115**A-**115**Q to have two main positions inflated (**505**E-**505**F) and uninflated (**505**A-**505**D). Alternatively, slats **115**A-**115**Q may have more than two main positions. When slats **115**A-**115**Q are attached to cap **105** and base **110** they may be positioned to form panels **505**A-**505**F.

[0044] Phase change material **510** may be used within system **500**. It may be used as positioned between panels **505**E and **505**F. Alternatively, it can be positioned below or above one or more of panels **505**A-**505**F. Phase change material **510** may allow heat to flow through it based on certain temperatures to further facilitate the dynamic insulative properties.

[0045] When panels **505**A-**505**F of system **500** are inflated slats **115**A-**115**Q may be positioned substantially perpendicular to cap **105** and base **110**. Substantially in this context means plus or minus 10 degrees. Inflator **550** may be used to inflate system **500** to adjust slats **115**A-**115**Q from being substantially parallel to base **110** and cap **105** to being substantially perpendicular to base **110** and cap **105**. Substantially in this context means plus or minus 10 degrees. This may be accomplished through the use of a fan, compressed air, or other types of inflators **550**. Alternatively, inflator **550** may be rope, strap, or some other connector attached to one or more of cap **105** or base **110** that may be pulled in a direction to inflate one or more of panels **505**A-**505**F creating a greater separation between cap **105** and base **110**. Inflator **550** may be actuated by indicator **545**. Indicator **545** may be a processor that connects to one or more temperature moisture or other sensors. One temperature sensor may be positioned outside and another temperature sensor may be positioned near system **500**. Processors may monitor the difference in the temperature sensors and based on the difference actuate inflator **550** to inflate one or more panels **505**A-**505**F. Alternatively, indicator **545** may be a temperature sensor to actuate the inflator **550** at a preprogrammed temperature. When inflator **550** is activated air movement from inflator **550** may blow in between the uninflated slats **115**A-**115**Q and may cause slats **115**A-**115**Q to stand on end such that slats **115**A-**115**Q are positioned substantially perpendicular to base **110** and cap **105**. By standing slats **115**A-**115**Q, having insulative properties, on end, this may allow heat to flow between slats **115**A-**115**Q and through cap **105** and base **110**.

[0046] Panels **505**A-**505**F, as described above may include cap **105** attached to a first of end one or more slats **115**A-**115**Q, and base **110** may be attached to a second end of the one or more slats **115**A-**115**Q. Movements, relative to cap **105** and base **110** may occur along a horizontal plane (a plane that runs parallel to the length of cap **105** and base **110**) and a vertical plane (a plane that runs perpendicular to the length of cap **105** and base **110**). When indicator **545** actuates inflator **550** cap **105** and base **110** may move relative to each other such that the space between cap **105** and base **110** increases. This can be accomplished in various methods. For example, cap **105** may move up along the vertical plane away from base **110** while base does not move along the vertical plane up or down. Alternatively, base **110** may move down along the vertical plane away from cap **105** while cap **105** does not move along the vertical plane up or down. Also, both base **110** and cap **105** move away from each other along the vertical plane.

[0047] Movement along the horizontal plane may occur simultaneously with the movement along the vertical plane relative to cap **105** and base **110**. For example, base **110** may move along a horizontal plane while cap **105** remains motionless along the horizontal plain. The alternate may also happen where cap **105** may move along a horizontal plane while base **110** remains motionless along the horizontal plane. Also, both base **110** and cap **105** may move away from each other horizontally.

[0048] Moreover, indicator **545** may store information and monitor how quickly the temperature reaches the optimal level. Indicator may further use artificial intelligence ("AI") such as machine learning ("ML") to adjust at what temperature inflator **550** is actuated. As a failsafe, system **500** may be set up such that the default position of panels **505**A-**505**F may be in an uninflated position. The uninflated position inhibits the flow of heat and acts as traditional non-dynamic insulation, as depicted in FIGS. **2**-**3**. Therefore, if system **500** goes down or system **500** is unable to use power because of a power outage the building may remain insulated.

[0049] FIG. **6** illustrates manufacturing system **600** to manufacture slats **620** similar to slats **115**A-**115**Q (as depicted in FIGS. **1**-**4**) for panels **505**A-F of dynamic insulation system **500**. Manufacturing system **600** may include a first layer **605** print adhesive **630**. Then you may add a second layer **610** followed by print adhesive **635**. Afterwards, a third layer **615** may be added and after a print an ink/coating **645** may be applied. Following the completion of the fabrication manufacturing system **600** may include a cutter **625** to slice to become panel **650**A. System **600** may be completed with these stacked layers **605**-**615**. Product mix, adhesive, and cutting patterns may be digitally controlled (as illustrated) or utilize hard tooling for higher throughput. Manufacturing system **600** may be used to create panels **505**A-**505**G as depicted in FIG. **5**. Also, manufacturing system **600** may be used to create phase change panel **510** depicted in FIG. **5**.

[0050] FIG. **7** illustrates an outcome of manufacturing system **600** to manufacture slats **650**A-C similar to slats

115A-**115**Q (as depicted in FIGS. **1-4**)) for panels **505**A-**505**F of dynamic insulation system **500**. The outcome of manufacturing system **600** includes a first layer **605** attached to a second layer **610** that is attached to third layer **615**. Sheet **640** includes a separation **620** that when cut may customize the size of slats **650**A-C that may be similar to slats **115**A-**115**Q. The attachment to cap **105** and base **110** may also be an automated process. Automated processes may allow for custom sizes of slats that can be combined to produce customize sized panels to be installed in a building to be fitted with a dynamic insulation system **500**.

[0051] Further, although specific implementations of the disclosure have been described and illustrated, the disclosure is not to be limited to the specific forms or arrangements of parts so described and illustrated. The scope of the disclosure is to be defined by the claims appended hereto, any future claims submitted here and in different applications, and their equivalents.

What is claimed is:

1. A dynamic insulation system comprising:

a base

one or more slats attached at a first end to the base;

a cap attached to a second end of the one or more slats; and

an inflator.

2. The dynamic insulation system of claim **1**, wherein the one or more slats have an uninflated position.

3. The dynamic insulation system of claim **2**, wherein the one or more slats have an inflated position that is different from the uninflated position.

4. The dynamic insulation system of claim **3**, wherein to be positioned in the inflated position the base and the cap move relative to each other.

5. The dynamic insulation system of claim **2**, further comprises:

an indicator.

6. The dynamic insulation system of claim **5**, wherein the indicator communicates with a temperature sensor.

7. The dynamic insulation system of claim **1**, wherein the position of the slats changes their insulative properties.

8. The dynamic insulation system of claim **1**, wherein the one or more slats combine to create a panel.

9. The dynamic insulation system of claim **1**, wherein the panel is sized to fit and attach to one or more trusses.

10. The dynamic insulation system of claim **9**, further comprises:

a phase change material.

11. The dynamic insulation system of claim **10**, wherein the phase change material is positioned above the panel.

12. The dynamic insulation system of claim **9**, wherein the phase change material is positioned below the panel.

13. The dynamic insulation system of claim **9**, wherein the panel is positioned above existing insulation.

14. The dynamic insulation system of claim **9**, wherein the panels can be positioned on an inside portion of the outside truss.

15. The dynamic insulation system of claim **9** wherein the panels can be positioned on an inside truss.

16. The dynamic insulation system of claim **6**, wherein the indicator actuates the inflator.

17. The dynamic insulation system of claim **16** wherein the indicator actuates the inflator based on the internal temperature reading.

18. The dynamic insulation system of claim **17** wherein the indicator actuates the inflator based on the external temperature.

19. The dynamic insulation system of claim **18**, wherein the indicator actuates the inflator based on the difference between the external temperature and the internal temperature.

20. The dynamic insulation system of claim **18**, wherein the indicator actuates the inflator based on the difference between the external temperature and the internal temperature and machine learning.

* * * * *