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Systems and methods for power generation in aircraft cabins

Abstract

A floor module for a power generation system may comprise: a housing including a flexible top plate; a plurality of generator assemblies disposed within the housing, each generator in the plurality of generator assemblies comprising: a moveable portion disposed adjacent to the flexible top plate, the moveable portion including a shaft extending away from the flexible top plate; and a piezoelectric transducer aligned with the shaft, the piezoelectric transducer configured to compress in response to the moveable portion translating toward the piezoelectric transducer from a force on the flexible top plate.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application claims priority to, and the benefit of, Indian Provisional Patent Application No. 202141039601, having DAS code 60ED, filed Sep. 1, 2021 and titled “SYSTEMS AND METHODS FOR POWER GENERATION IN AIRCRAFT CABINS,” which application is

incorporated herein by reference in its entirety for all purposes.

FILED

(2) The present disclosure relates generally to systems and methods for power generation and, more particularly, to systems and methods for power generation in an aircraft cabin.

BACKGROUND

(3) Passengers and crew walk about an aircraft cabin throughout a respective aircraft flight. All the energy from walking about the aircraft cabin is wasted and not utilized by systems within an aircraft. Various systems in an aircraft cabin utilize electricity, such as lighting systems, electronic charging systems, or the like.

SUMMARY

(4) A floor module for a power generation system is disclosed herein. The floor module may comprise: a housing including a flexible top plate; a plurality of generator assemblies disposed within the housing, each generator in the plurality of generator assemblies comprising: a moveable portion disposed adjacent to the flexible top plate, the moveable portion including a shaft extending away from the flexible top plate; and a piezoelectric transducer aligned with the shaft, the piezoelectric transducer configured to compress in response to the moveable portion translating toward the piezoelectric transducer from a force on the flexible top plate.

(5) In various embodiments, each generator assembly in the plurality of generator assemblies further comprises a fixed base, the piezoelectric transducer disposed within the fixed base. Each generator assembly in the plurality of generator assemblies may further comprise a spring disposed between the fixed base and the moveable portion. The spring may be configured to bias the moveable portion away from the piezoelectric transducer in response to a force being removed from the top plate. The floor module may further comprise a wiring harness, the wiring harness electrically coupling the piezoelectric transducer for each generator assembly in the plurality of generator assemblies together. The housing may further comprise a base plate, and the flexible top plate may be removable and is coupled to the base plate. The plurality of generator assemblies may be disposed between the base plate and the flexible top plate. A set of generator assemblies in the plurality of generator assemblies may be configured to compress in response to a pressure disposed on an area of the flexible top plate.

(6) A power generation system is disclosed herein. The power generation system may comprise: an electrical device; and a floor assembly including a floor module, the floor module comprising: a generator assembly including a moveable portion, a generator, and a fixed base, the generator in electrical communication with the electrical device, the moveable portion configured to translate relative to the fixed base, the generator configured to convert mechanical energy from the moveable portion to electrical energy, the electrical energy supplied to the electrical device.

(7) In various embodiments, the electrical device may be an electrical storage device, the electrical storage device configured to supply power to on-board electronics. The electrical device may comprise a plurality of light units spaced apart adjacent to an aisle defined by the floor assembly. The aisle may be in an aircraft. The power generation system may further comprise a plurality of the generator assembly. The power generation system may further comprise a rectifier disposed electrically between the electrical device and the plurality of generator assemblies. The generator may be a piezoelectric transducer.

(8) An aircraft is disclosed herein. The aircraft may comprise: an electrical device; a floor assembly at least partially defining an aisle; and a floor module having a plurality of generator assemblies disposed therein, the plurality of generator assemblies configured to convert mechanical energy from a passenger walking on the floor module to electrical energy, the electrical energy supplied to the electrical device.

(9) In various embodiments, the electrical device is a plurality of light units disposed adjacent to the aisle. The electrical device may be an electrical storage device configured to store and supply the electrical energy to electronics on-board the aircraft. Each generator assembly in the plurality of

generator assemblies may comprise a moveable portion, the moveable portion configured to create the mechanical energy. The aircraft may further comprise a plurality of the floor module.

(10) The forgoing features and elements may be combined in various combinations without exclusivity, unless expressly indicated herein otherwise. These features and elements as well as the operation of the disclosed embodiments will become more apparent in light of the following description and accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The subject matter of the present disclosure is particularly pointed out and distinctly claimed in the concluding portion of the specification. A more complete understanding of the present disclosure, however, may best be obtained by referring to the following detailed description and claims in connection with the following drawings. While the drawings illustrate various embodiments employing the principles described herein, the drawings do not limit the scope of the claims.

(2) FIG. 1 illustrates a side view from within an aircraft cabin, in accordance with various embodiments;

(3) FIG. 2 illustrates a floor assembly with a power generation system, in accordance with various embodiments;

(4) FIG. 3 illustrates a floor module for a floor assembly, in accordance with various embodiments;

(5) FIG. 4 illustrates a perspective cross-sectional view of a generator assembly of a floor module, in accordance with various embodiments;

(6) FIG. 5 illustrates a schematic view of a piezoelectric transducer, in accordance with various embodiments;

(7) FIG. 6A illustrates a cross-sectional view of a cabin floor in an aircraft, in accordance with various embodiments;

(8) FIG. 6B illustrates a cross-sectional view of a cabin floor in an aircraft, in accordance with various embodiments;

(9) FIG. 7 illustrates a schematic view of a power generation system, in accordance with various embodiments.

(10) FIG. 8 illustrates a plan view of an aisle in an aircraft, in accordance with various embodiments;

(11) FIG. 9 illustrates a plan view of an aircraft cabin, in accordance with various embodiments; and

(12) FIG. 10 illustrates a perspective cross-sectional view of a generator assembly, in accordance with various embodiments.

DETAILED DESCRIPTION

(13) The following detailed description of various embodiments herein makes reference to the accompanying drawings, which show various embodiments by way of illustration. While these various embodiments are described in sufficient detail to enable those skilled in the art to practice the disclosure, it should be understood that other embodiments may be realized and that changes may be made without departing from the scope of the disclosure. Thus, the detailed description herein is presented for purposes of illustration only and not of limitation. Furthermore, any reference to singular includes plural embodiments, and any reference to more than one component or step may include a singular embodiment or step. Also, any reference to attached, fixed, connected, or the like may include permanent, removable, temporary, partial, full or any other possible attachment option. Additionally, any reference to without contact (or similar phrases) may also include reduced contact or minimal contact. It should also be understood that unless

specifically stated otherwise, references to “a,” “an” or “the” may include one or more than one and that reference to an item in the singular may also include the item in the plural. Further, all ranges may include upper and lower values and all ranges and ratio limits disclosed herein may be combined.

(14) Disclosed herein are systems and methods for power generation within an aircraft cabin. The system disclosed herein may utilize various generators, such as a piezoelectric transducer disposed within a floor assembly of an aircraft cabin. Although described herein with respect to piezoelectric transducers, the present disclosure is not limited in this regard. For example, a generator configured to convert rotational motion to electrical energy is within the scope of this disclosure. In various embodiments, in response to any of the piezoelectric transducers being compress (e.g., in response to a passenger stepping on the floor assembly), electrical energy may be generated, stored, and/or utilized as described further herein. In various embodiments, the system may include a power generation unit configured to control dispersion of electrical energy generated from the floor assembly as described further herein.

(15) With reference to FIG. 1, a cabin **50** of an aircraft **10** is shown, in accordance with various embodiments. The aircraft **10** may be any aircraft such as an airplane, a helicopter, or any other aircraft. The aircraft **10** may include an aisle **100** to facilitate maneuvering of passengers throughout the cabin **50**. The aisle **100** may be disposed between rows of seats **60**, between columns of seats, at an entrance to the aircraft **10**, or the like. During boarding and de-boarding, passengers line up and walk along the aisle **100**, energy which is typically lost and not re-purposed. Although aisle **100** is illustrated as being between columns of seats and in an exit row, the present disclosure is not limited in this regard. For example, aisle **100** may extend between adjacent rows of seats and still be within the scope of this disclosure.

(16) Referring now to FIG. 2 a floor assembly **200** for use in an aisle **100** of a cabin **50** of an aircraft **10** from FIG. 1 is illustrated, in accordance with various embodiments. Although described herein with respect to the aisle **100** of the cabin **50**, the present disclosure is not limited in this regard. For example, the floor assembly **200** may be utilized in various other applications, such as movie theaters, malls, offices, etc. In various embodiments, the floor assembly **200** comprises a plurality of floor modules **210**. The plurality of floor modules **210** may be modular. In this regard, each floor module in the plurality of floor modules **210** may comprise be shaped and configured to be aligned with adjacent floor modules in the plurality of floor modules **210** and be adaptable to various floor configurations, such as aisle **100** from FIG. 1, in accordance with various embodiments.

(17) Each floor module in the plurality of floor modules **210** may comprise a housing. For example, the floor module **220** comprises a housing **222** as described further herein. The housing **230** may be configured to house a portion of a power generation system **300**, in accordance with various embodiments. In this regard, each housing **230** may be configured to house a plurality of generator assemblies. Each generator assembly in the plurality of generator assemblies is configured to convert a mechanical force (e.g., from compression of the piezoelectric generator in response to a passenger stepping on the piezoelectric generator) into electrical energy as described further herein. In various embodiments, the electrical energy may be stored, used to power lights proximate the aisle **100** from FIG. 1, or the like.

(18) In various embodiments, the plurality of generator assemblies from each floor module in the plurality of floor modules **210** may be electrically coupled (i.e., in series and/or parallel) to adjacent floor modules. In various embodiments, the plurality of floor modules **210** are electrically coupled to an energy storage device (e.g., a supercapacitor, a battery, or the like), or directly to an electrically powered device, such as aisle lights.

(19) Referring now to FIG. 3, an exploded view of a floor module **220** for use in a power generation system **300** from FIG. 2 is illustrated, in accordance with various embodiments. The floor module **220** comprises the housing **230** from FIG. 2. The housing **230** may comprise a base

plate **232**, sidewalls **234**, and a top plate **236**. The base plate **232** and the sidewalls **234** may be a monolithic component (i.e., formed from a single piece of material). However, the present disclosure is not limited in this regard. For example, the base plate **232** and the sidewalls **234** may be formed of separate materials and coupled together, in accordance with various embodiments. The top plate **236** may removably coupled to the base plate (e.g., via fasteners or the like). In various embodiments, the base plate **232** and the sidewalls **234** define a recess **238** configured to receive a plurality of generator assemblies **240**. In various embodiments, the top plate **236** may comprise a flexible sheet. In this regard, the top plate may flex, or bend, in response to a pressure being applied away from various mounting locations **239**.

(20) In various embodiments, the generator assemblies **240** may be aligned in rows and columns. Although illustrated as being aligned in rows and columns, the plurality of generator assemblies **240** are not limited in this regard. For example, the generator assemblies **240** may be arranged and configured in various orientations based on a configuration of an aisle **100** from FIG. **1** utilizing the power generation system **300** from FIG. **2**. In various embodiments, the plurality of generator assemblies **240** are disposed between the base plate **232** and the top plate **236**. In this regard, in response to the top plate **236** being stepped on, the top plate **236** may deform toward the base plate **232**, compressing a set of generator assemblies in the plurality of generator assemblies **240**. Thus, mechanical energy from the step may be converted to electrical energy by the set of generator assemblies in the plurality of generator assemblies **240**.

(21) In various embodiments, the floor module **220** further comprises a wiring harness **250**. The wiring harness **250** may be configured to electrically couple a generator of each generator assembly in the plurality of generator assemblies **240** together. In this regard, the wiring harness **250** may be configured to couple each generator in series and/or parallel, in accordance with various embodiments. The wiring harness **250** may be configured to be electrically coupled to an electrical load (e.g., a light), an energy storage device (e.g., a battery, a supercapacitor, etc.), or a combination of the two, in accordance with various embodiments.

(22) In various embodiments, a first sidewall **233** and a second sidewall **235** in the sidewalls may comprise a plurality of apertures **260**. The first sidewall **233** may be disposed opposite the second sidewall **235**. Although illustrated as the first sidewall **233** and the second sidewall **235** being opposite, the present disclosure is not limited in this regard. For example, the first sidewall **233** and the second sidewall **235** may be adjacent sidewalls, in accordance with various embodiments.

(23) The plurality of apertures **260** disposed in sidewalls **233**, **235** may be configured to receive a portion of the wiring harness **250**. In this regard, the wiring harness **250** may be coupled to adjacent floor modules in the plurality of floor modules **210** from FIG. **2** and/or routed to the electrical load and/or energy storage device, as described further herein.

(24) In various embodiments, the base plate **232** comprises a plurality of recesses **231**. The plurality of recesses **231** may be configured as mounting locations for generators as described further herein. In this regard, a generator may be configured to be disposed within the plurality of recesses **231**. Although described herein as being recesses, the present disclosure is not limited in this regard. For example, the mounting locations for the generator may be raised above a surface of the base plate **232** in accordance with various embodiments. Additionally, each generator may be mounted directly within a respective generator assembly in the plurality of generator assemblies, in accordance with various embodiments.

(25) Referring now to FIG. **4**, a perspective cross-sectional view of a generator assembly **400** in the plurality of generator assemblies **240** from FIG. **3**, in accordance with various embodiments. In various embodiments, the generator assembly **400** comprises a fixed base **410** and a moveable portion **420**. In various embodiments, the fixed base **410** may be a part of the base plate **232** from FIG. **3** or mounted to the base plate **232**. The present disclosure is not limited in this regard.

(26) In various embodiments, the generator assembly **400** comprises a height adjuster **430**. The height adjuster **430** may be disposed in a recess **412** of the fixed base **410**. In this regard, the height

adjuster **430** may be configured to adjust a height **H1** of a piezoelectric mating surface **432** of the height adjuster **430** relative to an axial surface **414** defined by the recess **412**. Additionally, the height adjuster **430** may facilitate assembly of the generator assembly **400**. In various embodiments, the height adjuster further comprises a slot **434** configured to house a piezoelectric transducer **450** and any associated wiring from the wiring harness **250** from FIG. 3. Although illustrated as having the piezoelectric transducer **440**, the present disclosure is not limited in this regard. For example, with brief reference to FIG. 10, a generator **1050** of a generator assembly **400** may be configured to rotate in response to the moveable portion **420** translating (e.g., via engagement with a shaft **1022**, in accordance with various embodiments).

(27) In various embodiments, the moveable portion **420** comprises a base **422**, sidewalls **424** extending in a vertical direction (i.e., Z-direction) from a perimeter of the base **422** towards the fixed base **410** of the generator assembly **400**. In various embodiments, the moveable portion further comprises a shaft **426** extending from the base **422** of the moveable portion toward the height adjuster **430**. The shaft **426** is aligned with the piezoelectric transducer **450**.

(28) In various embodiments, the generator assembly **400** further comprises a spring **460** disposed between the base **422** of the moveable portion and a recess surface **416** of the fixed base **410**. In various embodiments, the spring **460** is a compression spring. In various embodiments, a plurality of the spring **460** are disposed circumferentially around a centerline defined by the shaft **426**. Although illustrated in this manner, the present disclosure is not limited in this regard. For example, a single wave style spring may be disposed around the shaft **426** and be within the scope of this disclosure.

(29) In various embodiments, the generator assembly further comprises a nut **470**. The nut **470** may be coupled to the shaft **426** of the moveable portion **420**. In this regard, the nut **470** may be configured to adjust a gap between the base **422** of the moveable portion and a top surface **418** of the fixed base **410**. In this regard, the nut **470** may further be configured to adjust an initial compression of the spring **460** upon assembly. In various embodiments, the spring **460** may be in a neutral state in response to assembly. In various embodiments, the spring **460** may be slightly compressed in response to assembly. The present disclosure is not limited in this regard.

(30) In various embodiments, in response to a top surface of base **422** of the moveable portion **420** experiencing a pressure in a downward direction (i.e., -Z direction), the shaft **426** moves toward the piezoelectric transducer **450**, contacting and creating a force on the piezoelectric transducer **450**, and compressing the piezoelectric transducer **450**. In response to the piezoelectric transducer **450** being compressed from the force, the piezoelectric transducer **450** converts the mechanical energy to electrical energy. With reference now to FIG. 5, the piezoelectric transducer **450** comprises **452** and a negative terminal **454**. In this regard, an electrical wire from the wiring harness **250** from FIG. 3 may be routed and coupled to the positive terminal **452** and a second electrical wire from the wiring harness **250** may be routed and coupled to the negative terminal. Thus, the piezoelectric transducer **450** may be in an electrical circuit and coupled to an energy storage device (e.g., a supercapacitor, a battery, etc.) and/or an electrical load (e.g., a light).

(31) Referring now to FIG. 6A, a cross sectional view of the floor assembly **200** with the floor module **220** installed and forming an aisle **100** of an aircraft **10** from FIG. 1 is illustrated, in accordance with various embodiments. In various embodiments, each floor module in the plurality of floor modules **210** of the floor assembly **200** from FIG. 2 (e.g., floor module **220**) may be disposed vertically between a carpet **604** and a floor panel **602**. In this regard, the carpet **604** may flex with the top plate **236** of floor module **220** and compress each moveable portion **420** of each generator assembly **400** from FIG. 4 that is in an area of a step (e.g., a ball of a foot or the like). For example, with reference now to FIG. 6B, pressure from a person's foot **610** may compress an area of a top plate **236**, which compresses a set of generator assemblies (e.g., generator assembly **612** and generator assembly **614**), while surrounding generator assemblies (e.g., generator assembly **616** and generator assembly **618**) may remain static. In response to the set of generator assemblies

(e.g., generator assembly **612** and generator assembly **614**) being compressed from the person's foot, a voltage output may be generated by a piezoelectric transducer **450** from FIG. **4** for each generator assembly being compressed (e.g., generator assembly **612** and **614**). The voltage output may correspond to a displacement of a respective piezoelectric transducer **450** from FIG. **4** from an uncompressed state to the compressed state. Thus, more compression may produce a greater voltage output.

(32) With continued reference to FIG. **6B**, a cross-sectional view of a portion of the floor assembly **200** with the power generation system **300** from FIG. **2** in use is illustrated, in accordance with various embodiments. In various embodiments, a negative terminal of each piezoelectric transducer is electrically coupled to a negative terminal of adjacent piezoelectric transducer within a floor module **220**. In this regard, all piezoelectric transducers in a floor module **220** may be coupled in parallel, in accordance with various embodiments. In various embodiments, all piezoelectric transducers in a floor module **220** may be coupled in series. The present disclosure is not limited in this regard.

(33) Referring now to FIG. **7**, a schematic view of a portion of an electrical system **700** for a power generation system **300** from FIG. **2** is illustrated, in accordance with various embodiments. The power generation system **300** comprises the plurality of generator assemblies **240** (e.g., generator assemblies **612**, **614**, **616**, **618**). Each generator assembly comprises a piezoelectric transducer in accordance with the piezoelectric transducer **450** from FIG. **4** (e.g., piezoelectric transducers **622**, **624**, **626**, **628**). The piezoelectric transducers **622**, **624**, **626**, **628** may be electrically coupled together in series, in parallel, or a combination of the two. The piezoelectric transducers **622**, **624**, **626**, **628** are all electrically coupled to an electrical device **630**. The electrical device **630** may be an electrical load (e.g., an electrically powered light), an energy storage device (e.g., a battery or a supercapacitor).

(34) In various embodiments, the electrical system **700** further comprises a rectifier **640** disposed between the electrical device **630** and the plurality of generator assemblies **240**. In this regard, the rectifier **640** is configured to convert an oscillating alternating current (AC) from the piezoelectric transducers **622**, **624**, **626**, **628**, to a direct current (DC) for use in the electrical device **630** as described further herein.

(35) When the electrical device **630** is an electrical load, the power generated from the piezoelectric transducers **622**, **624**, **626**, **628** may be utilized immediately to power the electrical load (e.g., to light an aisle during an emergency event, a boarding event, or the like. In various embodiments, when the electrical device **630** is an energy storage device, the power generated from the piezoelectric transducers **622**, **624**, **626**, **628** may be stored and utilized later (e.g., for charging stations, lighting systems, or other forms of usable power in an aircraft). In this regard, the power generation system **300** disclosed herein may supplement a power supply provided on an aircraft, reducing the power supply, in accordance with various embodiments.

(36) Referring now to FIG. **8**, a plan view of a portion of an aisle **800** using a floor assembly **200** from FIG. **2** is illustrated, in accordance with various embodiments. In various embodiments, the aisle comprises a plurality of light units **810**. The plurality of light units **810** may be disposed on a first lateral side and a second lateral side of the aisle **800**.

(37) In various embodiments, the light units **810** are configured to be powered by the power generation system **300** from FIGS. **2** and **7** disclosed herein. In this regard, in response to a piezoelectric transducer (e.g., piezoelectric transducers **622**, **624**, **626**, **628**) being compressed, a set of light units in the plurality of light units **810** may be electrically powered and illuminated. Any number of configurations of coupling the piezoelectric transducers to the light units in the plurality of light units **810** may be contemplated by one skilled in the art. The present disclosure is not limited in this regard.

(38) In various embodiments, some areas of an aircraft cabin **50** from FIG. **1** may provide a greater power benefit from utilizing the power generation system **300** from FIG. **7**. For example, as

illustrated in FIG. 9, an aisle portion that is proximate various lavatories may experience greater foot traffic relative to an aft portion of an aisle. In this regard, the aisle portion proximate the lavatories may provide greater power generation relative to the aft portion of the aisle, in accordance with various embodiments. Thus, installing the floor assembly **200** from FIG. 2 may be prioritized in high foot traffic areas, in accordance with various embodiments.

(39) Benefits, other advantages, and solutions to problems have been described herein with regard to specific embodiments. Furthermore, the connecting lines shown in the various figures contained herein are intended to represent exemplary functional relationships and/or physical couplings between the various elements. It should be noted that many alternative or additional functional relationships or physical connections may be present in a practical system. However, the benefits, advantages, solutions to problems, and any elements that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as critical, required, or essential features or elements of the disclosure. The scope of the disclosure is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean “one and only one” unless explicitly so stated, but rather “one or more.” Moreover, where a phrase similar to “at least one of A, B, or C” is used in the claims, it is intended that the phrase be interpreted to mean that A alone may be present in an embodiment, B alone may be present in an embodiment, C alone may be present in an embodiment, or that any combination of the elements A, B and C may be present in a single embodiment; for example, A and B, A and C, B and C, or A and B and C. Different cross-hatching is used throughout the figures to denote different parts but not necessarily to denote the same or different materials.

(40) Systems, methods and apparatus are provided herein. In the detailed description herein, references to “one embodiment,” “an embodiment,” “various embodiments,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described. After reading the description, it will be apparent to one skilled in the relevant art(s) how to implement the disclosure in alternative embodiments.

(41) Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112(f) unless the element is expressly recited using the phrase “means for.” As used herein, the terms “comprises,” “comprising,” or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus.

(42) Finally, it should be understood that any of the above described concepts can be used alone or in combination with any or all of the other above described concepts. Although various embodiments have been disclosed and described, one of ordinary skill in this art would recognize that certain modifications would come within the scope of this disclosure. Accordingly, the description is not intended to be exhaustive or to limit the principles described or illustrated herein to any precise form. Many modifications and variations are possible in light of the above teaching.

Claims

1. A floor module for a power generation system, the floor module comprising: a housing including a flexible top plate; a plurality of generator assemblies disposed within the housing, each generator

- in the plurality of generator assemblies comprising: a moveable portion disposed adjacent to the flexible top plate, the moveable portion including a shaft extending away from the flexible top plate; and a piezoelectric transducer aligned with the shaft, the piezoelectric transducer configured to compress in response to the moveable portion translating toward the piezoelectric transducer from a force on the flexible top plate.
2. The floor module of claim 1, wherein each generator assembly in the plurality of generator assemblies further comprises a fixed base, the piezoelectric transducer disposed within the fixed base.
 3. The floor module of claim 1, wherein each generator assembly in the plurality of generator assemblies further comprises a spring disposed between the fixed based and the moveable portion.
 4. The floor module of claim 3, wherein the spring is configured to bias the moveable portion away from the piezoelectric transducer.
 5. The floor module of claim 1, further comprising a wiring harness, the wiring harness electrically coupling the piezoelectric transducer for each generator assembly in the plurality of generator assemblies together.
 6. The floor module of claim 1, wherein the housing further comprises a base plate, and wherein the flexible top plate is removable and is coupled to the base plate.
 7. The floor module of claim 6, wherein the plurality of generator assemblies is disposed between the base plate and the flexible top plate.
 8. The floor module of claim 1, wherein a set of generator assemblies in the plurality of generator assemblies are configured to compress in response to a pressure disposed on an area of the flexible top plate.
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