PTO/AIA/96 (11-23)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(c)

First Named Inventor/Patent Owner: VSPACE CO., LTD.

Application No./Patent No.: _____ Filed/Issue Date: 2025-10-30

Titled: BATTERY MODULE FOR ELECTRIC PROPULSION AIRCRAFT AND BATTERY PACK INCLUDING THE SAME

VSPACE CO., LTD., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached*.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached*.

2. From: _____ To: _____

   The document was recorded in the United States Patent and Trademark Office at

   Reel _____, Frame _____, or for which a copy thereof is attached*.

PTO/AIA/96 (11-23)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ *As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Jin Seo Park/	2025-10-30
Signature	Date
Jin Seo Park	80,773
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to: 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law; 2) a Federal, state, local, or international agency, in response to its request; 3) a contractor of the USPTO having need for the information in order to perform a contract; 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record; 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record; 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations; 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals; 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)); 9) the Office of Personnel Management (OPM) for personnel research purposes; and 9) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Application Data Sheet 37 CFR 1.76

The Application Data Sheet is part of the provisional or non-provisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.

Inventor Information

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Application Information

Customer number	**192379 -**
Correspondence address	---
Title of invention	**BATTERY MODULE FOR ELECTRIC PROPULSION AIRCRAFT AND BATTERY PACK INCLUDING THE SAME**
Attorney docket number	**P10449US00**
Entity status	Small
Application type	Nonprovisional Application under 35 USC 111(a)
Subject matter	Utility
Total number of drawing sheets	4

Suggested figure for publication	---
Filing by reference	No
Publication request	Normal eighteen-month publication

Representative Information

of representatives: 1

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).

Customer number 192379

Domestic Benefit/National Stage Information

of benefit claims: 0

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c), 386(c), or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Data was not provided for this section.

Foreign Priority Information

of foreign priority claims: 1

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the Application Data Sheet constitutes the claim for priority as required by 35 U.S.C. 119 (b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application number	**10-2025-0152733**
Country	Republic Of Korea
Filing Date	10/21/2025
Access code	2FB2

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

Checking this box will cause the application to be examined under the first inventor to file provisions of the AIA.

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 2016, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization or Opt-Out of Authorization to Permit Access

When this Application Data Sheet is properly signed and filled with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE:
This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. **Priority Document Exchange (PDX)**
Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the China National Intellectual Property Administration (CNIPA), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h) (1).

B. **Search Results from U.S. Application to EPO**

Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with the search results from the instant application.

NOTE:

Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Applicant Information

of applicants: 1

The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46.

1. **VSPACE CO.,LTD.**
312, 17, Cheomdangieop1-ro,
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KOREA, REPUBLIC OF

Phone: ---
Fax: ---
Email: ---

Applicant: Organization
Applicant type: Assignee

Assignee Information including Non-Applicant Assignee Information

of assignees: 0

An assignee-applicant identified in the "Applicant" section will appear on the patent application as an applicant.

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of

CFR to have an assignment recorded by the Office.

Data was not provided for this section.

Signature

NOTE:

This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c)**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See CFR 1.4(d) for the manner of making signatures and certifications.

Signature	First name	Last name	Registration #	Date
/Jin Seo Park/	Jin Seo	Park	80,773	10/30/2025

FIG. 1

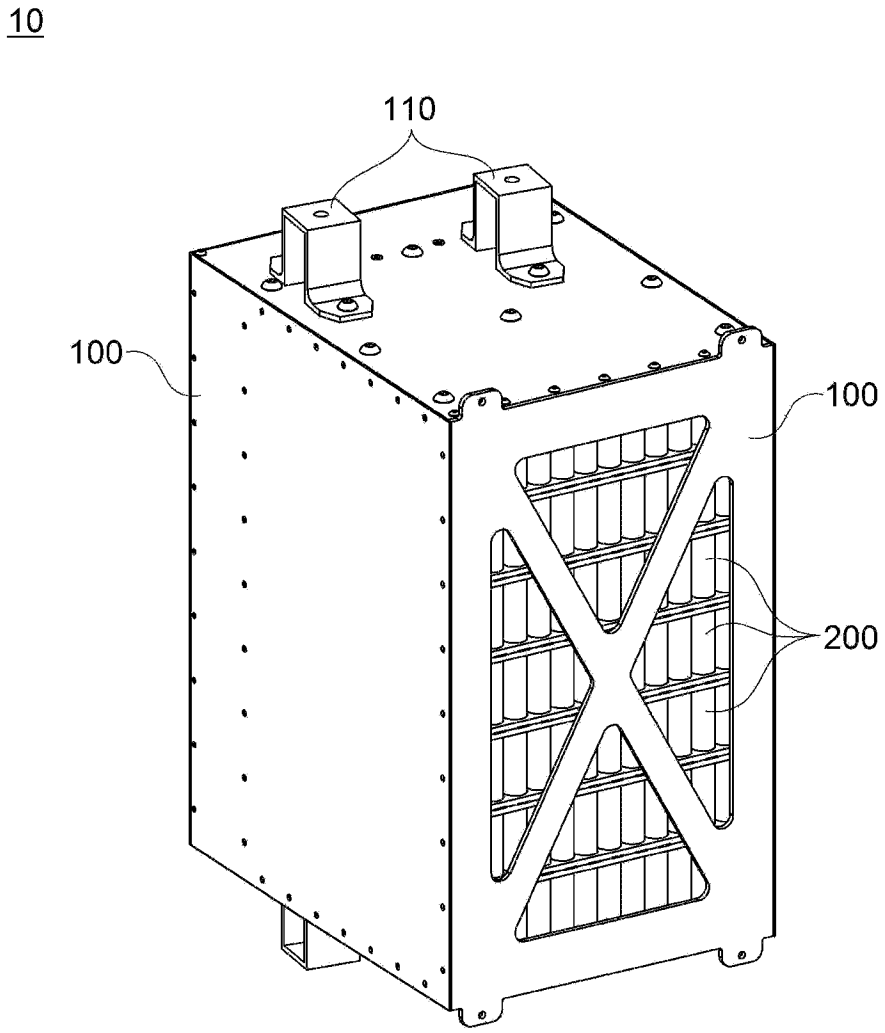


FIG. 2

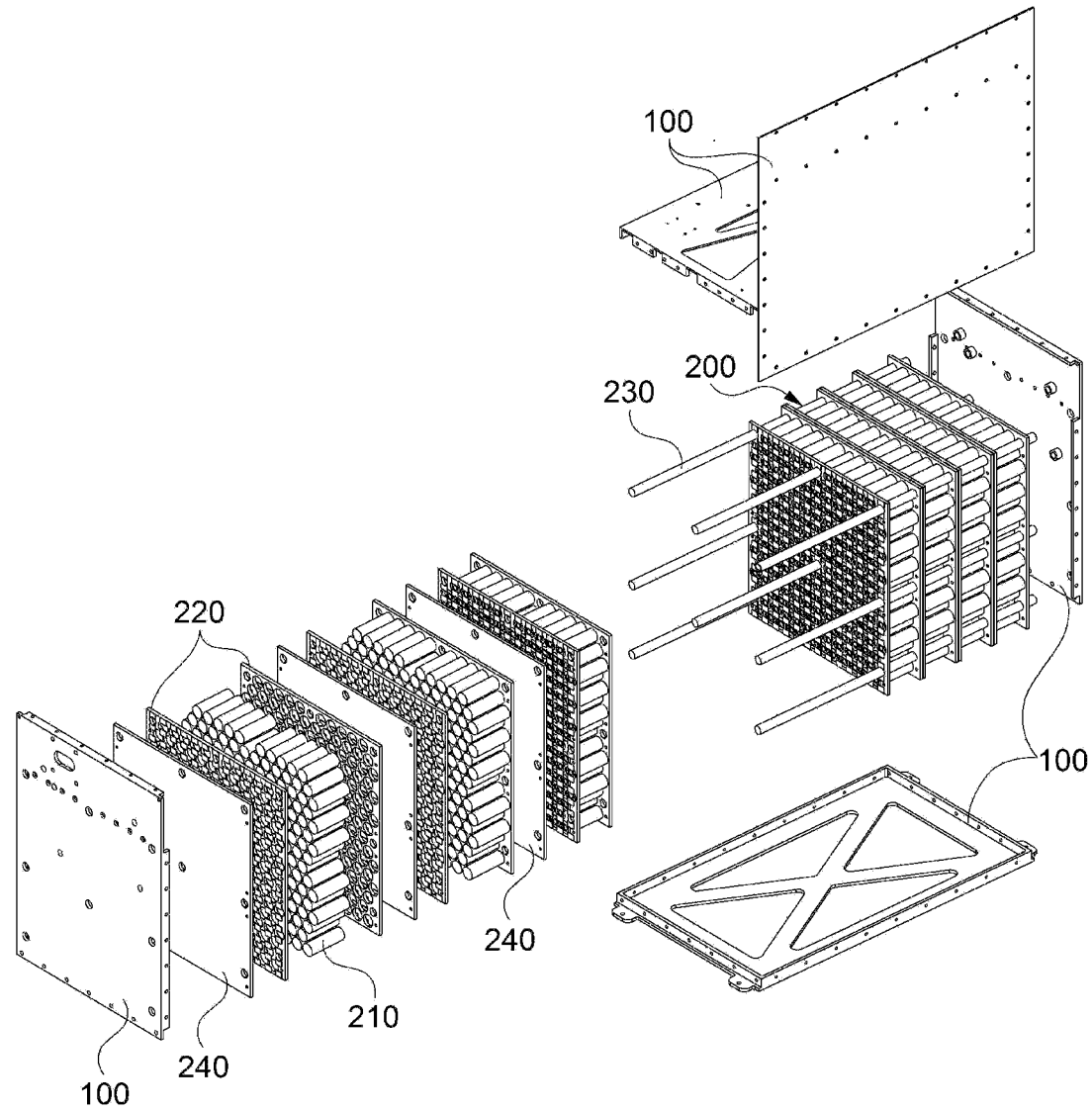


FIG. 3

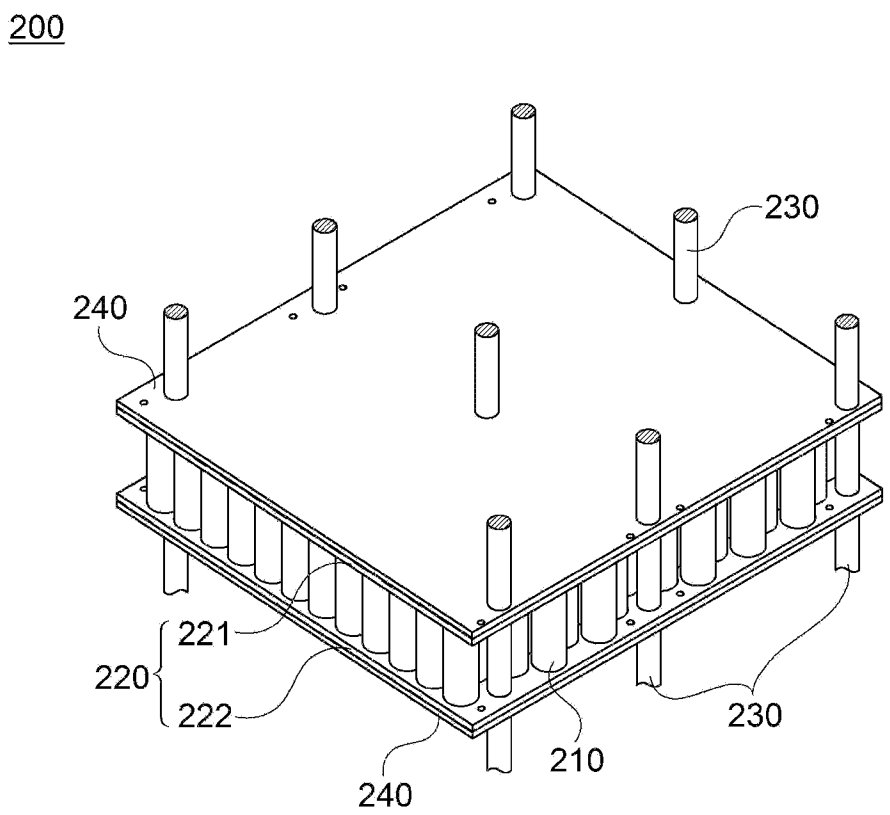
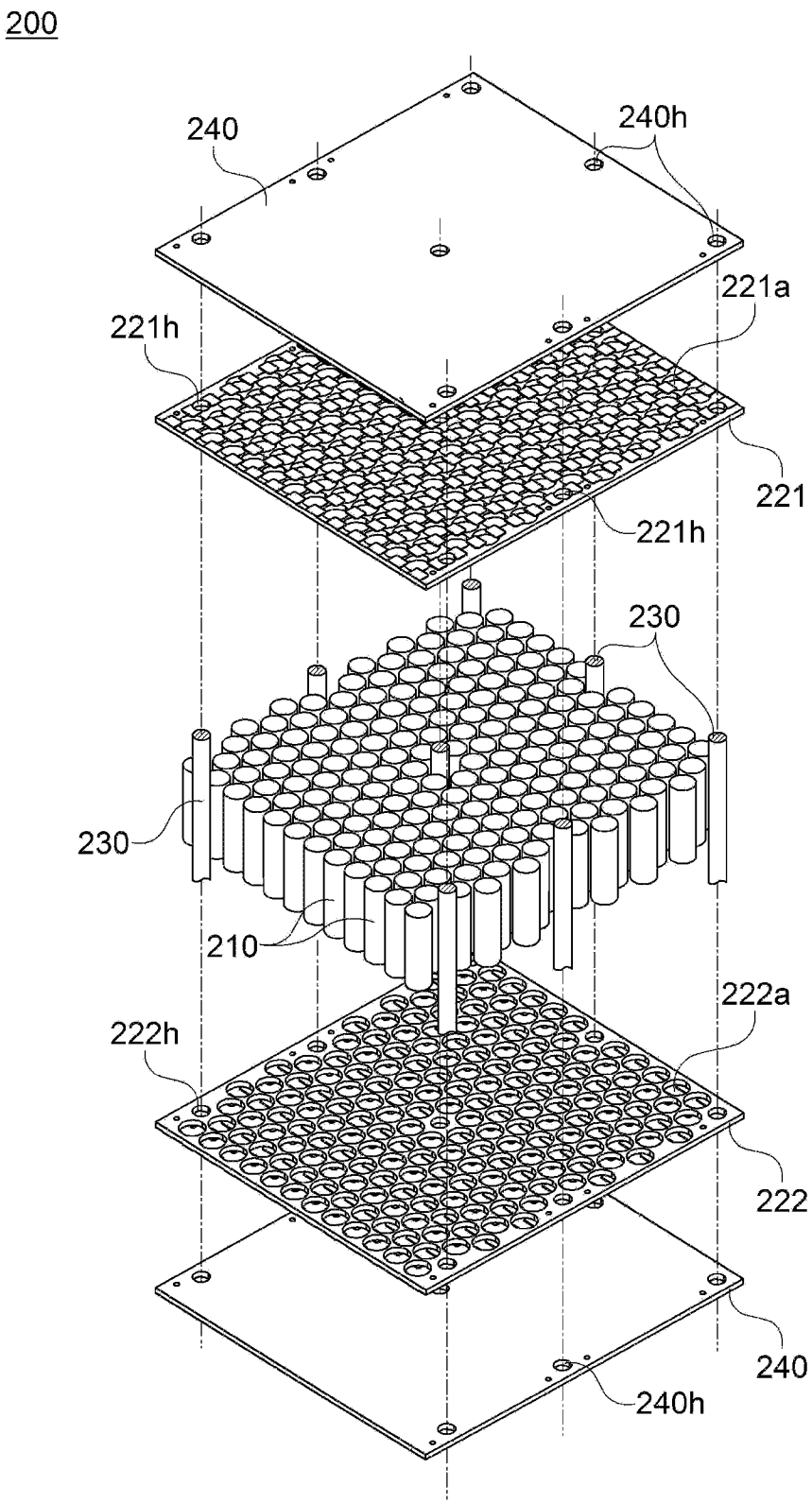


FIG. 4


200
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230
210
222a
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222
240
240h

BATTERY MODULE FOR ELECTRIC PROPULSION AIRCRAFT AND BATTERY PACK INCLUDING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from and the benefit of Korean Patent Application No. 10-2025-0152733, filed on October 21, 2025, which is hereby incorporated by reference for all purposes as if fully set forth herein

BACKGROUND

[0002] FIELD

[0003] Embodiments of the invention relate generally to a battery module for an electric propulsion aircraft and a battery pack including the same, and more particularly, to a battery module and a battery pack including the same that are capable of enhancing thermal stability while securing structural rigidity without increasing a thickness of a case of the battery module.

[0004] DISCUSSION OF THE BACKGROUND

[0005] In recent years, as the demand for environmentally friendly and highly efficient air transportation means has increased, research on electric propulsion aircraft, which use electricity as a power source instead of fossil fuels, has been actively conducted.

[0006] Such an electric propulsion aircraft can offer various advantages, such as reducing carbon emissions and operating costs, and decreasing noise generated during operation. As a battery system having high energy density and stability is required for stable driving of an electric propulsion aircraft, various types of battery systems are being developed.

[0007] The above information disclosed in this Background section is only for

understanding of the background of the inventive concepts, and, therefore, it may contain information that does not constitute prior art.

SUMMARY

[0008] The conventional battery system typically has a structure that fixes a plurality of battery cells connected in series and in parallel through a cell holder and protects a battery module through a case (or an "outer case"). In the conventional battery system, since the cell holder only serves to maintain the positions and intervals of battery cells, the thickness of the case needs to be increased to ensure structural rigidity. In an electric propulsion aircraft, it is important to reduce the weight of a battery system. However, as the thickness of the case increases, the overall weight of the battery system increases. Therefore, there is a need for a method capable of securing the rigidity of the battery system without increasing the thickness of the case.

[0009] In addition, when operating an electric propulsion aircraft, safety issues, such as the battery module being damaged due to vibrations generated during rotation of a propeller or during a power conversion process of an aircraft propulsion device, or the battery cell reaching a state of thermal runaway and causing the battery system to explode, may occur. Although the conventional battery system attempts to prevent damage to a battery module or explosion of a battery cell due to vibrations through a filler (for example, foam), deformation or hardening of the filler may occur during operation of an aircraft, making it difficult to effectively prevent damage to the battery modules or explosion of the battery cells caused by the vibration.

[0010] In the field of electric propulsion aircraft, stability is absolutely critical. Therefore, there is an increasing need for new methods for minimizing damage to battery

modules or explosion of battery systems during operation of an aircraft.

[0011] Accordingly, an object of the present disclosure is directed to providing a battery module and a battery pack including the same that are capable of securing structural rigidity without increasing the thickness of a case and can effectively prevent damage or thermal runaway of battery cells caused by vibrations generated during operation of an electric propulsion aircraft.

[0012] Additional features of the inventive concepts will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the inventive concepts.

[0013] According to an aspect of the present disclosure, there is provided a battery module for an electric propulsion aircraft according to one embodiment includes: a plurality of battery cells; a plurality of cell holders disposed in a longitudinal direction of the battery module and including accommodating portions for accommodating the plurality of battery cells and insertion holes; reinforcing bars extending in the longitudinal direction of the battery module and inserted into the insertion holes to support the plurality of cell holders; and a protective pad disposed adjacent to the plurality of cell holders to absorb vibration transmitted to the battery module or prevent heat from being transferred to the outside of the battery module.

[0014] The plurality of cell holders may include: a first cell holder configured to accommodate one end of each of the battery cells; and a second cell holder configured to accommodate the other end opposite to the one end of each of the battery cells.

[0015] The reinforcing bars may be disposed to prevent the battery module from bending or twisting.

[0016] Each of the reinforcing bars may include a material having thermal conductivity.

[0017] The reinforcing bar may be disposed in contact with at least a portion of the plurality of battery cells to transfer heat generated in the plurality of battery cells to the outside of the battery module.

[0018] According to another embodiment, the reinforcing bar may include an insulating coating layer disposed to surround an outer circumferential surface of the reinforcing bar.

[0019] The insulating coating layer may include a ceramic coating layer.

[0020] The protective pad may include a through hole through which the reinforcing bar passes.

[0021] According to one embodiment, the protective pad may include at least one of a ceramic, mica, and an insulating composite.

[0022] The protective pad may have a thermal conductivity of 0.5 W/m·K or less and a heat-resistant temperature of 600 °C or higher.

[0023] Also, a thickness of the protective pad may be 1.5 T.

[0024] A battery pack for an electric propulsion aircraft according to one embodiment may include: a case; and a plurality of battery modules disposed inside the case, wherein each of the plurality of battery modules includes: a plurality of battery cells; a plurality of cell holders disposed in a longitudinal direction of the battery module and including accommodating portions configured to accommodate the plurality of battery cells and insertion holes; reinforcing bars extending in the longitudinal direction of the case and inserted into the insertion holes to support the plurality of cell holders; and a protective pad that absorbs vibration transmitted to the battery module or prevents heat from being transferred to the outside of the battery module, and the reinforcing bars are coupled to the case and disposed to transfer heat generated in the battery module to the case.

[0025] According to one embodiment, the reinforcing bar may be coupled to the case and disposed to transfer heat generated in the battery module to the case.

[0026] According to one embodiment, each of the plurality of battery modules may further include a protective pad that absorbs vibration transmitted to the battery module or prevents heat from being transferred to the outside of the battery module.

[0027] The protective pad may be disposed between the plurality of cell holders and a plurality of cell holders of another battery module.

[0028] According to one embodiment, the case may include a fixing member configured to fix the battery pack to an electric propulsion aircraft.

[0029] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and together with the description serve to explain the inventive concepts.

[0031] FIG. 1 is a perspective view of a battery pack for an electric propulsion aircraft according to one embodiment.

[0032] FIG. 2 is an exploded perspective view of the battery pack for an electric propulsion aircraft shown in FIG. 1.

[0033] FIG. 3 is a perspective view showing a battery module of the battery pack for an

electric propulsion aircraft according to one embodiment.

[0034] FIG. 4 is an exploded perspective view of the battery module shown in FIG. 3.

DETAILED DESCRIPTION

[0035] In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of various embodiments or implementations of the invention. As used herein "embodiments" and "implementations" are interchangeable words that are non-limiting examples of devices or methods employing one or more of the inventive concepts disclosed herein. It is apparent, however, that various embodiments may be practiced without these specific details or with one or more equivalent arrangements. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring various embodiments. Further, various embodiments may be different, but do not have to be exclusive. For example, specific shapes, configurations, and characteristics of an embodiment may be used or implemented in another embodiment without departing from the inventive concepts.

[0036] Unless otherwise specified, the illustrated embodiments are to be understood as providing features of varying detail of some ways in which the inventive concepts may be implemented in practice. Therefore, unless otherwise specified, the features, components, modules, layers, films, panels, regions, and/or aspects, etc. (hereinafter individually or collectively referred to as "elements"), of the various embodiments may be otherwise combined, separated, interchanged, and/or rearranged without departing from the inventive concepts.

[0037] The use of cross-hatching and/or shading in the accompanying drawings is generally provided to clarify boundaries between adjacent elements. As such, neither the

presence nor the absence of cross-hatching or shading conveys or indicates any preference or requirement for particular materials, material properties, dimensions, proportions, commonalities between illustrated elements, and/or any other characteristic, attribute, property, etc., of the elements, unless specified. Further, in the accompanying drawings, the size and relative sizes of elements may be exaggerated for clarity and/or descriptive purposes. When an embodiment may be implemented differently, a specific process order may be performed differently from the described order. For example, two consecutively described processes may be performed substantially at the same time or performed in an order opposite to the described order. Also, like reference numerals denote like elements.

[0038] When an element, such as a layer, is referred to as being "on," "connected to," or "coupled to" another element or layer, it may be directly on, connected to, or coupled to the other element or layer or intervening elements or layers may be present. When, however, an element or layer is referred to as being "directly on," "directly connected to," or "directly coupled to" another element or layer, there are no intervening elements or layers present. To this end, the term "connected" may refer to physical, electrical, and/or fluid connection, with or without intervening elements. Further, the D1-axis, the D2-axis, and the D3-axis are not limited to three axes of a rectangular coordinate system, such as the x, y, and z – axes, and may be interpreted in a broader sense. For example, the D1-axis, the D2-axis, and the D3-axis may be perpendicular to one another, or may represent different directions that are not perpendicular to one another. For the purposes of this disclosure, "at least one of X, Y, and Z" and "at least one selected from the group consisting of X, Y, and Z" may be construed as X only, Y only, Z only, or any combination of two or more of X, Y, and Z, such as, for instance, XYZ, XYY, YZ, and ZZ. As used herein, the term "and/or" includes any and all combinations of one or more of the

associated listed items.

[0039] Although the terms "first," "second," etc. may be used herein to describe various types of elements, these elements should not be limited by these terms. These terms are used to distinguish one element from another element. Thus, a first element discussed below could be termed a second element without departing from the teachings of the disclosure.

[0040] Spatially relative terms, such as "beneath," "below," "under," "lower," "above," "upper," "over," "higher," "side" (e.g., as in "sidewall"), and the like, may be used herein for descriptive purposes, and, thereby, to describe one elements relationship to another element(s) as illustrated in the drawings. Spatially relative terms are intended to encompass different orientations of an apparatus in use, operation, and/or manufacture in addition to the orientation depicted in the drawings. For example, if the apparatus in the drawings is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. Furthermore, the apparatus may be otherwise oriented (e.g., rotated 90 degrees or at other orientations), and, as such, the spatially relative descriptors used herein interpreted accordingly.

[0041] The terminology used herein is for the purpose of describing particular embodiments and is not intended to be limiting. As used herein, the singular forms, "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. Moreover, the terms "comprises," "comprising," "includes," and/or "including," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, components, and/or groups thereof, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or

groups thereof. It is also noted that, as used herein, the terms "substantially," "about," and other similar terms, are used as terms of approximation and not as terms of degree, and, as such, are utilized to account for inherent deviations in measured, calculated, and/or provided values that would be recognized by one of ordinary skill in the art.

[0042] Various embodiments are described herein with reference to sectional and/or exploded illustrations that are schematic illustrations of idealized embodiments and/or intermediate structures. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments disclosed herein should not necessarily be construed as limited to the particular illustrated shapes of regions, but are to include deviations in shapes that result from, for instance, manufacturing. In this manner, regions illustrated in the drawings may be schematic in nature and the shapes of these regions may not reflect actual shapes of regions of a device and, as such, are not necessarily intended to be limiting.

[0043] As customary in the field, some embodiments are described and illustrated in the accompanying drawings in terms of functional blocks, units, and/or modules. Those skilled in the art will appreciate that these blocks, units, and/or modules are physically implemented by electronic (or optical) circuits, such as logic circuits, discrete components, microprocessors, hard-wired circuits, memory elements, wiring connections, and the like, which may be formed using semiconductor-based fabrication techniques or other manufacturing technologies. In the case of the blocks, units, and/or modules being implemented by microprocessors or other similar hardware, they may be programmed and controlled using software (e.g., microcode) to perform various functions discussed herein and may optionally be driven by firmware and/or software. It is also contemplated that each block, unit, and/or module may be implemented by dedicated

hardware, or as a combination of dedicated hardware to perform some functions and a processor (e.g., one or more programmed microprocessors and associated circuitry) to perform other functions. Also, each block, unit, and/or module of some embodiments may be physically separated into two or more interacting and discrete blocks, units, and/or modules without departing from the scope of the inventive concepts. Further, the blocks, units, and/or modules of some embodiments may be physically combined into more complex blocks, units, and/or modules without departing from the scope of the inventive concepts.

[0044] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure is a part. Terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and should not be interpreted in an idealized or overly formal sense, unless expressly so defined herein.

[0045] FIG. 1 is a perspective view of a battery pack for an electric propulsion aircraft according to one embodiment.

[0046] Referring to FIG. 1, a battery pack 10 for an electric propulsion aircraft according to one embodiment may include a case 100 and a plurality of battery modules 200 accommodated inside the case 100 and may be mounted in an electric propulsion aircraft to supply power for driving the electric propulsion aircraft. Although the battery pack 10 may be mounted in, for example, a multi-copter-type aircraft for urban air mobility, a type of electric propulsion aircraft to which the battery pack 10 is mounted is not limited thereto.

[0047] The case 100 may form the overall exterior appearance of the battery pack 10 for an electric propulsion aircraft, and a space in which the plurality of battery modules 200 are

accommodated (or "accommodation space") may be formed inside the case 100.

[0048] The case 100 may be coupled or fixed to the electric propulsion aircraft to protect the plurality of battery modules 200 accommodated inside the case 100 from external impact or inflow of external foreign substances. For example, the case 100 may include a fixing member 110 for fixing or coupling the battery pack 10 to the electric propulsion aircraft. Although the fixing member 110 may protrude from the case 100 and may be coupled to a region of the electric propulsion aircraft, a shape or coupling method of the fixing member 110 is not limited to the illustrated embodiment.

[0049] The plurality of battery modules 200 may be accommodated inside the case 100 and may serve to supply power required for operation of the electric propulsion aircraft. For example, the battery module 200 may include a plurality of battery cells, a cell holder for fixing and/or supporting the plurality of battery cells, and a reinforcing bar for supporting the cell holder, and may be electrically or operatively connected to a power source of the electric propulsion aircraft to supply power required for operation of the electric propulsion aircraft.

[0050] Since the battery pack 10 may be damaged by impacts generated during operation of the electric propulsion aircraft, it is important to secure the structural rigidity of the battery pack 10. In a conventional battery pack, since the cell holder only serves to maintain the arrangement of battery cells, a thickness and size of the case need to be increased to ensure the structural rigidity of the battery pack.

[0051] As characteristics of the electric propulsion aircraft require miniaturization and weight reduction of the battery pack, there are limitations on increasing the thickness and size of the case, making it difficult to secure sufficient structural rigidity in the conventional battery pack.

[0052] On the other hand, the battery pack 10 according to one embodiment may secure sufficient structural rigidity without increasing the thickness and/or size of the case 100 through the battery module 200 having a structure that can secure structural rigidity by itself. Hereinafter, the components of the battery pack 10 for an electric propulsion aircraft will be described in detail with reference to FIG. 2.

[0053] FIG. 2 is an exploded perspective view of the battery pack for an electric propulsion aircraft shown in FIG. 1.

[0054] Referring to FIG. 2, a battery pack 10 for an electric propulsion aircraft according to one embodiment may include a case 100 (for example, the case 100 of FIG. 1) and a plurality of battery modules 200 (for example, the battery modules 200 of FIG. 1).

[0055] The plurality of battery modules 200 may be disposed inside the case 100 in a longitudinal direction of the battery pack 10 or the case 100. For example, the plurality of battery modules 200 may include a first battery module and a second battery module, and the second battery module may be stacked on the first battery module. The plurality of battery modules 200 including the first battery module and the second battery module is only one embodiment, and the number of battery modules 200 is not limited to the above-described embodiment.

[0056] Each of the battery modules 200 may include a plurality of battery cells 210, a plurality of cell holders 220, and a reinforcing bar 230, and secure structural rigidity by itself without depending on the case 100. The plurality of battery cells 210 may be arranged in a predetermined matrix (for example, an N×M matrix (where N and M are natural numbers)) through the plurality of cell holders 220, and the structural rigidity of the battery module 200 may be secured as the reinforcing bar 230 is inserted into the cell holder 220. For example, the

reinforcing bar 230 may be inserted into the cell holder 220 and disposed to prevent the battery module 200 from being bent or twisted by an external force or stress applied to the battery module 200.

[0057] In a conventional battery module, it was common to include only the plurality of battery cells 210 and the plurality of cell holders 220 that accommodate the plurality of battery cells 210 without the reinforcing bar 230. As a result, since the battery module itself could not secure structural rigidity, a thickness and/or size of the case 100 had to be increased to secure structural rigidity.

[0058] On the other hand, the battery pack 10 for an electric propulsion aircraft according to one embodiment may secure structural rigidity using only the battery module 200 without the case 100 through the reinforcing bar 230 inserted into the plurality of cell holders 220. Accordingly, in the battery pack 10 for an electric propulsion aircraft according to one embodiment, the case 100 may be used only for protecting the battery module 200 so that the thickness and/or size of the case 100 is reduced, and as a result, a weight reduction of the battery pack 10 for an electric propulsion aircraft can be achieved.

[0059] The weight of the battery pack 10 for an electric propulsion aircraft may directly affect the flight performance of the electric propulsion aircraft, and the battery pack 10 for an electric propulsion aircraft of the present disclosure may contribute to improving the flight performance of the electric propulsion aircraft through weight reduction.

[0060] According to one embodiment, the plurality of battery modules 200 may further include a protective pad 240 disposed between the plurality of battery modules 200. The protective pad 240 may serve to absorb shock applied from the outside or absorb heat. For example, the protective pad 240 may be disposed between the cell holder 220 of the first battery

module and the cell holder 220 of the second battery module to absorb vibration caused by external impact or to prevent heat generated in one battery module (for example, the first battery module) from being transferred to another battery module (for example, the second battery module).

[0061] The battery pack 10 for an electric propulsion aircraft according to one embodiment may secure stability against vibration and heat by preventing vibration or thermal runaway generated in any one of the battery modules 200 from propagating through the protective pad 240. Hereinafter, the battery modules 200 constituting the battery pack 10 will be described in detail with reference to FIGS. 3 and 4.

[0062] FIG. 3 is a perspective view showing a battery module of a battery pack for an electric propulsion aircraft according to one embodiment, and FIG. 4 is an exploded perspective view of the battery module shown in FIG. 3. In this case, the battery module 200 shown in FIGS. 3 and 4 is one embodiment of the battery module 200 applied to the battery pack 10 for an electric propulsion aircraft of FIG. 1 or 2.

[0063] Referring to FIGS. 3 and 4, the battery module 200 according to one embodiment may include a plurality of battery cells 210, a plurality of cell holders 220, a reinforcing bar 230, and a protective pad 240. The components of the battery module 200 are not limited thereto, and at least one component (for example, the protective pad 240) may be omitted, or another component may be added according to an embodiment.

[0064] The plurality of battery cells 210 may supply power required for operation of the electric propulsion aircraft. For example, although the plurality of battery cells 210 may include cylindrical batteries (for example, 21700 batteries), a type of the battery cells 210 is not limited thereto.

[0065] The plurality of cell holders 220 may be disposed to be spaced a predetermined distance apart from each other in a longitudinal direction of the battery module 200, and the plurality of battery cells 210 may be disposed while maintaining a predetermined interval. For example, each of the plurality of cell holders 220 may include an accommodating portion for accommodating the plurality of battery cells 210 and an insertion hole into which the reinforcing bar 230 is inserted. In this case, the accommodating portions of the plurality of cell holders 220 may be disposed in a grid shape of an N×M matrix (where N and M are natural numbers), and the plurality of battery cells 210 may be inserted into the accommodating portions and disposed in an N×M matrix.

[0066] According to one embodiment, the plurality of cell holders 220 may include a first cell holder 221 that accommodates one end of each of the plurality of battery cells 210, and a second cell holder 222 that is spaced apart from the first cell holder 221 in the longitudinal direction of the battery module 200 and accommodates the other end of each of the plurality of battery cells 210 in a direction opposite to the one end. The first cell holder 221 may include a first accommodating portion 221a and a first insertion hole 221h. Additionally, the second cell holder 222 may include a second accommodating portion 222a disposed at a position corresponding to the first accommodating portion 221a and a second insertion hole 222h disposed at a position corresponding to the first insertion hole 221h. One end of each of the plurality of battery cells 210 may be accommodated in the first accommodating portion 221a of the first cell holder 221, and the other end opposite to the one end of each of the plurality of battery cells 210 may be accommodated in the second accommodating portion 222a of the second cell holder 222. As the one end and the other end of each of the plurality of battery cells 210 are accommodated in the first cell holder 221 and the second cell holder 222, the plurality of

battery cells 210 may be arranged in an N×M matrix with a specified interval.

[0067] The reinforcing bar 230 may extend in the longitudinal direction of the battery module 200 and may be inserted into the insertion holes of the plurality of cell holders 220 to secure the structural rigidity of the plurality of battery cells 210 and the plurality of cell holders 220. For example, the reinforcing bar 230 may be inserted into the first insertion hole 221h of the first cell holder 221 and the second insertion hole 222h of the second cell holder 222. The reinforcing bar 230 may prevent the battery module 200 from being bent or twisted due to stress applied to the battery module 200 while inserted into the first cell holder 221 and the second cell holder 222. That is, the reinforcing bar 230 may serve to secure the structural rigidity of the battery module 200. A conventional battery module had to secure structural rigidity through an outer case (for example, the case 100 in FIG. 1), and to secure structural rigidity, a thickness and/or size of the outer case had to be increased, which inevitably increased the overall weight of battery cells. In contrast, the battery module 200 according to one embodiment may secure structural rigidity by itself through the reinforcing bar 230 and may secure structural rigidity without increasing the thickness and/or size of the outer case, thereby achieving weight reduction of the battery pack (for example, the battery pack 10 of FIG. 1).

[0068] The reinforcing bar 230 may be disposed in contact with at least a portion of a region of the plurality of battery cells 210 while inserted into the plurality of cell holders 220. In this case, the reinforcing bar 230 may include a material having thermal conductivity (for example, aluminum), and the reinforcing bar 230 may transfer heat generated in the plurality of battery cells 210 through the above-described structure. For example, one end and/or the other end of the reinforcing bar 230 may be in contact with the case of the battery pack, and through the disposition structure, the reinforcing bar 230 may function as a heat transfer path, thereby

allowing heat generated in the battery cell 210 to be transferred to the case.

[0069] Additionally, the reinforcing bar 230 may include an insulating coating layer (not shown) (for example, a ceramic coating layer) disposed to surround an outer circumferential surface of the reinforcing bar 230. For example, the insulating coating layer may be formed by applying an insulating material (for example, a ceramic) onto the outer circumferential surface of the reinforcing bar 230 but is not limited thereto. As the reinforcing bar 230 is disposed in contact with at least a portion of a region of the plurality of battery cells 210, an electrical short-circuit of the plurality of battery cells 210 may occur due to the reinforcing bar 230. However, the battery module 200 according to one embodiment may prevent electrical short-circuiting of the plurality of battery cells 210 through the reinforcing bar 230 including the insulating coating layer.

[0070] The protective pad 240 (or "explosion transfer prevention pad") may be disposed adjacent to the plurality of cell holders 220 to absorb vibration and prevent heat generated in the plurality of battery cells 210 from being transferred to other battery modules. For example, the protective pad 240 may be stacked on the plurality of cell holders 220 and disposed between the plurality of cell holders 220 of the battery module 200 and a cell holder of another battery module. In this case, the protective pad 240 may include through holes disposed at positions corresponding to the insertion holes of the plurality of cell holders 220, and the reinforcing bars 230 may be inserted into the insertion holes of the plurality of cell holders 220 and the through holes of the protective pad 240 to secure the structural rigidity of the battery module 200.

[0071] The protective pad 240 according to one embodiment may include a material capable of absorbing vibration while minimizing heat transfer. For example, the protective pad 240 may include, but is not limited to, at least one of a ceramic, mica, and an insulating

composite. In this case, the protective pad 240 may have a thermal conductivity of about 0.5 W/m·K or less and a heat-resistant temperature of about 600 °C or higher. Additionally, although a thickness of the protective pad 240 may be about 1.5 T, the thickness of the protective pad 240 is not limited thereto.

[0072] Low-frequency vibrations may be generated by a propeller during operation of the electric propulsion aircraft, or high-frequency vibrations may be generated during a power conversion process. A situation in which the electrical connection between the plurality of battery cells 210 and the electric propulsion aircraft is cut off may arise due to the generated low-frequency or high-frequency vibrations. For example, a shock may be applied to a soldering portion of the plurality of battery cells 210 or an electrical contact portion of the battery cells 210 due to vibration, which may cut off the electrical connection between the plurality of battery cells 210 and the electric propulsion aircraft. As a result, the flight of the electric propulsion aircraft may be interrupted, which may cause a safety-related accident.

[0073] The battery module 200 according to one embodiment may absorb vibrations generated during an operation of the electric propulsion aircraft through the protective pad 240, thereby preventing the electrical connection between the battery cell 210 and the electric propulsion aircraft from being cut off due to the vibrations. That is, the battery module 200 may secure stability against vibration through the protective pad 240, thereby enabling long-term operation of the battery module 200.

[0074] In addition, when at least one of the battery cells 210 of the battery module 200 reaches a state of thermal runaway, heat generated in the battery cell 210 may be transferred to another battery cell 210 or another battery module 200, thereby possibly causing a chain explosion.

[0075] In a conventional battery module, although chain explosions were prevented by blocking heat through a filler filled in the battery module, there was a problem in that the filler alone could not effectively block heat transfer to other battery modules. On the other hand, the battery module 200 according to one embodiment may effectively prevent heat generated in the battery cell 210 from being transferred to another battery cell 210 or another battery module 200 through the protective pad 240 instead of a filler. For example, the battery module 200 may prevent heat generated in the battery cell 210 from being transferred to another battery cell 210 or another battery module 200 by absorbing the heat generated in the battery cell 210 through the protective pad 240 or by dispersing and transferring the heat generated in the battery cell 210 to another battery module 200.

[0076] The battery module 200 according to one embodiment may prevent chain explosions by alleviating temperature non-uniformity that may occur between a plurality of battery modules 200 through the protective pad 240, thereby ensuring not only stability against vibration of the battery module 200 but also thermal stability.

[0077] A battery pack according to various embodiments of the present disclosure (for example, the battery pack 10 of FIGS. 1 and 2) may improve the flight performance of an electric propulsion aircraft by reducing the weight of the battery pack through the battery module 200 capable of securing structural rigidity by itself. In addition, the battery pack according to various embodiments of the present disclosure may improve the stability of the battery pack by suppressing vibration and ensuring thermal stability through the protective pad 240 disposed between the battery modules 200.

[0078] A battery pack for an electric propulsion aircraft according to various embodiments of the present disclosure can achieve weight reduction by securing structural

rigidity using only the battery module itself without increasing the thickness of a case.

[0079] In addition, a battery pack for an electric propulsion aircraft according to various embodiments of the present disclosure can prevent damage to battery cells caused by vibrations generated during operation of an electric propulsion aircraft and can also prevent heat from being transferred to other battery modules even when the battery cells reach a state of thermal runaway.

[0080] The effects of the embodiments are not limited to the above-described effects, and other effects that have not been described can be clearly understood by a person having ordinary skill in the art to which the embodiments belong from the present specification and the attached drawings.

[0081] The above-described embodiments of the present disclosure or other embodiments are not mutually exclusive or distinct from each other. The above-described embodiments of the present disclosure or other embodiments may have their respective components or functions combined or used together.

[0082] For example, this means that a component A described in a specific embodiment and/or drawing may be combined with a component B described in another embodiment and/or drawing. That is, even when the coupling between the components is not directly described, coupling is possible unless it is stated that the coupling is impossible.

[0083] Although certain embodiments and implementations have been described herein, other embodiments and modifications will be apparent from this description. Accordingly, the inventive concepts are not limited to such embodiments, but rather to the broader scope of the appended claims and various obvious modifications and equivalent arrangements as would be apparent to a person of ordinary skill in the art.

WHAT IS CLAIMED IS:

1. A battery module for an electric propulsion aircraft, comprising:

a plurality of battery cells;

a plurality of cell holders disposed in a longitudinal direction of the battery module and including accommodating portions configured to accommodate the plurality of battery cells and insertion holes;

reinforcing bars extending in the longitudinal direction of the battery module and inserted into the insertion holes to support the plurality of cell holders; and

a protective pad disposed adjacent to the plurality of cell holders to absorb vibration transmitted to the battery module or to prevent heat from being transferred to the outside of the battery module.

2. The battery module of claim 1, wherein the plurality of cell holders include:

a first cell holder configured to accommodate one end of each of the battery cells; and

a second cell holder configured to accommodate the other end opposite to the one end of each of the battery cells.

3. The battery module of claim 1, wherein the reinforcing bars are disposed to prevent the battery module from bending or twisting.

4. The battery module of claim 3, wherein each of the reinforcing bars includes a material having thermal conductivity.

5. The battery module of claim 4, wherein the reinforcing bar is disposed in contact with at least a portion of the plurality of battery cells to transfer heat generated in the plurality of battery cells to the outside of the battery module.

6. The battery module of claim 5, wherein the reinforcing bar includes an insulating coating layer disposed to surround an outer circumferential surface of the reinforcing bar.

7. The battery module of claim 6, wherein the insulating coating layer includes a ceramic coating layer.

8. The battery module of claim 1, wherein the protective pad includes through holes through which the reinforcing bars pass.

9. The battery module of claim 1, wherein the protective pad includes at least one of a ceramic, mica, and an insulating composite.

10. The battery module of claim 9, wherein the protective pad has a thermal conductivity of 0.5 W/m·K or less and a heat-resistant temperature of 600 °C or higher.

11. The battery module of claim 9, wherein a thickness of the protective pad is 1.5 T.

12. A battery pack for an electric propulsion aircraft, comprising:

a case; and

a plurality of battery modules disposed inside the case,

wherein each of the plurality of battery modules includes:

a plurality of battery cells;

a plurality of cell holders disposed in a longitudinal direction of the battery module and including accommodating portions configured to accommodate the plurality of battery cells and insertion holes;

reinforcing bars extending in the longitudinal direction of the case and inserted into the insertion holes to support the plurality of cell holders; and

a protective pad that absorbs vibration transmitted to the battery module or prevents heat from being transferred to the outside of the battery module, and

the reinforcing bars are coupled to the case and disposed to transfer heat generated in the battery module to the case.

13. The battery pack of claim 12, wherein the protective pad is disposed between the plurality of cell holders and a plurality of cell holders of another battery module.

14. The battery pack of claim 12, wherein the case includes a fixing member configured to fix the battery pack to an electric propulsion aircraft.

ABSTRACT

A battery module for an electric propulsion aircraft may include: a plurality of battery cells; a plurality of cell holders disposed in a longitudinal direction of the battery module and including accommodating portions configured to accommodate the plurality of battery cells and insertion holes; reinforcing bars extending in the longitudinal direction of the battery module and inserted into the insertion holes to support the plurality of cell holders; and a protective pad disposed adjacent to the plurality of cell holders to absorb vibration transmitted to the battery module or prevent heat from being transferred to the outside of the battery module.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
19/375,100	**10/30/2025 08:28:04 PM Z ET**	**P10449US00**

Title of Invention

BATTERY MODULE FOR ELECTRIC PROPULSION AIRCRAFT AND BATTERY PACK INCLUDING THE SAME

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2321	FILED BY	Ellie Park
PATENT CENTER #	72965948	FILING DATE	-
CUSTOMER #	192379	FIRST NAMED INVENTOR	SUHO YU
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	JIN SEO PARK

Documents

TOTAL DOCUMENTS: 6

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
generatedADS72965948.pdf	6	Application Data Sheet	121 KB
POA_VSPACE.pdf	2	Power of Attorney	170 KB
P10449US00 Combined Declaration and Assignment_signed.pdf	3	Oath or Declaration filed	305 KB
P10449US00 Statement Under 3.73.pdf	3	Assignee showing of ownership per 37 CFR 3.73	300 KB
P10449US00 Specification-APP.TEXT.docx	24	Application body structured text document	34 KB

Warning: One or more pages are missing page numbering. Page numbering will be automatically applied after submission.

P10449US00 Drawings.pdf	4	Drawings-only black and white line drawings	3972 KB

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PTO/AIA/80 (07-17)
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COMBINED DECLARATION (37 C.F.R. §1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 C.F.R. §1.76) AND ASSIGNMENT OF INVENTION

Title of Invention	**BATTERY MODULE FOR ELECTRIC PROPULSION AIRCRAFT AND BATTERY PACK INCLUDING THE SAME**

DECLARATION

As the below named inventor, I hereby declare that:

This declaration is directed to:

☒ The attached application, or

☐ United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. §1001 by fine or imprisonment of not more than five (5) years, or both.

NOTE: 37 C.F.R. §1.63(c) states, "A person may not execute an oath or declaration unless the person has reviewed and understands the contents of the application, including the claims and is aware of the duty to disclose to the Office all information known to be material to patentability as defined in §1.56."

In the event that the filing date and/or application number are not entered above at the time I execute this document, and if such information is deemed necessary, I hereby authorize and request the attorney of record to insert above the filing date and/or application number of the application.

ASSIGNMENT

WHEREAS, I am the inventor of an invention described and/or claimed in the application identified in this document; and

WHEREAS, for good and valuable consideration, I hereby assign to

VSPACE CO., LTD.

having a place of business at 312, 17, Cheomdangieop1-ro, Sandong-eup, Gyeongsangbuk-do, Gumi-si, 39171, Republic of Korea, ("ASSIGNEE") the entire right, title, and interest for the United States as defined in 35 U.S.C. §100, in the aforesaid invention;

I hereby confirm any prior assignment to ASSIGNEE, and to the extent that I have not already done so, agree to assign, and hereby do, sell, assign and transfer unto ASSIGNEE and its successors in interest, the full and exclusive right, title, and interest in the United States of America and throughout the world, including the right to claim priority under the laws of the United States, the Paris Convention, and any foreign countries, to the inventions as described in the application identified in this document, to the application itself, and all divisions, continuations, continuations-in-part, or other applications claiming priority directly or indirectly from the application identified in this document, and any United States or foreign Letters Patent, utility model, or other similar rights which may be granted thereon, including reissues, reexaminations and extensions thereof, and all copyright rights throughout the world in the application identified in this document and the subject matter disclosed therein, these rights, title, and interest to be held and enjoyed by ASSIGNEE to the full end of the term for which the Letters Patent, utility model, or other similar rights, are granted and any extensions thereof as fully and entirely as the same would have been held by the undersigned had this assignment and sale not been made, the right to sue for, and recover for past infringements of, or liabilities for, any of the rights relating to any the applications, patents, utility models, or other similar rights, resulting therefrom, and the copyright rights;

I hereby covenant and agree to execute all instruments or documents required or requested for the making and prosecution of any applications of any type for patent, utility model, or other similar rights, and for copyright, in the United States and in all foreign countries including, but not limited to, any provisional, continuation, continuation-in-part, divisional, renewal or substitute thereof, and as to letters patent any reissue, re-examination, or extension thereof, and for litigation regarding, or for the purpose of protecting title and to the aforesaid invention, the United States application for patent, or Letters Patent therefor, and to testify in support thereof, for the benefit of ASSIGNEE without further or other compensation than that above set forth; and

I hereby grant the attorney of record the power to insert on this document any further identification that may be necessary or desirable in order to comply with the rules of the United States Patent and Trademark Office or other authority for recordation of this document.

Name of Inventor: **YU, SUHO**	
Signature: 유수호	Date: 25. 10. 27

Name of Inventor: **CHO, BUMDONG**	
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Name of Inventor: **LEE, CHANGSU**	
Signature: 이창수	Date: 25. 10. 27

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
19/375,100	**10/30/2025 08:28:04 PM Z ET**	**P10449US00**

Title of Invention

BATTERY MODULE FOR ELECTRIC PROPULSION AIRCRAFT AND BATTERY PACK INCLUDING THE SAME

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2321	FILED BY	Ellie Park
PATENT CENTER #	72965948	AUTHORIZED BY	JIN SEO PARK
CUSTOMER #	192379	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	SUHO YU

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 4511	**E20250TK30075709**	**Ellie Park**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
4011	BASIC FILING FEE- UTILITY	70.00	1	70.00
2111	UTILITY PATENT APPL. SEARCH FEE	308.00	1	308.00
2311	EXAMINATION OF ORIGINAL PATENT APPLICATION	352.00	1	352.00
			TOTAL AMOUNT:	**$730.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d)

and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

DocCode - SCORE

Placeholder Sheet for Supplemental Content

Application Number: 19375100 Document Date: 10/30/2025

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