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(54) Title: ENERGY STORAGE DEVICE

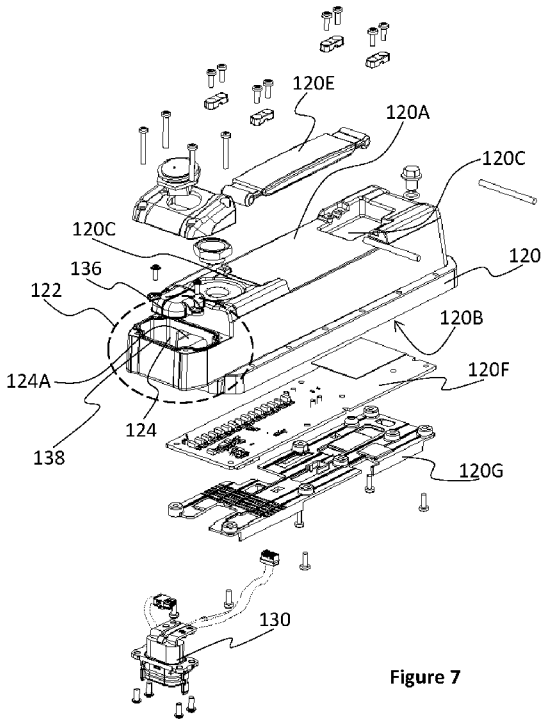

Figure 7

(57) Abstract: Present invention relates to energy storage device 100 for a vehicle. The energy storage device 100 comprises a battery box 110 having a base member 102, a plurality of walls 104 extending from the base member 102 and an open end 106. The open end 106 is configured to receive one or more battery modules 112. The energy storage device 100 further comprises a top cover 120, which is disposed onto the open end 106 of the battery box 110. The top cover 120 comprises an extended portion 122 in a longitudinal direction "D1" of the energy storage device 100. The energy storage device 100 further comprises a first connector 130 disposed at the extended portion 122 of the top cover 120. The first connector 130 is configured to removably connect with the one or more battery modules 112.

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TITLE OF INVENTION

Energy Storage Device

FIELD OF THE INVENTION

[001] Present invention relates to an energy storage device, more particularly relates to a dockable energy storage device for a vehicle.

BACKGROUND OF THE INVENTION

[002] In existing technologies with respect to energy storage devices like a battery pack in vehicles, there is a connector disposed on a casing of the battery pack. The connector on the casing could be inaccessible to a user of the battery pack, thereby making it difficult for them to recharge it. Moreover, the connector on the casing especially if the connector is on an underside of the battery pack is not visible to the user and can cause issues while docking and undocking it from the vehicle.

[003] Further, the connectors on the top portion may bring forth issues regarding water ingress and other complications, thereby jeopardising the safety of the user.

[004] When the vehicle is moving, various vibrations and jerky movements can cause the battery pack to get disconnected from its connector, causing the vehicle to come to a complete stop. A modification in the connector will effectively need a complete redesign of the casing of the battery pack. In addition, without proper guiding provisions in the battery pack, the user may incorrectly dock the battery pack causing difficulties. Further, attaching and detaching the battery pack from the dock is complicated for the user. If any additional components and covers are used to keep the battery pack from moving, it would cause an increase in weight of the vehicle.

[005] Many attempts have been made to address one or more limitations as mentioned above. In one kind of existing storage battery connecting interface structure, it comprises a battery cylinder, wherein an upper end of the battery cylinder is connected with a top cover. The side of the battery cylinder is fixedly installed with a storage battery connecting interface. One side of the top cover is fixedly connected with an interface socket. The side of the interface socket is equipped with a key. The bottom end of the interface socket is provided with five inserting spring sheet opening. The storage battery connecting interface is provided with an inserting spring sheet inserted with the inserting spring sheet opening and is detachably connected with the interface socket through the key. However, the connector as discussed above has a button to attach and detach the battery pack that acts like a locking key that is placed at the edge of the pack that may not be easily accessible to the customer.

[006] In yet another kind of battery seat barrel assembly, it comprises a lower seat barrel and an upper seat barrel plate frame. The upper seat barrel plate frame is detachably installed on the upper end barrel opening of the lower seat barrel. The upper seat barrel plate frame is provided with a through hole for the battery to pass through. The upper end barrel opening of the through hole one and the lower seat barrel are opposite. The battery is placed in the lower seat barrel. One side of the upper cover in the battery is fixed with the plug male head. One side of the upper end barrel opening of the lower seat barrel can be upwards and downwards elastic mounting plug female seat, and the upper seat barrel plate frame corresponding to the plug female seat is provided with an avoiding gap. When placing the battery, the plug male head is inserted with the plug female seat together after avoiding the gap. However, in the battery seat barrel assembly as discussed above, there are no proper guiders allocated for the battery pack to dock in the vehicle.

[007] Thus, there is a need in the art for providing an energy storage device which addresses the aforementioned problems and limitations.

SUMMARY OF THE INVENTION

[008] In one aspect, the present invention is directed to energy storage device for a vehicle. The energy storage device comprises a battery box. The battery box comprises a base member, a plurality of walls extending from the base member and an open end. The open end of the battery box being configured to receive one or more battery modules. The energy storage device further comprises a top cover. The top cover being disposed onto the open end of the battery box. The top cover comprises an extended portion in a longitudinal direction of the energy storage device. The energy storage device further comprises a first connector disposed at the extended portion of the top cover. The first connector being configured to removably connect with the one or more battery modules.

[009] In an embodiment, the extended portion of the top cover comprises a receptacle for accommodating the first connector. The first connector is mounted in an overhang condition, facing downwards.

[010] In a further embodiment, the energy storage comprises a second connector. The second connector comprises the one or more electrical terminals. The first connector being configured to removably connect between the one or more electrical terminals of the second connector and the one or more battery modules.

[011] In a further embodiment, the second connector being disposed onto a mounting plate member through one or more fasteners. The mounting plate member being connected to the vehicle.

[012] In a further embodiment, the one or more fasteners comprises bolts having a first portion and a second portion. The first portion has threaded portion and a diameter lesser than a diameter of the second portion. The first portion of the bolts enables a secure mounting of the second connector with the mounting plate member.

[013] In a further embodiment, at least a portion of the second portion of the bolts is covered by a plurality of springs for applying a force in an upward direction to enable an unbroken connection between the second connector and the first connector.

[014] In a further embodiment, the second connector is configured to accommodate the first connector on a top surface of the second connector.

[015] In a further embodiment, the first connector comprises one or more guiding members. The one or more guiding members comprises a notch which is being configured to lock with the second connector provided in the vehicle.

[016] In a further embodiment, the first connector comprises a cover flap. The cover flap being configured to protect power terminals from water and/or dust ingress.

[017] In a further embodiment, the first connector comprises a gasket, thereby avoiding ingress of water, dust, or other foreign matters into the first connector.

[018] In a further embodiment, the second connector comprises one or more drain holes for draining any accumulated water.

BRIEF DESCRIPTION OF THE DRAWINGS

[019] Reference will be made to embodiments of the invention, examples of which may be illustrated in accompanying figures. These figures are intended to be illustrative, not limiting. Although the invention is generally described in context of these embodiments, it should be

understood that it is not intended to limit the scope of the invention to these particular embodiments.

Figure 1 illustrates a side view of an energy storage device, in accordance with an embodiment of the present invention.

Figure 2 illustrates a perspective view of the energy storage device shown in Figure 1, in accordance with an embodiment of the present invention.

Figure 3 illustrates an exploded view of the energy storage device shown in Figures 1 and 2, in accordance with an embodiment of the present invention.

Figure 4 illustrates a side view of a top cover of the energy storage device shown in Figures 1 – 3, in accordance with an embodiment of the present invention.

Figure 5 illustrates a top view of the top cover shown in Figure 4, in accordance with an embodiment of the present invention.

Figure 6 illustrates a bottom view of the top cover in Figures 4 and 5, in accordance with an embodiment of the present invention.

Figure 7 illustrates an exploded view of the top cover and a first connector in accordance with an embodiment of the present invention.

Figure 8 illustrates a perspective view of an assembly of the first connector and a second connector of the energy storage device, in accordance with an embodiment of the present invention.

Figure 9 illustrates an exploded view of the assembly shown in Figure 8, in accordance with an embodiment of the present invention.

Figures 10 – 12 illustrate various views of the assembly of the first connector and the second connector of the energy storage device, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[020] Various features and embodiments of the present invention here will be discernible from the following further description thereof, set out hereunder.

[021] Present invention relates to an energy storage device, more particularly relates to a dockable energy storage device for a vehicle.

[022] Referring to Figures 1 – 3, the energy storage device 100 in various views is illustrated, in accordance with an embodiment of the present invention. The energy storage device 100 for a vehicle (not shown), comprises a battery box 110. The battery box 110 functions as a protective casing for one or more battery modules 112 disposed in the battery box 110. In an embodiment, the battery box 110 comprises a base member 102, a plurality of walls 104 extending from the base member 102 and an open end 106. In some embodiments, the base member 102 is a horizontal member forming a supporting structure for the battery box 110 and is adapted to withstand a weight of the one or more battery modules 112 and other components connected with the one or more battery modules 112 in the battery box 110. In some embodiment, the plurality of walls 104 of the battery box 110 is extended from the base member 110 in a vertical direction. In the illustrated embodiment of Figure 3, the battery box 110 comprises two walls 104 having curved portions 104A forming a front wall and a rear wall when the two walls 104 are joined through one or more fasteners like screws. In some embodiments, the two walls 104 mounted onto the base member 102 are fastened through one or more fastening members like screws. The fabrication method of fastening through the screws is not meant to be limiting the scope of the present invention. In some exemplary embodiments, the battery box 110 can be having a single body or casing being manufactured through a molding method or any other methods known in the art. In some embodiments, the base member 102 and the walls 104 may be manufactured by a

material including, but not limited to, a polymer material or a metallic material or any other material known in the art. The open end 106 of the battery box 110 is configured to receive the one or more battery modules 112. The open end 106 of the battery box 110 is being covered by a top cover 120 (shown in Figures 4 – 7).

[023] Referring to Figures 4 – 7, it illustrates various views of the top cover 120 of the battery box 110. The battery box 110 further comprises the top cover 120, which is disposed onto the open end 106 of the battery box 110. In some embodiments, the top cover 120 comprises an outer surface 120A and an inner surface 120B opposite to the outer surface 120A. In some embodiments as shown in Figure 5, the outer surface 120A of the top cover 120 may be provided with one or more mounting provisions 120C for attaching one or more auxiliary elements of the energy storage device 100. In some embodiments, the one or more auxiliary elements may include, but not limited to, a handle member 120E. In an embodiment as shown in Figure 6, the inner surface 120B is provided with one or more mounting provisions 120D for accommodating one or more electrical/electronic and/or no electrical/electronic components of the energy storage device 100. In some embodiment, the electrical components may include, but not limited to, a printed board circuit 120F, a Battery Management System (BMS) (not shown) and one or more sensors (not shown). In some embodiments, the inner surface 120B may be covered by a closure member 120G from a bottom side of the inner surface 120B of the top cover 120. The closure member 120G may securely house the electrical/electronic and/or no electrical/electronic components of the energy storage device 100. In an embodiment, the inner surface 120B is oriented to face the open end 106 of the battery box 110, particularly, the closure member 120G connected below the inner surface 120B faces the open end 106 of the battery box 110. In an embodiment, the top cover 120 is mounted onto the assembled walls 104 at the open end

106 through one or more fasteners like screws. In some other embodiments, the top cover 120 is mounted onto the assembled walls 104 at the open end 106 through a hinge mechanism (not shown). Thus, the mechanism used for attaching the top cover 120 with the open end 106 of the battery box 110 should not be meant to be limiting the scope of the present invention. In some embodiments, the top cover 120 may be manufactured by a material including, but not limited to, a polymer material or a metallic material or any other material known in the art.

[024] Referring again to Figures 4 – 7, the top cover 120 comprises an extended portion 122 at one end of the top cover 120. In an embodiment, the extended portion 122 is provided in a longitudinal direction "D1" (shown in Figure 4) of the energy storage device 100. In some other embodiments, the extended portion 122 may also be provided in a lateral direction "L1". Thus, the illustrated embodiment of providing the extended portion 122 at the longitudinal direction "D1" should not be meant to be limiting the scope of the present invention. In some embodiments, the extended portion 122 is connected to any one end of the top cover 120, wherein the other end of the top cover 120 being a fixed or hinged to the open end 106 of the battery box 110. That is to say, one end of the top cover 120 may be provided with the extended portion 122 and the other end of the top cover 120 may be connected fixedly or hingedly.

[025] In an embodiment, the extended portion 122 of the top cover 120 comprises a receptacle 124 for accommodating a first connector 130. In some embodiments, the receptacle 124 in the extended portion 122 is a through hole having an axis oriented in a vertical direction. The receptacle 124 may be in a geometric shape like circular or oval or may be in a non-geometric shape. However, it should be understood that the shape of receptacle 124 should facilitate easy or smooth passage for accommodating the first

connector 130. In some embodiments, the extended portion 122 further comprises at least one longitudinal hole 124A (shown in Figures 6 and 7) for providing a passage for one or more wires 130A (shown in Figure 6) or electrical/electronic elements. In an exemplary embodiment, the one or more wires 130A is extending from a first connector 130 (shown in Figures 7 – 12) of the energy storage device 100. Referring to Figure 4, in an exemplary embodiment, the first connector 130 is mounted in an overhang condition, facing downwards.

[026] In the embodiment illustrated in Figure 9, the first connector 130 comprises one or more guiding members 132. The one or more guiding members 132 comprises a notch 134 which is being configured to lock with a second connector 140 provided in the vehicle. In an embodiment, the first connector 130 comprises a cover flap 136 (shown in Figure 7), which is configured to protect power terminals from water and/or dust ingress. The first connector 130 further comprises a gasket 138, thereby avoiding ingress of water, dust, or other foreign matters or particles into the first connector 130.

[027] Referring to Figures 8 – 12, it illustrates various views of an assembly of the first connector 130 with a second connector 140 of the energy storage device 100. In an embodiment, the first connector 130 is configured to removably connect with the one or more battery modules 112 for electrically connecting the battery modules 112 with the vehicle via the second connector 140. In other words, the second connector 140 is configured to accommodate the first connector 130 on a top surface 142 of the second connector 140.

[028] As shown in Figured 8 – 12, the second connector 140 comprises the one or more electrical terminals. The first connector 130 is configured to removably connect between the one or more electrical terminals of the second connector 140 and the one or more battery modules 112. In an embodiment, the second connector 140 is disposed onto a mounting plate member 150 through one or more fasteners 160 (clearly shown in Figure 9).

[029] In an embodiment as shown in Figure 9, the one or more fasteners 160 comprises bolts having a first portion 162 and a second portion 164. The first portion 162 has a threaded portion 162A and a diameter “d1” lesser than a diameter “d2” of the second portion 164. The first portion 162 of the bolts enables a secure mounting of the second connector 140 with the mounting plate member 150. In an embodiment of the present invention, the mounting plate member 150 is further connected to the vehicle. In an embodiment, at least a portion of the second portion 164 of the bolts are covered by a plurality of springs 170 for applying a force in an upward direction “F1” (shown in Figure 10) to enable an unbroken connection between the second connector 140 and the first connector 130. In some embodiments of the present invention, the second connector 140 comprises one or more drain holes (not shown) for draining any accumulated water.

[030] Advantageously, the energy storage device as disclosed in the present invention increases performance, durability, aesthetics, manufacturability, ease of assembly, handling, comfort, market attractiveness and safety. The design as disclosed in the present invention can be applied in two-wheeled vehicles, three-wheeled vehicles or any other automotives in the industry.

[031] The energy storage device as disclosed in the present invention further provides an advantage of safely removing of the battery modules for recharging and safely docking it back into the vehicle.

[032] The handle member provided in the energy storage device enables easy lifting and handling of a battery pack.

[033] The first connector having the guiding member help the user place the battery at the right place without effort. The guiding members help in easy and aligned connection between the first and second connectors.

[034] The energy storage device having the spring ensures that the first connector and the second connector are connected at all the times, even during the movement of the vehicle and vibrations, and thereby providing an effective connectivity of the battery box with the vehicle.

[035] The audio-visual unit indicates the battery pack's health and other parameters to the user.

[036] The location of the first connector on the extended portion of the top cover and orientation facing downwards are advantageous ensuring prevention of water/dust entry into the connector or the battery modules.

[037] The second connector having the drain holes ensures that water does not clog into the connectors.

[038] The casing need not be changed, the connector is in the top cover, therefore any battery pack can be modified to have this functionality.

[039] The guiding member in the first connector of the top cover has a notch which can lock into the second connector (vehicle side), thereby ensuring that connection is maintained even during movement of the vehicle.

[040] The gasket fits around the periphery of the connector, ensuring that there is no water entry.

[041] Weight distribution in the energy storage unit is done adequately such that there is no additional stress on the connector.

[042] The location of the first connector enables easy wire routing from the connector to the terminals of the battery pack, thereby reducing the length of the wires used for connection.

[043] The present invention solves the technical problems of resistance to malfunction and disconnection due to vibration and movement of vehicle, battery docking including attaching

and detaching with ease due to guiders and latching, electric shock, where the user is safeguarded by providing adequate handles and minimal interference while docking the battery pack, on-road vibration, where the battery is not disconnected due to on road vibration, weight distribution, wherein the weight is equally distributed thereby not putting additional stress on the docking region. Additionally, the user is given an indication about the battery health and life cycle by displaying and indicating various kinds of battery parameters, the user is warned about hazardous and dangerous situations related to the battery pack through the audio-visual unit.

[044] While the present invention has been described with respect to certain embodiments, it will be apparent to those skilled in the art that various changes and modification may be made without departing from the scope of the invention as defined in the following claims.

List of Reference Numerals and Characters

100: Energy storage device

102: Base member

104: Walls

104A: Curved portions of the walls

106: Open end of the battery box

110: Battery box

112: Battery modules

120: Top cover

120A: Outer surface of the top cover

120B: Inner surface of the top cover

120C: Mounting provisions on the outer surface

120D: Mounting provisions on the inner surface

120E: Handle member

120F: Printed board circuit

120G: Closure member

122: Extended portion in top cover

124: Receptacle in top cover

124A: Longitudinal hole in the receptacle

130: First connector

130A: Wires

132: Guiding members

134: Notch in the guiding member

136: Cover flap in the first connector

138: Gasket

142: Top surface of the second connector

150: Mounting plate member

160: Fasteners

162: First portion

162A: Threaded portion

164: Second portion

170: Springs

D1: Longitudinal direction of energy storage device

L1: Lateral direction of energy storage device

d1: Diameter of first portion

d2: Diameter of second portion

F1: Upward direction

CLAIMS:

1. Energy storage device (100) for a vehicle, comprising:

a battery box (110), the battery box (110) comprising a base member (102), a plurality of walls (104) extending from the base member (102) and an open end (106), the open end (106) being configured to receive one or more battery modules (112);

a top cover (120), the top cover (120) being disposed onto the open end (106) of the battery box (110), the top cover (120) comprising an extended portion (122) in a longitudinal direction (D1) of the energy storage device (100); and

a first connector (130) disposed at the extended portion (122) of the top cover (120), the first connector (130) being configured to removably connect with the one or more battery modules (112).

2. The energy storage device (100) as claimed in claim 1, wherein the extended portion (122) of the top cover (120) comprises a receptacle (124) for accommodating the first connector (130), wherein the first connector (130) is mounted in an overhang condition, facing downwards.

3. The energy storage device (100) as claimed in claim 1 comprising a second connector (140), wherein the second connector (140) comprises the one or more electrical terminals, wherein the first connector (130) being configured to removably connect between the one or more electrical terminals of the second connector (140) and the one or more battery modules (112).

4. The energy storage device (100) as claimed in claim 3, wherein the second connector (140) being disposed onto a mounting plate member (150) through one or more fasteners (160), the mounting plate member (150) being connected to the vehicle.

5. The energy storage device (100) as claimed in claim 4, wherein the one or more fasteners (160) comprises bolts having a first portion (162) and a second portion (164), the first portion (162) has threaded portion (162A) and a diameter (d1) lesser than a diameter (d2) of the second portion (164), wherein the first portion (162) of the bolts enables a secure mounting of the second connector (140) with the mounting plate member (150).

6. The energy storage device (100) as claimed in claim 5, wherein at least a portion of the second portion (164) of the bolts are covered by a plurality of springs (170) for applying a force in an upward direction (F1) to enable an unbroken connection between the second connector (140) and the first connector (130).

7. The energy storage device (100) as claimed in claim 3, wherein the second connector (140) is configured to accommodate the first connector (130) on a top surface (142) of the second connector (140).

8. The energy storage device (100) as claimed in claim 1, wherein the first connector (130) comprises one or more guiding members (132), the one or more guiding members (132) comprising a notch (134) which is being configured to lock with the second connector (140) provided in the vehicle.

9. The energy storage device (100) as claimed in claim 1, the first connector (130) comprises a cover flap (136), the cover flap (136) being configured to protect power terminals from water and/or dust ingress.

10. The energy storage device (100) as claimed in claim 1, wherein the first connector (130) comprises a gasket (138), thereby avoiding ingress of water, dust, or other foreign matters into the first connector (130).

11. The energy storage device (100) as claimed in claim 1, wherein the second connector (140) comprises one or more drain holes for draining any accumulated water.

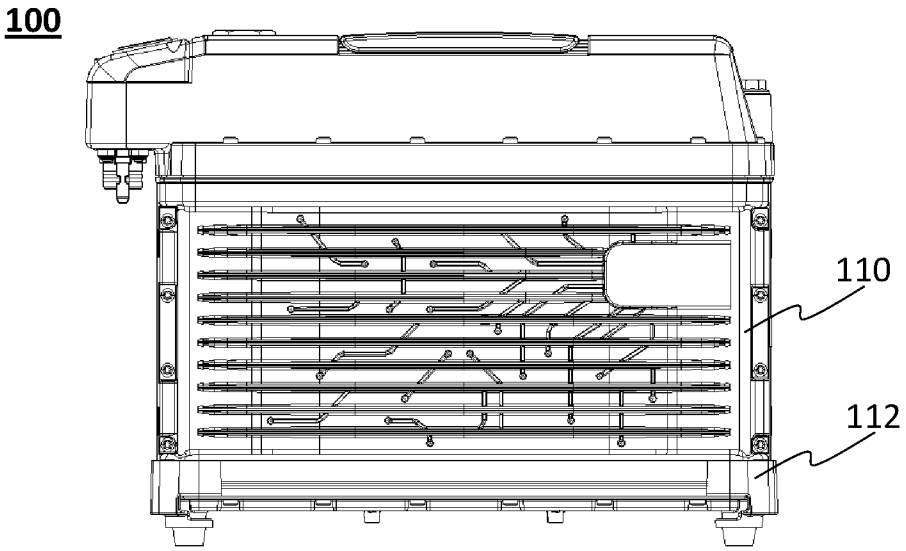


Figure 1

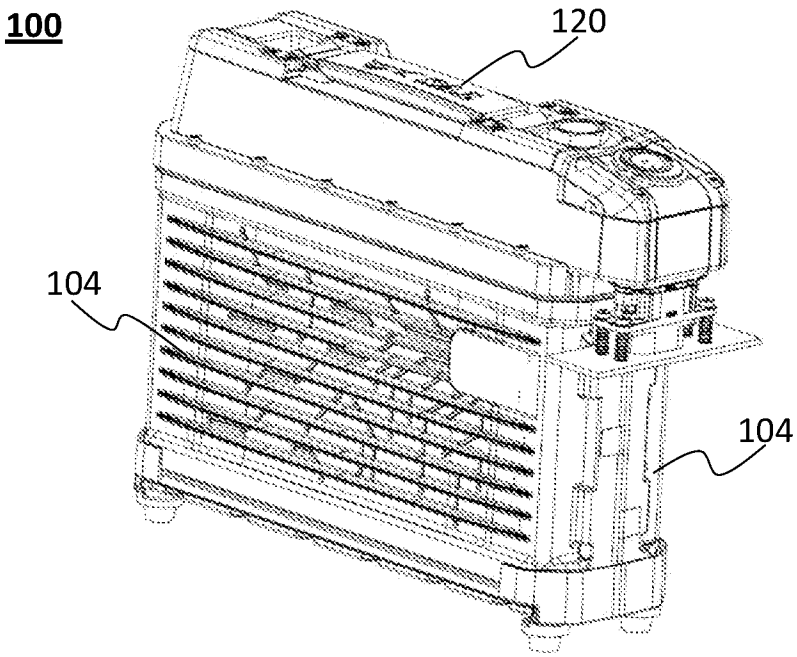


Figure 2

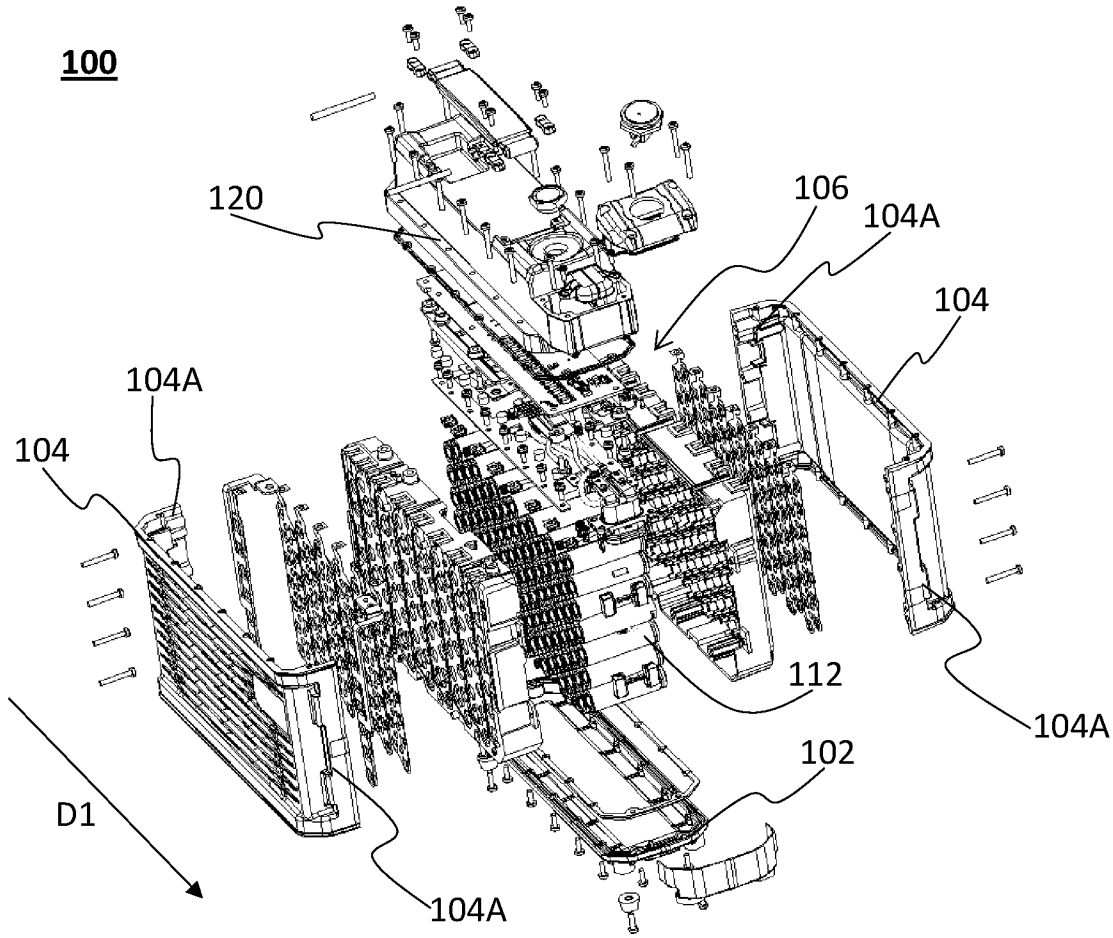


Figure 3

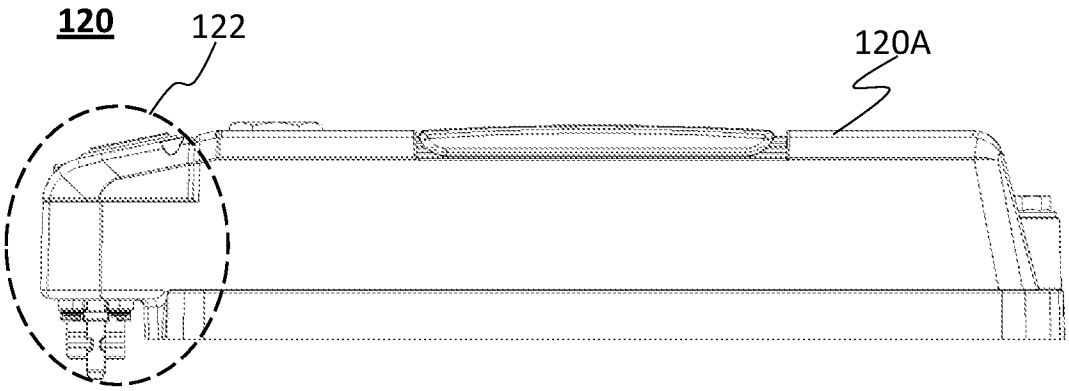


Figure 4

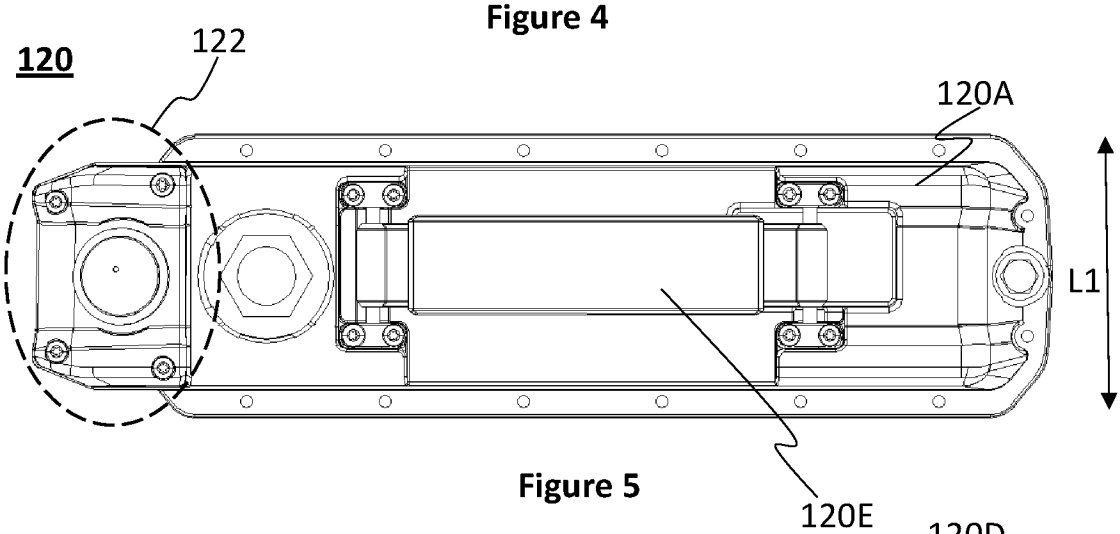


Figure 5

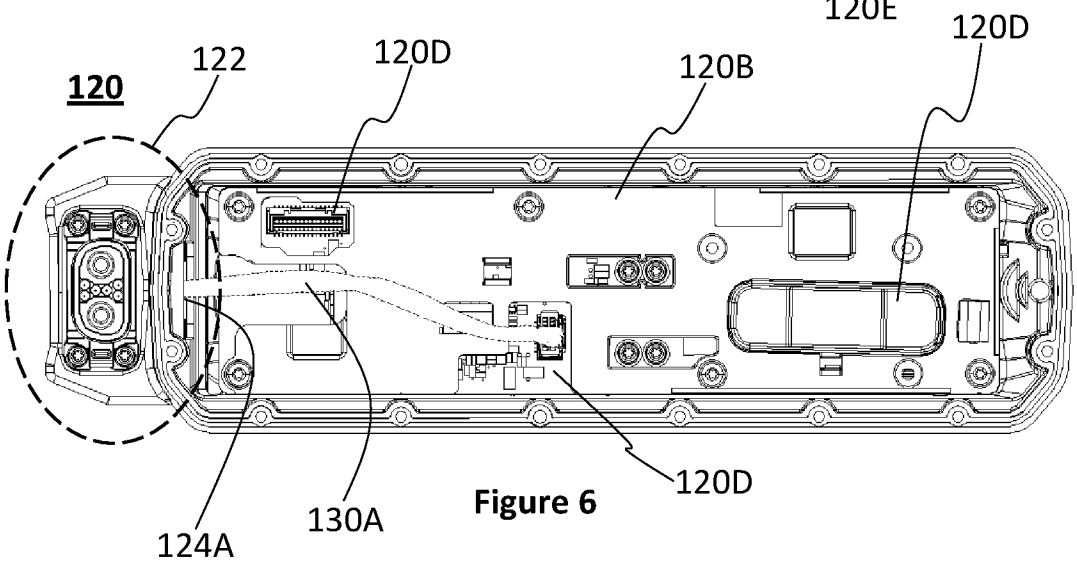
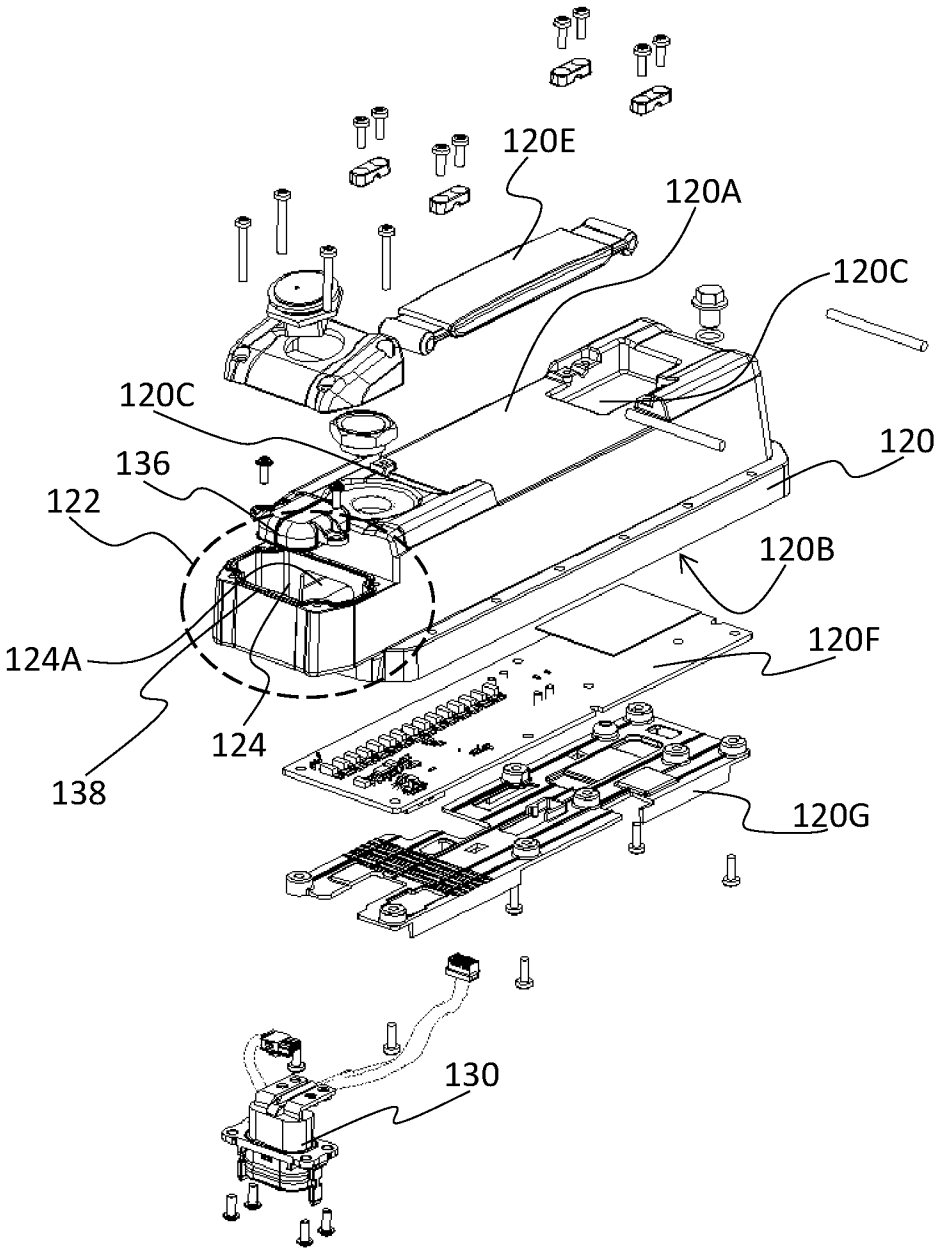


Figure 6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120C
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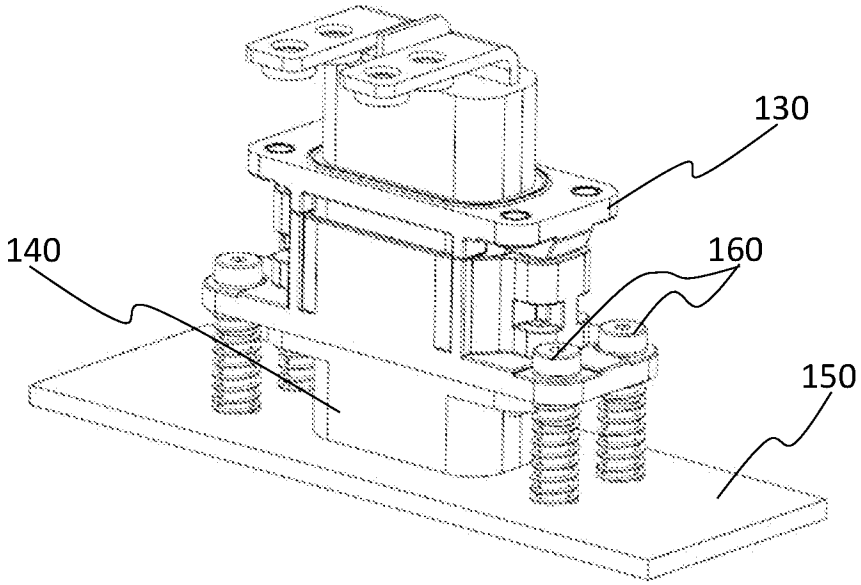
120G
130

Figure 7



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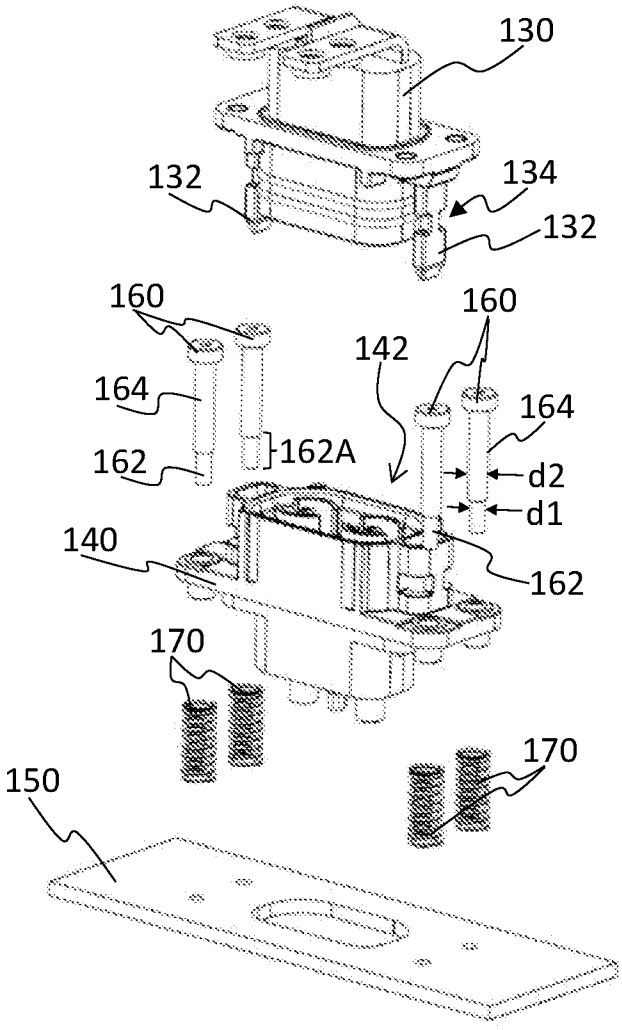
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Figure 9

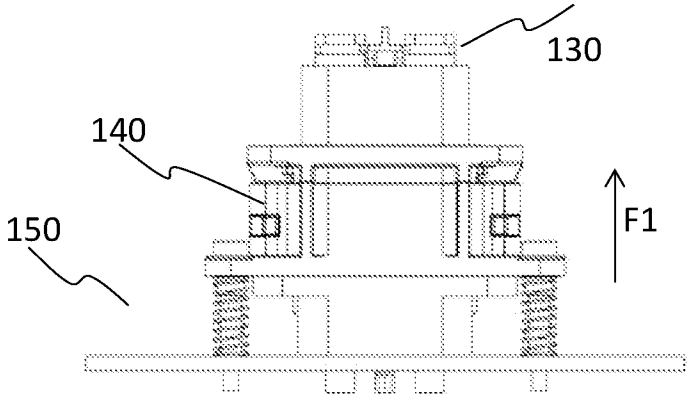

Figure 10

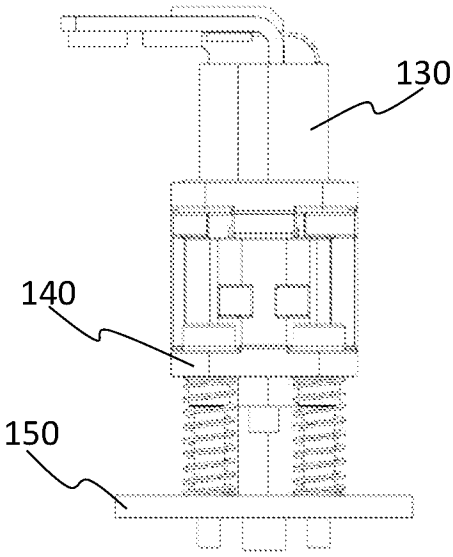

Figure 11

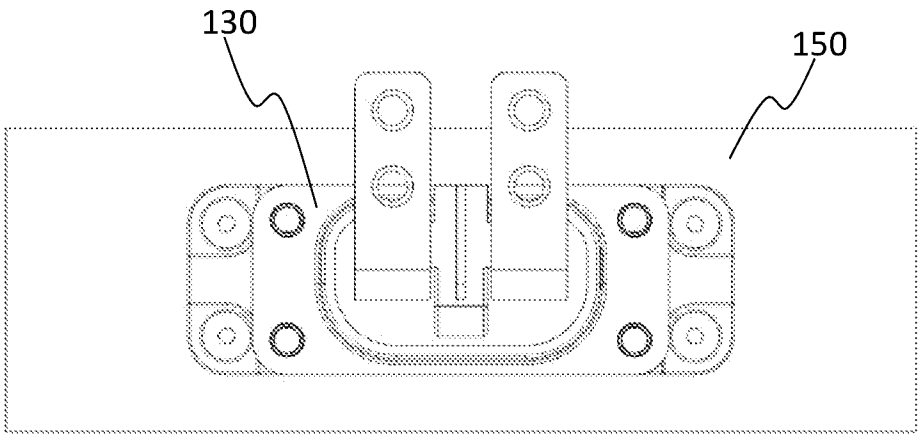

Figure 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2024/050375

A. CLASSIFICATION OF SUBJECT MATTER
H01M10/04,H01M10/058,H01M50/50,B60L53/22 Version=2024.01

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01M,B60L

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

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

PatSeer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP3223338A1 (XING MOBILITY INC) 27 September, 2017(27-09-2017) Abstract, Paragraph [0005, 0010]	1-11
Y	DE102019102016A1 (JUNGHEINRICH AG) 30 July, 2020 (30-07-2020) (English translation from Google Patent) Whole document specifically description	1-11

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23-07-2024	23-07-2024

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Arnab Bhattacharyya Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2024/050375

Citation	Pub.Date	Family	Pub.Date
EP 3223338 A1	27-09-2017	US 10784545 B2	22-09-2020
		TW I604653 B	01-11-2017
		CN 107230750 B	04-03-2022
		JP 6254658 B2	27-12-2017
		KR 101947235 B1	12-02-2019