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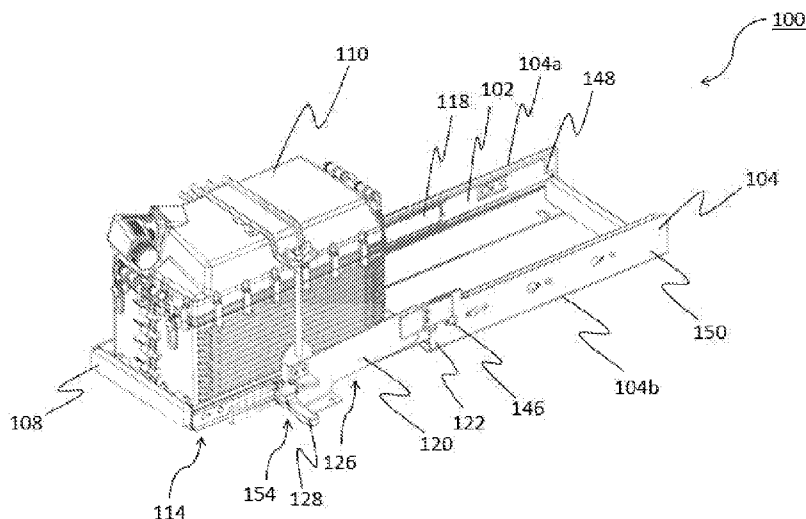


Figure 2

(57) Abstract: Present invention provides support structure (100) for battery pack (110) of vehicle (200). Support structure (100) includes guiderail member (104) mounted on chassis member (204) and tray member (108). Tray member (108) is slidably mounted onto guiderail member (104) and adapted to receive battery pack (110). Tray member (108) is adapted to be operable between closed position (112) and open position (114) along guiderail member (104). In closed position (112) tray member (108) is in-flush configuration with chassis member (204) inhibiting access to battery pack (110) and in open position (114) tray member (108) protrudes from chassis member (204) for enabling access to battery pack (110). Such a construction enables a user to conveniently operate the support structure (100) by bare hands, i.e. without the need for special tools, while mitigating cumbersome dismantling process required for accessing the battery pack (110).

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TITLE OF INVENTION**SUPPORT STRUCTURE FOR A BATTERY PACK OF A VEHICLE****FIELD OF THE INVENTION**

[001] The present invention relates to a support structure for a battery pack of a vehicle.

BACKGROUND OF THE INVENTION

[002] A battery pack is one of the essential components in a powertrain of a vehicle, particularly in electric vehicles. The battery pack generally includes a single battery module or may be a combination of several battery cells adapted to discharge a desired voltage or power for operating the vehicle.

[003] The battery pack being a heavy module is typically mounted via a support structure onto the frame of the vehicle. The battery pack may either be mounted onto a front portion or a rear portion of the vehicle via the support structure. The battery pack mounted at the front or the rear portion of the vehicle may be prone to directly receive impact forces in an event of a vehicle collision. Such impact forces may puncture the batteries in the battery pack which may lead to an explosion, which is hazardous.

[004] To overcome the aforementioned problems, protective frame structures may be provided for the battery pack. The protective frame structure surrounds the battery pack for protection against impact forces in the event of the vehicle collision. The protective frame structure minimizes transfer of the impact forces to the battery pack during the vehicle collision, thereby rendering protection to the battery pack. However, the protective frame structure is generally bulky and cumbersome to operate, while also requiring a substantially large manpower for assembling or dismantling the battery pack therefrom. Also, the

protective frame structure is time consuming and laborious to operate due to surface-to-surface friction between the battery pack and the protective frame structure, resulting in an increased service or maintenance time, which is undesirable.

[005] Additionally, the protective frame structure along with the battery pack is typically mounted either at the front portion or the rear portion of the vehicle. As such, even with the protective frame structure, the battery may be directly exposed to impact forces during the vehicle collision. Also, the battery pack mounted at the front portion requires an increased wiring harness length, which further increases the costs incurred for assembly and maintenance.

[006] Furthermore, the battery pack positioned either at the front portion and the rear portion may not provide an optimal Center of Gravity (CG) to the vehicle, which inherently affects vehicle's maneuverability. This is due to the unstable weight distribution caused by mounting of the battery pack at either the front or the rear portion of the vehicle. As an example, when a three-wheeled cargo vehicle having the battery pack at the rear portion is loaded, the weight of the load and the battery pack creates an imbalance in the vehicle at the rear portion. This results in lift-off of the vehicle during movement, which is undesirable. As such, positioning the battery pack either at the front or the rear portion results in an uneven weight distribution in the vehicle, which affects maneuverability of the vehicle.

[007] In view of the above, there is a need for a support structure for a battery which addresses at least the aforementioned problems.

SUMMARY OF THE INVENTION

[008] In one aspect, a support structure for a battery pack of a vehicle is disclosed. The support structure includes at least one guiderail member mounted on a chassis member of the vehicle and a tray member. The tray member is slidably mounted onto the guiderail member and adapted to receive the battery pack. The tray member is adapted to be operable between a closed position and an open position along the guiderail member. In the closed position, the tray member is in-flush configuration with the chassis member inhibiting access to the battery pack and in the open position the tray member protrudes from the chassis member for enabling access to the battery pack.

[009] In an embodiment of the invention, the guiderail member includes an extendible rail slidably mounted thereon and coupled to the tray member. The extendible rail is adapted to support load of the battery pack on the tray member when the tray member is in the open position.

[010] In an embodiment of the invention, the guiderail member includes a first guiderail member and a second guiderail member. The first and the second guiderail members are oriented parallelly with one another and spaced apart by a distance for accommodating the battery pack.

[011] In an embodiment of the invention, the support structure includes a flap member hingedly connected to a fore end of the second guiderail member. The flap member is operable between a locked condition and an unlocked condition. In the locked condition, the flap member engages with the first guiderail member for securing the tray member in the closed position and in the unlocked condition the flap member is disengaged from the

first guiderail member for allowing movement of the tray member from the closed position to the open position.

[012] In an embodiment of the invention, the support structure includes an adjustable lock clamp defined on the flap member and adapted to engage with a pin member defined on
5 an outer surface of the first guiderail member. The lock clamp engages with the pin member for securing the flap member with the first guiderail member in the locked condition and disengages with the pin member when the flap member is in the unlocked condition.

[013] In an embodiment of the invention, the flap member includes a safety lock defined
10 adjacent to the adjustable lock clamp. The safety lock is configured with a fork like structure adapted to engage with the one of first guiderail member and the second guiderail member at the closed position of the flap member, for preventing unintended actuation of the flap member from the closed position to the open position.

[014] In an embodiment of the invention, the support structure includes a locking unit
15 defined on the tray member. The locking unit is configured to secure the battery pack onto the tray member.

[015] In an embodiment of the invention, the locking unit includes at least one column member extending vertically from a rim surface of the tray member. Each column member includes a first end mounted to the guiderail member and a threaded second end. A battery
20 holding bracket is configured with an aperture for receiving the threaded second end of the column member. The threaded second end received within the aperture is fastened via a fastening member for securing the battery holding bracket with the column member.

[016] In an embodiment of the invention, the support structure includes a cushion member disposed on the tray member for cushioning the battery pack thereon.

[017] In an embodiment of the invention, the guiderail member is mounted behind a passenger compartment and below a loading deck at a central portion of the chassis member.

[018] In an embodiment of the invention, each guiderail member includes a first stopper member defined at the fore end of the guiderail member and a second stopper member defined at an aft end of the guiderail member. The first stopper member and the second stopper member are adapted to restrict movement of the tray member therebetween.

[019] In an embodiment of the invention, the support structure for a battery pack of a vehicle is disclosed. The support structure includes at least one guiderail member mounted behind the passenger compartment and below the loading deck at the central portion of the chassis member of the vehicle. The guiderail member includes the first guiderail member and the second guiderail member. The tray member is slidably mounted onto the guiderail member and adapted to receive the battery pack. The tray member is adapted to be operable between a closed position and an open position along the guiderail member. In the closed position, the tray member is in-flush configuration with the chassis member inhibiting access to the battery pack and in the open position the tray member protrudes from the chassis member for enabling access to the battery pack.

[020] In an embodiment of the invention, a cargo vehicle is disclosed. The vehicle includes the passenger compartment configured on the chassis member. The loading deck is mounted on the chassis member and positioned behind the passenger compartment. Further, the battery pack is mounted behind the passenger compartment and below the

loading deck at a central portion of the chassis member. The support structure is adapted to support the battery pack on the chassis member and is operable between a closed position and an open position. In the closed position, the support structure is in-flush configuration with the chassis member inhibiting access to the battery pack, and in the open position the support structure protrudes from the chassis member for enabling access to the battery pack.

BRIEF DESCRIPTION OF THE DRAWINGS

[021] 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 is a schematic view of a cargo vehicle including a support structure for a battery pack, in accordance with an embodiment of the present invention.

Figure 2 is a perspective view of the support structure for the battery pack in an open position, in accordance with an embodiment of the present invention.

Figure 3 is a schematic view of the support structure, in accordance with an embodiment of the present invention.

Figure 4 is a perspective view of the support structure in a closed position, in accordance with an embodiment of the present invention.

Figure 5 is another perspective view of the support structure, in accordance with an embodiment of the present invention.

Figure 6 is a perspective view of the cargo vehicle depicting the support structure in the open position, in accordance with an embodiment of the present invention.

Figure 7 is a perspective view of the cargo vehicle depicting the support structure in the closed position in accordance with an embodiment of the present invention.

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DETAILED DESCRIPTION OF THE INVENTION

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

[023] In one aspect, the present invention discloses a support structure for a battery pack
10 of a vehicle. The support structure includes at least one guiderail member mounted onto the chassis member. The at least one guiderail member includes a first guiderail member and a second guiderail member, which are parallel with one another and spaced apart suitably by a distance for accommodating the battery pack. A tray member is slidably mounted onto the guiderail member, preferably onto the first and the second guiderail
15 member. The tray member is configured to receive the battery pack and adapted to be operable between a closed position and an open position along the guiderail members. In the closed position, the tray member is in-flush configuration with the chassis member inhibiting access to the battery pack. In the open position, the tray member protrudes from the chassis member for enabling access to the battery pack.

20 [024] Further, the support structure includes a flap member hingedly mounted on the at least one guiderail member. Preferably, the flap member is hingedly connected to a fore end of the second guiderail member. The flap member is operable between a locked condition and an unlocked condition. In the locked condition the flap member engages with

the first guiderail member for securing the tray member in the closed position. In the unlocked condition, the flap member is disengaged from the first guiderail member for allowing movement of the tray member from the closed position to the open position. As such, the flap member prevents accidental or unintended actuation of the tray member from the closed position to the open position. Further, a locking unit is provided on the tray member and is adapted to secure the battery pack thereon. Such a construction of the support structure in the present invention enables a user to conveniently operate the support structure from the closed position to the open position for accessing the battery pack during a requirement. As such, the support structure in the present invention mitigates cumbersome dismantling process required for accessing the battery pack.

[025] Additionally, the present invention discloses a cargo vehicle, having the battery pack positioned behind a passenger compartment and below a loading deck at a central portion of a chassis member of the vehicle. The support structure is provided for supporting the battery pack and is operable between the closed position and the open position. In the closed position, the support structure is in-flush configuration with the chassis member inhibiting access to the battery pack. In the open position, the support structure protrudes from the chassis member for enabling access to the battery pack. Such a construction of the support structure and its location on the vehicle, reduces transfer of impact forces onto the battery pack during a vehicle collision, thereby ensuring vehicle safety. Additionally, due to the location of the support structure and the battery pack, the weight distribution between a front portion and a rear portion of the vehicle is balanced, thereby enhancing maneuverability of the vehicle.

[026] Figure 1 illustrates an exemplary cargo vehicle 200, in accordance with an embodiment of the invention. The cargo vehicle 200 has an Internal combustion (IC) engine (not shown) or an electric powertrain (not shown) for driving the cargo vehicle 200. The cargo vehicle 200 has a front wheel 210, a rear wheel 212, a chassis member 204, a seat assembly 216 and a fuel tank (not shown). The IC engine may be disposed on the chassis member 204 under the seat assembly 216. The chassis member 204 includes a pair of long members 218 [for e.g. as shown in Figure 6] that extend in a vehicle front-rear direction of the vehicle 200. The pair of long members 218 extend in the vehicle front-rear direction substantially parallelly to each other. The chassis member 204 further has one or more cross members (not shown) that extend transversely between the pair of long members 218. A head pipe (not shown) supports a steering shaft and front suspensions attached to the steering shaft through a lower bracket. The front suspensions support the front wheel 210. The upper portion of the front wheel 210 is covered by a front fender 220 mounted to the lower portion of the front suspensions at the end of the steering shaft. A handlebar 222 is fixed to upper bracket and can rotate to both sides.

[027] A front portion of the chassis member 204 supports a plurality of body panels to form a passenger compartment 202, wherein the seat assembly 216 and the handlebar 222 are disposed inside the passenger compartment 202. A headlight 224 is provided on a front face of the passenger compartment 202. A pair of swing arms 226 are configured to extend rearwardly from the chassis member 204 and support a pair of rear wheels 212. Generally, the swing arms 226 are further supported by a dual rear suspension (not shown). Each of the rear wheels 212 are covered by a rear fender 228 that is disposed above each of the rear wheels 212. In an embodiment, the rear wheels 212 rotate by the

driving force of the Internal combustion engine transmitted from a differential unit of the IC engine through propeller shafts [not shown in Figures].

[028] The cargo vehicle 200 further has a loading deck 208 that is hingedly mounted on the chassis member 204. In an embodiment, the chassis member 204 has at least one rear longitudinal member such that the loading deck 208 is hingedly mounted on the rear longitudinal member. The loading deck 208 is configured to be operable between a lowered position and a raised position, wherein the loading deck 208 hinges about the chassis member 204, for allowing loading and unloading of goods and/or cargo on the loading deck 208.

[029] Further, the cargo vehicle 200 includes a battery pack 110, which is adapted to operate the power train. The battery pack 110 includes a single battery or a plurality of batteries assembled into a single unit. The battery pack 110 is supported onto the chassis member 204 via a support structure 100. The support structure 100 is adapted to enable a user or an operator to conveniently access the battery pack 110 mounted on the vehicle 200.

[030] Referring to Figure 2 in conjunction with Figure 1, the support structure 100 of the battery pack 110 is depicted. The support structure 100 is adapted to support the battery pack 110 onto the chassis member 204. The support structure 100 is operable between a closed position 112 [for e.g. as shown in Figure 7] and an open position 114 [for e.g. as shown in Figure 6]. In the closed position 112, the support structure 100 is in-flush configuration with the chassis member 204, thereby inhibiting access to the battery pack 110. In the open position 114, the support structure 100 protrudes from the chassis member 204 for enabling access to the battery pack 110. Such a construction of the

support structure 100 ensures minimal effort from the user for accessing and/or handling the battery pack 110.

[031] In an embodiment, the support structure 100 is configured to protrude along sides of the vehicle 200 in the open position 114. In other words, the support structure 100 is configured to protrude from either a right side and/or a left side of the vehicle 200 in the open position 114. Alternatively, the support structure 100 is configured to protrude either from a front side or a rear side of the vehicle 200 in the open position 114 as per requirement.

[032] In an embodiment, two battery packs 110 are provided [for e.g. as shown in Figures 6 and 7] in order to meet power requirements of the vehicle 200. In the present embodiment, a first battery pack 110a is mounted on the right side of the vehicle 200, while a second battery pack 110b is mounted on the left side of the vehicle 200. Accordingly, support structure 100 is provided for each of the battery packs 110a, 110b. However, the support structure 100 mounted to each of the battery packs 110a, 110b is referred and described as a single unit for the sake of simplicity in the present disclosure.

[033] The support structure 100 includes at least one guiderail member 104 mounted on the chassis member 204. The guiderail member 104 is mounted behind the passenger compartment 202 and below the loading deck 208 at a central portion 206 of the chassis member 204. In an embodiment, the central portion 206 is a middle portion of the chassis member 204 along the front-rear direction. A tray member 108 is slidably mounted onto the guiderail member 104 and is adapted to receive and/or support the battery pack 110. Due to the location of the guiderail member 104, the battery pack 110 is also positioned behind the passenger compartment 202 and below the loading deck 208 at the central portion 206

of the chassis member 204. Such a position of the battery pack 110 receives reduced impact force in the event of a vehicle collision, as compared to the front portion or the rear portion of the vehicle 200, thereby ensuring safety of the battery pack 110 and hence the vehicle 200.

5 [034] Referring to Figure 3 in conjunction with Figure 2, the tray member 108 includes a base surface 108a for receiving and resting the battery pack 110. A raised rim surface 108b is provided along the periphery of the base surface 108a for holding the battery pack 110 in place. As such, the base surface 108a along with the rim surface 108b provides necessary support for receiving and supporting the battery pack 110 thereon. The
10 dimensions of the base surface 108a are selected to enable resting of the battery pack 110 thereon, while the dimensions of the rim surface 108b are selected for holding of the battery pack 110 on the base surface 108a. Also, the base surface 108a and the rim surface 108b are made of a single-mold material or by integrating a plurality of bracket members 106 as per design feasibility and requirement. As an example, the base surface
15 108a is formed by linking of the plurality of bracket members 106 positioned strategically along the length. Such a construction ensures that the base surface 108a is light in weight, while maintaining the structural rigidity required for supporting the battery pack 110 thereon.

[035] In an embodiment, the tray member 108 is made of a metallic material, a non-
20 metallic material or a composite material adapted for receiving and supporting the battery pack 110. Accordingly, the base surface 108a and the rim surface 108b are made of the metallic material, the non-metallic material or the composite material as per requirement.

[036] Additionally, a cushion member 144 [for e.g. as shown in Figure 3] is disposed on the tray member 108, optionally on the base member 108a for cushioning the battery pack 110 thereon. The cushion member 144 is be provided on the rim surface 108b for cushioning the battery pack 110. The cushion member 144 also acts as a protective layer, by dampening vibrations transmitted to the battery pack 110 from the tray member 108 during movement of the vehicle 200. The cushion member 144 is made of a plastic material such as a polystyrene material, a polyurethane material and the like as per design feasibility and requirement.

[037] Further, the rim surface 108b of the tray member 108 is slidably mounted onto the at least one guiderail member 104 [for e.g. as shown in Figure 2] and is operable between the closed position 112 [for e.g. as shown in Figure 4] and the open position 114 along the guiderail member 104. The position of the tray member 108 also corresponds to the position of the support structure 100. That is, in the closed position 112, the tray member 108 is in-flush configuration with the chassis member 204 inhibiting access to the battery pack 110 to the user. While in the open position 114, the tray member 108 protrudes away from the chassis member 204 for enabling access of the battery pack 110 to the user.

[038] Alternatively, the base surface 108a may be slidably mounted onto the at least one guiderail member 104, instead of the rim surface 108b, for slidably operating the tray member 108 between the open position 114 and the closed position 112. Hence, either the base surface 108a or the rim surface 108b are slidably mounted onto the at least one guiderail member 104, so that the tray member 108 is slidably operable thereon.

[039] In an embodiment, the alignment of the guiderail member 104 with the chassis member 204 defines the direction of protrusion of the tray member 104. In other words, the

guiderail member 104 is aligned on the chassis member 204 such that, the tray member 108 is guided to protrude on one of the right side, the left side, the front side and the rear side of the vehicle 200.

[040] In an embodiment, the at least one guiderail member 104 includes a first guiderail member 104a and a second guiderail member 104b. The first and the second guiderail members 104a, 104b are oriented parallel to one another while also being spaced apart by a distance for accommodating the battery pack 110. As such, the distance between the first and the second guiderail members 104a, 104b corresponds to a width of the battery pack 110. Further, each of the first and the second guiderail members 104a, 104b include a corresponding track 102 on their inner surface. The track 102 on the first and the second guiderail members 104a, 104b engage with the rim surface 108b for slidably receiving the tray member 108. As such, the tray member 108 is operable between the open position 114 and the closed position 112 along the first and the second guiderail members 104a, 104b. The track 102 also prevents misalignment of the tray member 108 with the guiderail members 104a, 104b, facilitating ease of movement therebetween.

[041] In an embodiment, the alignment of the guiderail member 104 with the chassis member 204 or configuration of the track 102 on the guiderail member 104 defines the direction of movement of the tray member 104. In other words, the guiderail member 104 or the track 102 is aligned on the chassis member 204 such that, the tray member 108 may be guided to protrude on one of the right side, the left side, the front side and the rear side of the vehicle 200. Alternatively, the guiderail member 104 or the track 102 is inclined with respect to the chassis member 204 so that the tray member 108 is guided to protrude at an angle [not shown in Figures] on one of the right side, the left side, the front side and the

rear side of the vehicle 200. Such a construction, where the tray member 108 protrudes out of the vehicle 200 provides an additional leverage for the user to remove or assemble the battery pack 110 from the support structure 100.

[042] Further, the guiderail member 104 is defined with a first stopper member 146 at its fore end 122 and a second stopper member 148 at its aft end 150 [for e.g. as shown in Figure 2]. In other words, each of the first and the second guiderail members 104a, 104b are defined with the first stopper member 146 at their fore ends 122 and the second stopper member 148 at their aft ends 150. The first and the second stopper members 146, 148 are adapted to restrict movement of the tray member 108 therebetween, thereby preventing possibility of the tray member 108 being ejecting out of the guiderail members 104a, 104b during operation. In an embodiment, the first and the second stopper members 146, 148 are an engraved projection, or a protrusion provided in the track 102 of the first and the second guiderail member 104a, 104b, which engages with the rim surface 108b of the tray member 108. The engagement of the rim surface 108b with the first and the second stopper member 146, 148 restricts further movement of the tray member 108 thereon.

[043] In an embodiment, the rim surface 108b may be mounted onto the track 102 of the first and the second guiderail members 104, 104b via engagement members [not shown in Figures]. The engagement members may facilitate sliding movement of the tray member 108 along the first and the second guiderail members 104a, 104b by reducing friction between the contact surfaces. As an example, the engagement members may be roller members [not shown in Figures]. Alternatively, the engagement members are bearing

surfaces defined on the rim surface 108b. The bearing surfaces are directly mounted onto the track 102 of the guiderail members 104a, 104b for relative movement therebetween.

[044] Further, the support structure 100 includes an extendible rail 118 slidably mounted onto at least one of the guiderail members 104a, 104b while being fixedly mounted to the tray member 108. As such, the extendible rail 118 also slides along the guiderail members 104a, 104b with the tray member 108 upon actuation. The extendible rail 118 is mounted by conventional mounting techniques known in the art such as snap fitting, fastening and the like. In an embodiment, the extendible rail 118 is slidably mounted onto the guiderail members 104a, 104b by the engagement members similar to the rim surface 108b for facilitating sliding movement therebetween. Alternatively, extendible rail 118 includes bearing surfaces [not shown in Figures] that are directly mounted onto the track 102 of the guiderail members 104a, 104b for relative movement therebetween.

[045] In an embodiment, the extendible rail 118 is a rail member mounted telescopically onto each of the guiderail member 104. The extendible rail 118 is adapted to provide reinforcement to the tray member 108 for supporting the load of the battery pack 110, particularly when the tray member 108 is in the open position 114. In the present embodiment, the extendible rail 118 is made of metallic material, or non-metallic material or composite materials which can withstand the load thereon.

[046] The support structure 100 includes a locking unit 116 provided on the tray member 108. The locking unit 116 is adapted to secure the battery pack 110 onto the tray member 108. The locking unit 116 includes at least one column member 134 extending vertically from the rim surface 108b, optionally from a central portion 136 [for e.g. as shown in Figure 3] of the rim surface 108b. Each column member 134 includes a first end 134a mounted to

the guiderail member 104 and a threaded second end 134b. In an embodiment containing the first and the second guiderail members 104a, 104b, two column members 134 may be provided [for e.g. as shown in Figure 3].

[047] The locking unit 116 further includes a battery holding bracket 138 mounted onto the
5 battery pack 110. The battery holding bracket 138 includes aperture 140 adapted to receive the threaded second end 134b. A fastening member 142, optionally a wingnut, is provided for fastening the threaded second end 134b. Fastening of the threaded second end 134b upon insertion into the aperture 140, secures the battery pack 110 onto the tray member 108. Such a construction enables the user to readily unlock the locking unit 116 by
10 bare hands, without the need for special tools. Accordingly, making the process of removing or assembling the battery effortless and timesaving. In an embodiment, the column member 134 and the battery holding bracket 138 are made of metallic material, or non-metallic material or composite materials which can secure the battery pack 110 onto the tray member 108.

15 [048] Referring to Figure 4, the support structure 100 includes a flap member 120 disposed on at least one guiderail member 104. The flap member 120 is operable between a locked condition 124 and an unlocked condition 126 [for e.g. as shown in Figure 2]. Accordingly, the flap member 120 may be adapted to selectively allow movement of the tray member 108 from the closed position 112 to the open position 114. That is, in the
20 locked condition 124, the flap member 120 secures the tray member 108 in the closed position 112. In the unlocked condition 126, the flap member 120 allows movement of the tray member 108 from the closed position 112 to the open position 114.

[049] In an embodiment, the flap member 120 has one end 120a hingedly connected to the fore end 122 of the second guiderail member 104b, while the other end 120b is adapted to engage with the first guiderail member 104a. The other end 120b is adapted to engage with the first guide rail member 104a in the locked condition 124 of the flap member 120. Hence, the flap member in the unlocked condition 126 is disengaged from the first guiderail member 104a, thereby permitting movement of the tray member 108 from the closed position 112 to the open position 114. In the locked condition 124, the flap member 120 is hingedly operated about the fore end 122, so that the other end 120b engages with the first guiderail member 104a. It is pertinent to note that, the flap member 120 is operated to the locked condition 124 only when the tray member 108 is in the closed position 112.

[050] The flap member 120 also includes an adjustable lock clamp 128 defined on the other end 120b of the flap member 120 for engagement with the first guiderail member 104a. The adjustable lock clamp 128 includes a lever member 128a coupled to a movable clasp member 128b. The clasp member 128b is adapted to engage with a pin member 130 defined on an outer surface of the first guiderail member 104a, upon actuation of the lever member 128a to an engaged position 152 [for e.g. as shown in Figures 3 and 5]. The clasp member 128b is adapted to disengage with the pin member 130 upon actuation of the lever member 128a to a disengaged position 154 [for e.g. as shown in Figure 2]. Hence, the adjustable lock clamp 128 engages with the pin member 130 in the locked condition 124 of the flap member 120, for securing the flap member 120 with the first guiderail member 104a. The adjustable lock clamp 128 disengages with the pin member 130 in the unlocked condition 126 of the flap member 120. In an embodiment, the adjustable lock clamp 128 is

one of a latch clamp, a push-pull toggle clamp or any other fastening mechanism which enables to selectively secure the flap member 120 in the locked condition 124. In another embodiment, the adjustable lock clamp 128 engages with the pin member 130 or a groove [not shown in Figures] provided on the first guiderail member 104a as per configuration of the clamp selected.

[051] In an alternate embodiment, the flap member 120 is mounted onto the first guiderail member 104a and adapted to engage with the second guiderail member 104b. As such, the flap member 120 is configured to engage with the second guiderail member 104b instead of the first guiderail member 104a [for e.g. as shown in Figure 5].

[052] Additionally, the flap member 120 includes a safety lock 132 provided adjacent to the adjustable lock clamp 128. The safety lock 132 is configured with a fork-like structure 156 adapted to engage with the first guiderail member 104a [for e.g. as shown in Figure 4] or the second guiderail member 104b [for e.g. as shown in Figure 5], when the flap member 120 is at the locked condition. Engagement of the fork-like structure 156 with the first guiderail member 104a or the second guiderail member 104b prevents unintended actuation of the flap member 120. Consequently, preventing accidental operation of the tray member 108 to the open condition 114. The fork-like structure 156 conforms to a c-shaped structure which engages with a bracket member 158 [for e.g. as shown in Figure 5] extending from one of the first guiderail member 104a or the second guiderail member 104b. Upon engagement, the fork-like structure 156 prevents further movement of the flap member 120 from the locked condition 124 to the unlocked condition 126, thereby preventing unintended actuation.

[053] In an embodiment, the term guiderail member 104 includes plurality of rail member adapted to receive and guide the tray member 108.

[054] In an operational embodiment, the user reaches out to the support structure 100 provided at the central portion 206 of the chassis member 204 for accessing the battery pack 110. The user may firstly operate the flap member 120 to disengaged position 154 and thereafter slide the tray member 108 from the closed position 112 to the open position 114. Subsequently, the user may unfasten the fastening member 142 to unlock the locking unit 116, for accessing the battery pack 110. Upon accessing, the user may inspect the battery pack 110 either for replacement or maintenance as per requirement.

[055] Upon inspection, the user may place the battery pack 110 onto the tray member 108. Subsequently, the user aligns the battery holding bracket 138 with the threaded second end 148 and thereafter fastens the fastening member 142 to the threaded second end 148. Upon fastening, the tray member 108 is slidably operated to the closed position 112 from the open position 114 by the user. Thereafter, the flap member 120 is engaged with the guiderail member 104 via the adjustable lock clamp 128, optionally the first guiderail member 104, for securing the tray member 108.

[056] Advantageously, such a construction of the support structure 100 facilitates its actuation by bare hands, *i.e.* without the need for special tools, while mitigating cumbersome dismantling process required for accessing the battery pack [which is present in conventional support structure]. Also, location of the support structure 100 on the vehicle 200, reduces transfer of impact forces onto the battery pack during a vehicle collision, thereby ensuring vehicle safety. Additionally, due to the location of the support structure and the battery pack 110, the weight distribution between a front portion and a rear portion

of the vehicle 200 is balanced, thereby enhancing maneuverability of the vehicle 200. Further, the support structure 100 is adapted to protrude out of the vehicle 200 in its open position 114, which provides an additional leverage for the user to remove or assemble the battery pack 110 from the support structure 100.

5 [057] 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.

10 REFERENCE NUMERALS

- 100 - Support structure
- 102 - Track on guiderail member
- 104 - Guiderail member
- 104a - First guiderail member
- 104b - Second guiderail member
- 106 - Plurality of brackets
- 108 - Tray member
- 108a - Base surface
- 108b - Rim surface
- 110 - Battery pack
- 110a - First battery pack
- 110b - Second battery pack
- 112 - Closed position
- 114 - Open position
- 116 - Locking unit
- 118 - Extendible rail
- 120 - Flap member

- 120a - One end of the flap member
- 120b - Other end of the flap member
- 122 - Fore end of guiderail member
- 124 - Locked condition
- 126 - Unlocked condition
- 128 - Adjustable lock clamp
- 128a - Lever member
- 128b - Movable clasp member
- 130 - Pin member
- 132 - Safety lock
- 134 - Column member
- 134a - First end of column member
- 134b - Threaded second end of column member
- 136 - Central portion of the rim surface
- 138 - Battery holding bracket
- 140 - Aperture on battery holding bracket
- 142 - Fastening member
- 144 - Cushion member
- 146 - First stopper member
- 148 - Second stopper member
- 150 - Aft end of guiderail member
- 152 - Engaged position of lever member
- 154 - Disengaged position of lever member
- 156 - Fork-like structure of safety lock
- 158 - Bracket member
- 200 - Cargo vehicle
- 202 - Passenger compartment
- 204 - Chassis member
- 206 - Central portion of chassis member
- 208 - Loading deck
- 210 - Front wheel

- 212 - Rear wheel
- 216 - Seat assembly
- 218 - Long members
- 220 - Front fender
- 222 - Handlebar
- 224 - Headlight
- 226 - Swing arms
- 228 - Rear fender

CLAIMS:

1. A support structure (100) for a battery pack (110) of a vehicle (200), comprising:
at least one guiderail member (104) mounted on a chassis member (204) of the vehicle (200); and
5 a tray member (108) slidably mounted onto the guiderail member (104) and adapted to receive the battery pack (110), the tray member (108) adapted to be operable between a closed position (112) and an open position (114) along the guiderail member (104);
wherein in the closed position (112) the tray member (108) is in-flush configuration with the chassis member (204) inhibiting access to the battery pack (110), and in the open
10 position (114) the tray member (108) protrudes from the chassis member (204) for enabling access to the battery pack (110).
2. The support structure (100) as claimed in claim 1, wherein the guiderail member (104) comprises an extendible rail (118) slidably mounted thereon and coupled to the tray
15 member (108), the extendible rail (118) adapted to support load of the battery pack (110) on the tray member (108), when the tray member (108) is in the open position (114).
3. The support structure (100) as claimed in claim 1, wherein the guiderail member (104)
20 comprises a first guiderail member (104a) and a second guiderail member (104b), the first guiderail member (104a) and the second guiderail member (104b) being oriented parallelly with one another and spaced apart by a distance for accommodating the battery pack (110).

4. The support structure (100) as claimed in claim 3 comprises a flap member (120) hingedly connected to a fore end (122) of the second guiderail member (104b), the flap member (120) operable between a locked condition (124) and an unlocked condition (126),

wherein in the locked condition (124) the flap member (120) engages with the first guiderail member (104a) for securing the tray member (108) in the closed position (112) and in the unlocked condition (126) the flap member (120) is disengaged from the first guiderail member (104a) for allowing movement of the tray member (108) from the closed position (112) to the open position (114).

5. The support structure (100) as claimed in claim 4 comprises an adjustable lock clamp (128) defined on the flap member (120) and adapted to engage with a pin member (130) defined on an outer surface of the first guiderail member (104a),

wherein the adjustable lock clamp (128) engages with the pin member (130) for securing the flap member (120) with the first guiderail member (104a) in the locked condition (124) and disengages with the pin member (130) when the flap member (120) is in the unlocked condition (126).

6. The support structure (100) as claimed in claim 5, wherein the flap member (120) comprises a safety lock (132) defined adjacent to the adjustable lock clamp (128), the safety lock (132) configured with a fork like structure (156) adapted to engage with the one of first guiderail member (104a) and the second guiderail member (104b) at the

closed position (112) for preventing unintended actuation of the flap member (120) from the closed position (112) to the open position (114).

7. The support structure (100) as claimed in claim 1 comprises a locking unit (116) defined
5 on the tray member (108), the locking unit (116) configured to secure the battery pack (110) onto the tray member (108).

8. The support structure (100) as claimed in claim 7, wherein the locking unit (116) comprises:

10 at least one column member (134) extending vertically from a rim surface (108b) of the tray member (108), each column member (134) including a first end (134a) mounted to the guiderail member (104) and a threaded second end (134b); and

a battery holding bracket (138) configured with an aperture (140) for receiving the threaded second end (134b) of the column member (134), wherein the threaded second
15 end (134b) received within the aperture (140) is fastened via a fastening member (142) for securing the battery holding bracket (138) with the column member (134).

9. The support structure (100) as claimed in claim 1 comprises a cushion member (144) disposed on the tray member (108) for cushioning the battery pack (110) thereon.

20 10. The support structure (100) as claimed in claim 1, wherein the guiderail member (104) is mounted behind a passenger compartment (202) and below a loading deck (208) at a central portion (206) of the chassis member (204).

11. The support structure (100) as claimed in claim 1, wherein each guiderail member (104) includes a first stopper member (146) defined at the fore end (122) of the guiderail member (104) and a second stopper member (148) defined at an aft end (150) of the guiderail member (104), the first stopper member (146) and the second stopper member (148) adapted to restrict movement of the tray member (108) therebetween.

12. A support structure (100) for a battery pack (110) of a vehicle (200), comprising:
at least one guiderail member (104) mounted behind a passenger compartment (202) and below a loading deck (208) at a central portion (206) of a chassis member (204) of the vehicle (200), the guiderail member including a first guiderail member (104a) and a second guiderail member (104b); and
a tray member (108) slidably mounted onto the guiderail member (104) and adapted to receive the battery pack (110), the tray member (108) adapted to be operable between a closed position (112) and an open position (114) along the guiderail member (104);
wherein in the closed position (112) the tray member (108) is in-flush configuration with the chassis member (204) inhibiting access to the battery pack (110), and in the open position (114) the tray member (108) protrudes from the chassis member (204) for enabling access to the battery pack (110).

13. The support structure (100) as claimed in claim 12 comprises a flap member (120) hingedly connected to a fore end (122) of the second guiderail member (104b), the flap

member (120) operable between a locked condition (124) and an unlocked condition (126),

wherein in the locked condition (124) the flap member (120) engages with the first guiderail member (104a) for securing the tray member (108) in the closed position (112) and in the unlocked condition (126) the flap member (120) is disengaged from the first guiderail member (104a) for allowing movement of the tray member (108) from the closed position (112) to the open position (114).

14. The support structure (100) as claimed in claim 12 comprises a locking unit (116) defined on the tray member (108), the locking unit (116) configured to secure the battery pack (110) onto the tray member (108).

15. A cargo vehicle (200), comprising:

a passenger compartment (202) configured on a chassis member (204);

a loading deck (208) mounted on the chassis member (204) and positioned behind the passenger compartment (202);

a battery pack (110) mounted behind the passenger compartment (202) and below the loading deck (208) at a central portion (206) of the chassis member (204); and

a support structure (100) adapted to support the battery pack (110) on the chassis member (204), the support structure (100) operable between a closed position (112) and an open position (114),

wherein in the closed position (112) the support structure (100) is in-flush configuration with the chassis member (204) inhibiting access to the battery pack (110), and in the

open position (114) the support structure (100) protrudes from the chassis member (204) for enabling access to the battery pack (110).

16. The cargo vehicle (200) as claimed in claim 15, wherein support structure (100)

5 comprises:

at least one guiderail member (104) comprising a first guiderail member (104a) and a second guiderail member (104b);

a tray member (108) slidably mounted onto the guiderail member (104) and adapted to receive the battery pack (110), the tray member (108) operable along the guiderail member (104) for actuating the support structure (100) between the closed position (112) and the open position (114);

a flap member (120) hingedly connected to a fore end (122) of the second guiderail member (104b), the flap member (120) operable between a locked condition (124) and an unlocked condition (126),

15 wherein in the locked condition (124) the flap member (120) engages with the first guiderail member (104a) for securing the tray member (108) in the closed position (112) and in the unlocked condition (126) the flap member (120) is disengaged from the first guiderail member (104a) for allowing movement of the tray member (108) from the closed position (112) to the open position (114); and

20 a locking unit (116) defined on the tray member (108), the locking unit (116) configured to secure the battery pack (110) onto the tray member (108).

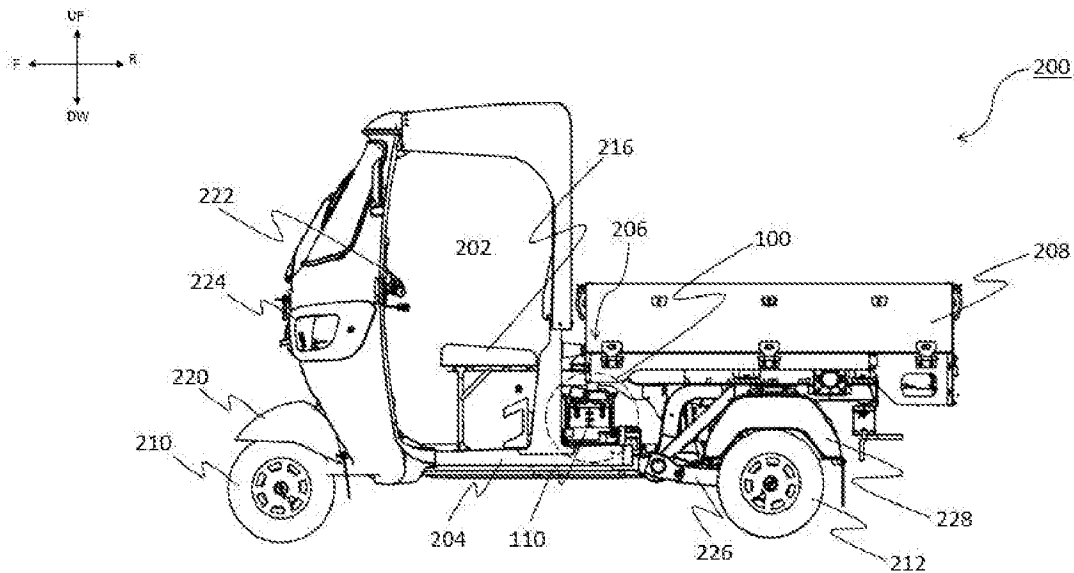


Figure 1

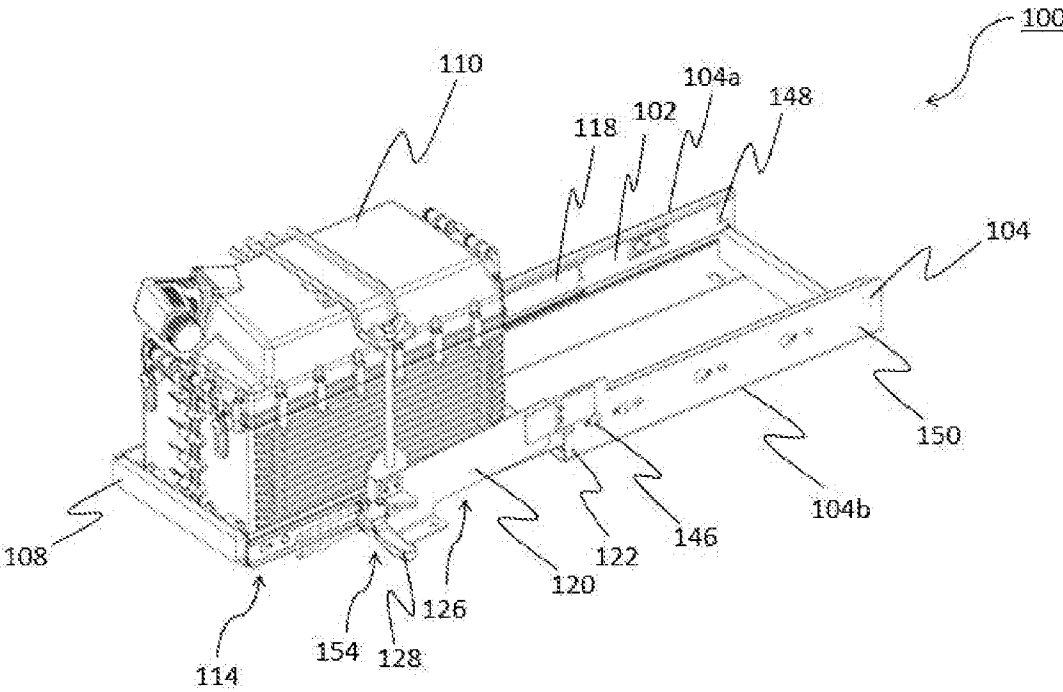


Figure 2

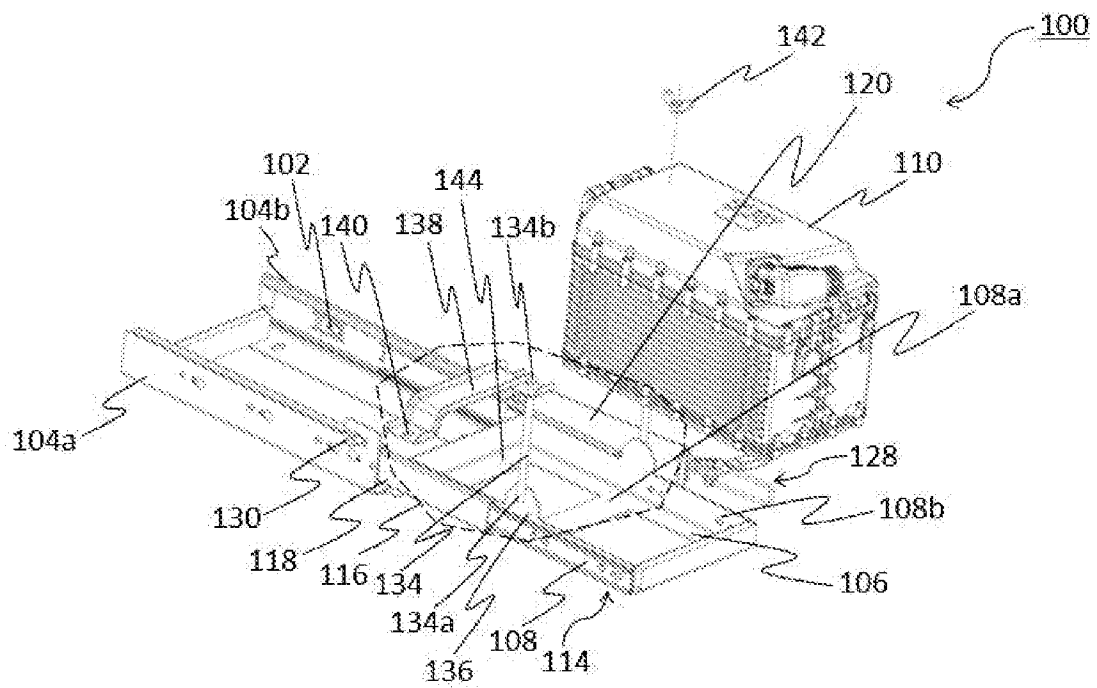


Figure 3

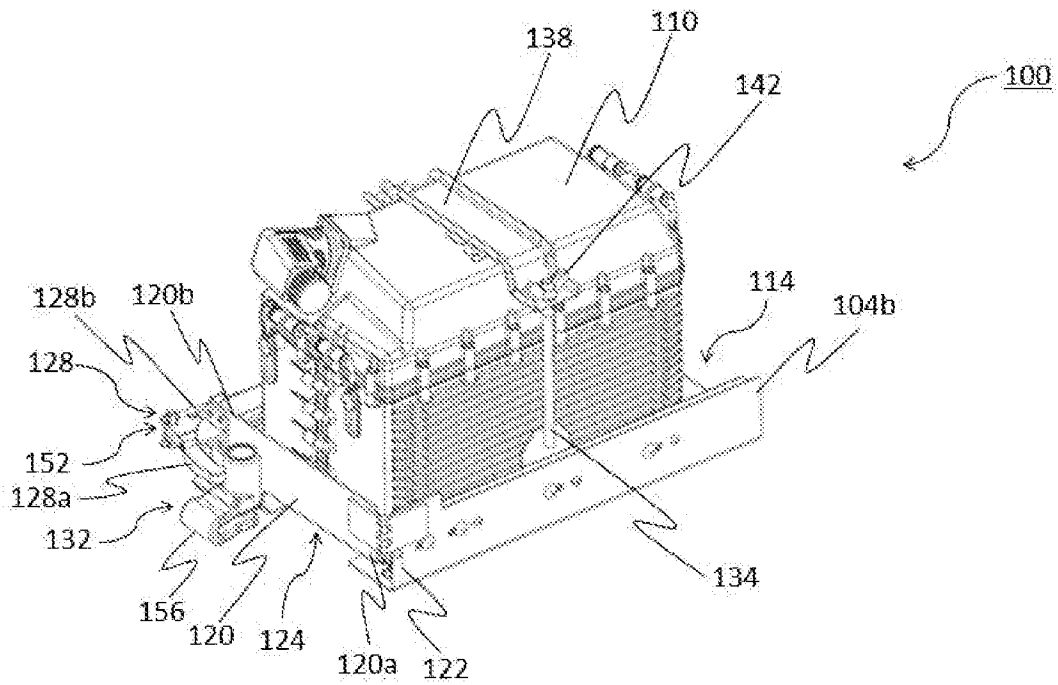
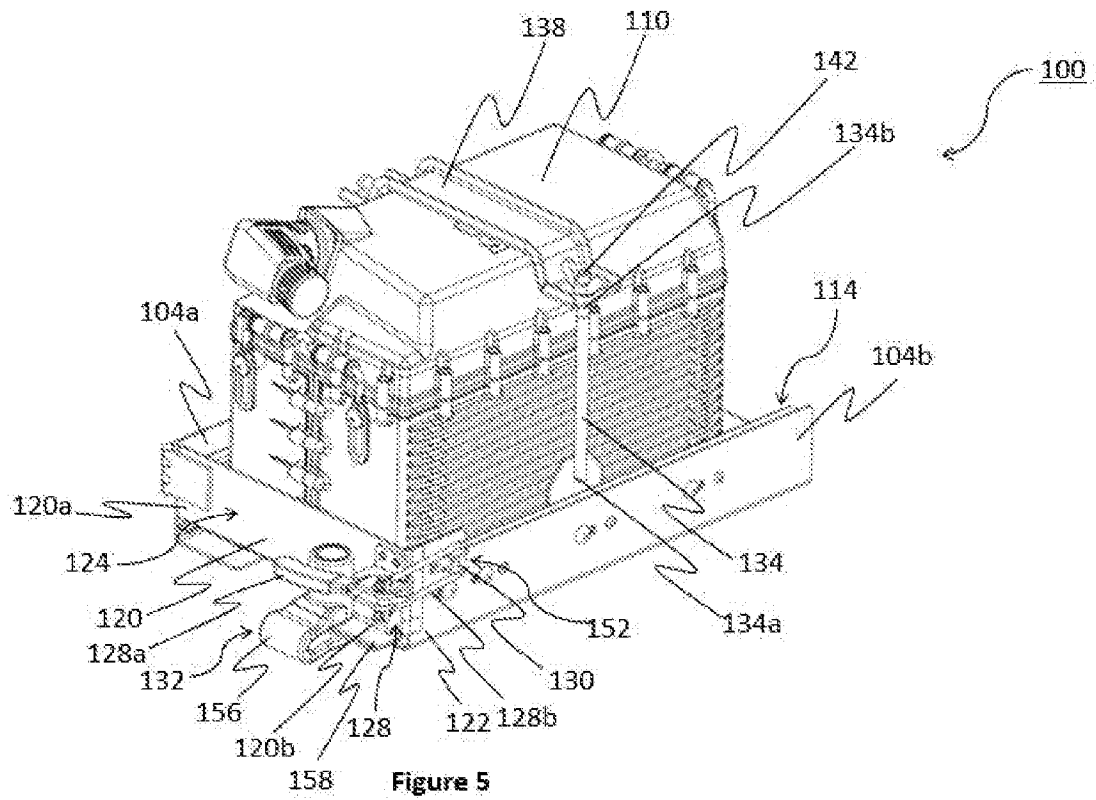


Figure 4



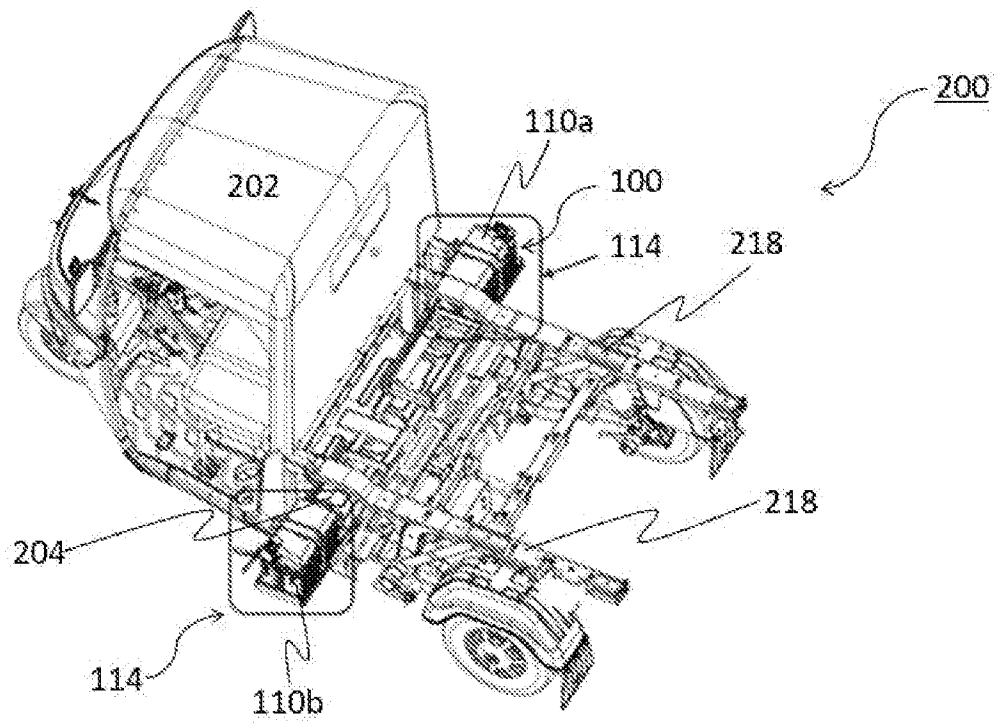


Figure 6

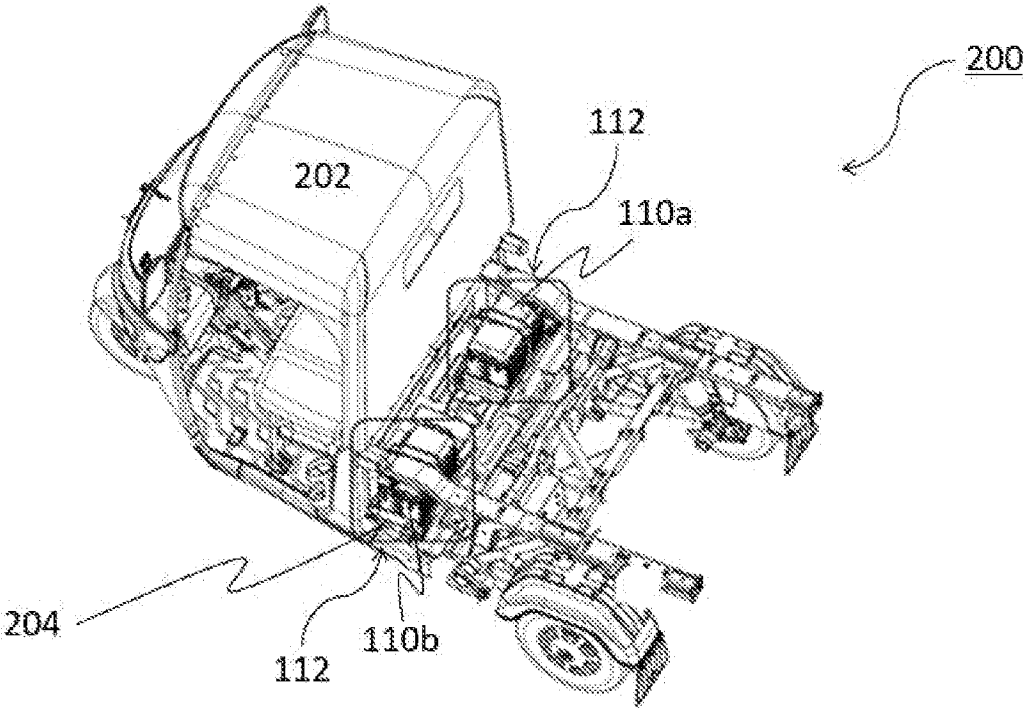


Figure 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2022/050431

A. CLASSIFICATION OF SUBJECT MATTER
B60K1/04, H01M50/20 Version=2022.01

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)

B60K

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

Electronic data base consulted during the international search (name of data base 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.
X	CN208993480U (HENAN SENYUAN HEAVY INDUSTRY CO LTD) 18 June 2019 Para 0009 to para 0031 and claims 1-8 as per english translation available on Espacenet	1-16

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

* Special categories of cited documents:

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"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

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"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

22-08-2022

Date of mailing of the international search report

22-08-2022

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