system and is tedious and a time consuming process. In some cases, the locking device consists of numerous components and parts which increase both the cost of manufacture and difficulty of assembly. In other cases, special tools and/or skill is required to assemble the battery pack. In still other cases, there is no reliable way to fixedly attach the securing device to the battery compartment of the vehicle so as to prevent access to and removal of the battery pack from the vehicle. In yet other cases, the securing device fitted loosely to the battery pack, may generate rattling and bumping sounds when the vehicle is driven over a rough or bumpy terrain.

[009] Other battery locking mechanisms are complex in design and incur high manufacturing costs.

[0010] Therefore, there exists a need for a modular battery connector and a method of providing the modular battery connector in a vehicle, which obviates the aforementioned drawbacks. Further, there exists a need for battery locking systems and methods for locking a battery pack in the vehicle, which obviates the aforementioned drawbacks.

## SUMMARY

[0010A] According an aspect, there is provided a modular battery connector including: a first connector assembly comprising a housing, at least one first power pin, at least one second power pin, a plurality of signal pins, a plurality of temperature sensors, a plurality of first sealing members, a plurality of second sealing members, and a gasket; and a second connector assembly comprising a housing, at least one first power pin, a plurality of second power pins, a plurality of first signal pins, a plurality of second signal pins, a plurality of first sealing members and a plurality of second sealing members, wherein the first connector assembly and the second connector assembly are assembled such that each guide member receiving portion of the housing in the first connector assembly is adapted to receive corresponding each guide member of the second connector assembly, and

each locating portion of the housing is adapted to facilitate alignment of the first connector assembly with respect to the second connector assembly; wherein said at least one first power pin and corresponding said at least one of said plurality of second power pins of said second connector assembly is adapted to be engaged with corresponding said at least one first power pin and said at least one second power pin of said first connector assembly respectively; each of said first signal pin or each of said second signal pin of said second connector assembly is adapted to be engaged with corresponding each of said signal pin of said first connector assembly when said first connector assembly is assembled onto said second connector assembly in a first orientation or a second orientation; said housing of said first connector assembly includes at least one power pin isolating portion, at least one signal pin holding portion and a plurality of locating portions, wherein said locating portions are integrated with a main enclosing wall of said housing; and said housing of said second connector assembly includes at least one first power pin enclosing wall, at least one power pin isolating portion and a plurality of locating portions, wherein said locating portions are integrated with a main enclosing wall of said housing.

[0010B] There is provided a method of providing a modular battery connector, said method including: removably mounting a housing of a first connector assembly onto a bottom cover of a battery pack; floatably mounting by, a plurality of fastener bushes and a plurality of fasteners, a housing of a second connector assembly onto a bottom cover of a dock system provided in at least one of a vehicle and a charging station; and assembling the first connector assembly to the seconds connector assembly by aligning the first connector assembly with respect to the second connector assembly, wherein said assembling the first connector assembly to the second connector assembly by aligning the first connector assembly with the second connector assembly by, introducing each guide

member of the second connector assembly into corresponding guide member receiving portion provided in a housing of the first connector assembly, and introducing each locating portion of the housing of the second connector assembly into corresponding each locating portion provided in the housing of the first connector assembly, wherein at least one first power pin and at least one of a plurality of second power pins of the second connector assembly is adapted to be engaged with corresponding at least one first power pin and at least one second power pin of the first connector assembly respectively; and each first signal pin or each second signal pin of the second connector assembly is adapted to be engaged with corresponding each signal pin of the first connector assembly during assembly of the first connector assembly to the second connector assembly in a first orientation or a second orientation.

[0010C] There is provided a battery locking system in a vehicle, said system including: an actuator; and a locking member, wherein said locking member is adapted to engage a guide member of a connector assembly of a battery connector thereby locking a battery pack with the connector assembly.

[0010D] There is provided a battery locking system in a vehicle, said system including: a housing; at least one control valve adapted to be provided in communication with a controller unit of at least one of a battery pack and the vehicle, said control valve is adapted to be provided in fluid communication with said housing, a movable member adapted to be provided inside said housing, said movable member is movably connected to said housing; and a locking member adapted to be connected to said movable member, wherein said control valve is adapted to regulate fluid flow in said housing to move said movable member which in turn moves said locking member to engage said locking member with a guide member of a connector assembly of a battery connector thereby locking the battery pack with the connector assembly when said control valve receives information from the controller unit.

[0010E] There is provided a battery locking system in a vehicle, said system including: an electric motor including, a locking member adapted to be engaged with a guide member of a connector assembly of a battery connector thereby locking a battery pack with the connector assembly when said electric motor receives information from a controller unit of at least one of the battery pack and the vehicle.

[0010F] There is provided a battery locking system in a vehicle, said system including: an electric motor having a shaft; at least one driving member adapted to be rotatably connected to said shaft; and a locking member adapted to be movably connected to said driving member, wherein said driving member is adapted to move said

locking member to engage said locking member with a guide member of a connector assembly of a battery connector thereby locking a battery pack with the connector assembly when said electric motor receives information from a controller unit of at least one of the battery pack and the vehicle.

[0010G] There is provided a method for locking a battery pack in a vehicle, said method including: locking the battery pack to a guide member of a connector assembly of a battery connector in the vehicle.

[0011] Embodiments herein provide a modular battery connector.

[0012] Embodiments herein provide the modular battery connector in at least a vehicle, which facilitates bi-directional orientation in which power pins and signal pins of a first connector assembly (female connector assembly) can be aligned and engaged with corresponding power pins and signal pins of a second connector assembly (male connector assembly) when the first connector assembly is being assembled onto the second connector assembly in a first orientation or a second orientation.

[0013] Embodiments herein provide a method of providing the modular battery connector in the vehicle.

[0014] Embodiments herein provide the modular battery connector in the vehicle, which is easy to align and assemble.

[0015] Embodiments herein provide the modular battery connector, which enables effective performance of the battery pack and ensures longer life of the battery pack.

[0016] Embodiments herein provide a bidirectional battery connector.

[0017] Embodiments herein provide the modular battery connector in the vehicle, which restricts entry of any of fluid (water), dust and any other foreign particles thereof thereby preventing short circuit in printed circuit board (PCB) of the battery pack, restricts damage to terminals and other electrical connections or components of the battery pack and also reduces the chances of battery fire.

[0018] Embodiments herein provide the modular battery connector, which restricts the possibility of electrical interference between at wire harness connections during assembly and operation or maintenance and also to restrict entry of dust or any foreign particles there between thereby preventing the chances of short circuit between power terminals.

[0019] Embodiments herein provide the modular battery connector in the vehicle, which includes a floating type second connector assembly which facilitates easy assembly of the first connector assembly with respect to the second connector assembly.

[0020] Embodiments herein provide the modular battery connector in the vehicle, which comprises temperature sensors for detecting temperature of power pins of the first connector assembly to determine mating position of power pins which can ensure effective performance and longer life of the modular battery connector and/or the battery pack.

[0021] Embodiments herein provide battery locking systems for the vehicle, which secures the battery pack to a guide member (guide pin) of the second connector assembly in the modular battery connector thereby preventing theft of the battery pack.

[0022] Embodiments herein provide methods for locking the battery pack in the vehicle.

[0023] Embodiments herein provide battery locking systems for the vehicle, which is reliable and incurs less cost.

[0024] Embodiments herein provide battery locking systems for the vehicle, which is automatic.

[0025] Embodiments herein provide an electro-hydraulic or pneumatic system for locking the battery pack in the vehicle.

[0026] Embodiments herein provide an electro-magnetic system for locking the battery pack in the vehicle.

[0027] Embodiments herein provide an electro-mechanical system for locking battery pack in the vehicle.

[0028] Embodiments herein provide a linear control system for locking the battery pack in the vehicle.

[0029] These and other embodiments herein will be better appreciated and understood when considered in conjunction with following description and accompanying drawings. It should be understood, however, that the following descriptions, while indicating embodiments and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

## BRIEF DESCRIPTION OF DRAWINGS

[0030] The embodiments are illustrated in the accompanying drawings, throughout which like reference letters indicate corresponding parts in various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[0031] Fig. 1a depicts a perspective view of a modular battery connector, according to first embodiments as disclosed herein;

[0032] Fig. 1b depicts a cross-sectional view of the modular battery connector, according to first embodiments as disclosed herein;

[0033] Fig. 2a depicts a perspective view of a first connector assembly (female connector assembly) of the battery connector, according to first embodiments as disclosed herein;

[0034] Fig. 2b depicts another perspective view of the first connector assembly, according to first embodiments as disclosed herein;

CLAIMS

1. A modular battery connector (10) comprising:

a first connector assembly (100) comprising a housing (102), at least one first power pin (103), at least one second power pin (104), a plurality of signal pins (106), a plurality of temperature sensors (108), a plurality of first sealing members (110), a plurality of second sealing members (112) and a gasket (114); and

a second connector assembly (200) comprising a housing (201), at least one first power pin (202), a plurality of second power pins (204), a plurality of first signal pins (206), and a plurality of second signal pins (208), a plurality of first sealing members (212), and a plurality of second sealing members (214),

wherein the first connector assembly (100) and the second connector assembly (200) are assembled such that

each guide member receiving portion (102G) of the housing (102) in the first connector assembly (100) is adapted to receive corresponding each guide member (210) of the second connector assembly (200), and

each locating portion (102L) of the housing (102) is adapted to facilitate alignment of the first connector assembly (100) with respect to the second connector assembly (200),

wherein

said at least one first power pin (202) and corresponding said at least one of said plurality of second power pins (204) of said second connector assembly (200) is adapted to be engaged with corresponding said at least one first power pin (103) and said at least one second power pin (104) of said first connector assembly (100) respectively;

each of said first signal pin (206) or each of said second signal pin (208) of said second connector assembly (200) is adapted to be engaged with corresponding each of said signal pin (106) of said first connector assembly (100) when said first connector assembly (100) is assembled onto said second connector assembly (200) in a first orientation or a second orientation;

said housing (102) of said first connector assembly (100) includes at least one power pin isolating portion (102T), at least one signal pin holding portion (102H) and a plurality of locating portions (102L), wherein said locating portions (102L) are integrated with a main enclosing wall (102D) of said housing (102); and

said housing (201) of said second connector assembly (200) includes at least one first power pin enclosing wall (201E), at least one power pin isolating portion (201P) and a plurality of locating portions (201L), wherein said locating portions (201L) are integrated with a main enclosing wall (201W) of said housing (201).

2. The modular battery connector (10) as claimed in claim 1, wherein each of said locating portion (201L) of said housing (201) engages with corresponding each of said portion (102L) of said housing (201) to facilitate alignment of said first connector assembly (100) with respect to said second connector assembly (200) when said first connector assembly (100) is assembled onto said second connector assembly (200) in said first orientation or said second orientation;

said first connector assembly (100) is a female connector assembly; and

said second connector assembly (200) is a male connector assembly.

3. The modular battery connector (10) as claimed in claim 1, wherein said at least first power pin (202)and each of said second power pin (204) of said second connector assembly (200) are provided in line and parallel and spaced away from each other; and

each of said second signal pin (208)is parallel and opposite and spaced away with respect to corresponding each of said first signal pin (206) of said second connector assembly (200).

4. A method (20) of providing a modular battery connector (10), said method (20) comprising:

removably mounting a housing (102) of a first connector assembly (100) onto a bottom cover (C) of a battery pack (B);

floatably mounting by, a plurality of fastener bushes (216) and a plurality of fasteners (218), a housing (201) of a second connector assembly (200) onto a bottom cover (D) of a dock system provided in at least one of a vehicle and a charging station; and

assembling the first connector assembly (100) to the second connector assembly (200) by aligning the first connector assembly (100) with respect to the second connector assembly (200),

wherein said assembling the first connector assembly (100) to the second connector assembly (200) by aligning the first connector assembly (100) with the second connector assembly (200) by,

introducing each guide member (210) of the second connector assembly (200) into corresponding guide member receiving portion (102G) provided in a housing (102) of the first connector assembly (100), and

introducing each locating portion (201L) of the housing (201) of the second connector assembly (200) into corresponding each locating portion (102L) provided in the housing (102) of the first connector assembly (100),

wherein

at least one first power pin (202) and at least one of a plurality of second power pins (204) of the second connector assembly (200) is adapted to be engaged with corresponding at least one first power pin (103) and at least one second power pin (104) of the first connector assembly (100) respectively; and

each first signal pin (206) or each second signal pin (208) of the second connector assembly (200) is adapted to be engaged with corresponding each signal pin (106) of the first connector assembly (100) during assembly of the first connector assembly (100) to the second connector assembly (200) in a first orientation or a second orientation.

5. The method (20) as claimed in claim 4, wherein said method (20) comprises,

locking the battery pack (B) with at least one guide member (210) of the second connector assembly (200) after said assembly of the first connector assembly (100) to the second connector assembly (200),

wherein

the guide member (210) is a guide pin;

the first connector assembly (100) is a female connector assembly; and

the second connector assembly (200) is a male connector assembly.

6. The modular battery connector (10) as claimed in claim 1,

wherein each of said first sealing member (110) of said first connector assembly (100) is adapted to be engaged with corresponding each power pin (103, 104) of said first connector assembly (100) to restrict fluid flow thereof; each of said second sealing member (112) of said first connector assembly (100) is adapted to be engaged with corresponding each signal pin (106) of said first connector assembly (100) to restrict at least fluid flow thereof;

each of said first sealing member (212) of said second connector assembly (200) is adapted to be engaged with corresponding each power pin (202, 204) of said second connector assembly (200) to restrict fluid flow thereof; and

each of said second sealing member (214) of said second connector assembly (200) is adapted to be engaged with corresponding each signal pin (206, 208) of said second connector assembly(200) to restrict at least fluid flow thereof.

7. The modular battery connector (10) as claimed in claim 6, wherein said gasket (114) adapted to be provided at interface between a housing (102) of said first connector assembly (100) and a bottom cover (C) of a battery pack (B) to restrict at least fluid flow into the battery pack (B);

each of said sealing element (110, 112) of said first connector assembly (100) is at least an O-ring; and

each of said sealing element (212, 214) of said second connector assembly (200) is at least an O-ring.

8. The modular battery connector (10) as claimed in claim 1,

wherein each of said temperature sensor (108) is adapted to be engaged with corresponding each power pin (103, 104) of said first connector assembly (100) to detect a temperature of each power pin (104) and accordingly each of said temperature sensor (108) provides the information about the measured temperature to a controller unit of a battery pack (B).

9. The modular battery connector (10) as claimed in claim 9, wherein the measured temperature of power pins (103, 104) provides a proportional value for contact resistance of power pins which in turn determines mating position of power pins (103, 104) of the said first connector assembly (100) with respect to corresponding power pins (202, 204) of a second connector assembly (200).

10. The modular battery connector (10) as claimed in claim 1, wherein the second connector assembly (200) comprising:

a plurality of fasteners (218); and

a plurality of fastener bushes (216), where each of said fastener bush (216) is adapted to receive corresponding each of said fastener (218) therethrough to facilitate floatable mounting of a housing (201) of said second connector assembly (200) to a bottom cover (D) of a dock system provided in at least one of a vehicle and a charging station.

11. The modular battery connector (10) as claimed in claim 10, wherein each of said fastener bush (216) includes a body (216B), a flange (216F) and a fastener receiving portion (216R);

each of said fastener (218) is not in contact with corresponding each of said fastener bush (216);

the fastener receiving portion (216R) of each of said fastener bush (216) and corresponding each of said fastener (218) defines a space (216RS) there between to allow a movement of said second connector assembly (200) with respect to said fasteners (218) during assembly of said connector assembly (200) with said first connector assembly (100);

the flange (216F) of each of said fastener bush (216) and head of corresponding each of said fastener (218) defines a space (216FS) there between to allow a movement of said second connector assembly (200) with respect to said fasteners (218) during assembly of said connector assembly (200) with said first connector assembly (100); and

each of said fastener (218) defines a chamfer (218C) adapted to restrict movement of said fastener (218) when said fastener (218) is moved beyond a predetermined position.

12. The modular battery connector (10) as claimed in claim 1, wherein said at least one power pin isolating portion (102T) is adapted to be integrated with said housing (102), where said at least one power pin isolating portion (102T) is adapted to isolate at least one said first power pin (103) from at least one said second power pin (104) of said first connector assembly (100); and

said at least one signal pin holding portion (102H) is adapted to hold corresponding at least one signal pin (106) of said first connector assembly (100).

13. The modular battery connector (10) as claimed in claim 1, wherein

said at least one first power pin enclosing wall (201E) adapted to extend from a base (201B) of said housing (201), said at least one first power pin enclosing wall (201E) is adapted to isolate at least one power pin (202) from corresponding at least one another power pin (204) and corresponding at least one signal pin (206, 208) of said second connector assembly (200); and

said at least one power pin isolating portion (201P) adapted to be integrated with a body (201D) of said housing (201), said at least one power pin isolating portion (201P) is adapted to isolate said at least one power pin (202) from corresponding at least one another power pin (204).