

“A modular and scalable battery swap station”

CROSS REFERENCE TO RELATED APPLICATION

This application is based on and derives the benefit of Indian Provisional Application 201741006182, the contents of which are incorporated herein by reference.

5

TECHNICAL FIELD

[001] This invention relates to swappable batteries and more particularly to stations for enabling swapping of rechargeable batteries.

BACKGROUND

10 [002] Mass adaptation of electric vehicles (EV) has always faced challenges related to batteries, such as limited energy storage in the batteries and time taken for recharging the batteries. Extensive research has been ongoing in the area of battery energy density and fast charging capability aimed at mitigating these problems.

15 [003] With this scenario, battery swapping offers a practically feasible method overcoming these limitations. A network of battery swap stations spread over a geographical area helps mitigate the issues caused by limited energy storage and battery recharging. However, current battery swap systems have limitations such as lack of standardization, capital intensity, difficulty to expand, usage optimization, and so on. Batteries are typically designed for specific vehicle types and/or connector/slot designs and are typically not adaptable to other vehicle systems/applications. Swap stations are typically capital intensive,
20 large permanent structures, which involve investments in prime land and structures. They can also pose logistic and financial challenges.

OBJECTS

[004] The principal object of embodiments herein is to disclose a portable, standardized swap station, wherein a device can swap rechargeable batteries with batteries
25 from the swap station.

[005] Another object of the embodiments herein is to disclose a portable, standardized swap station that is modular and scalable.

[006] Another object of the embodiments herein is to disclose a portable, standardized swap station that is easy to ship, install, use and relocate.

[007] Another object of the embodiments herein is to disclose a portable, standardized swap station that can be used as a portable energy source that can be used in stationary energy storage systems.

BRIEF DESCRIPTION OF FIGURES

5 [008] This invention is illustrated in the accompanying drawings, through out which like reference letters indicate corresponding parts in the various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[009] FIGs. 1a–1i depict a swap station comprising of a plurality of portable elements,
10 according to embodiments as disclosed herein;

[0010] FIGs. 2a, 2b and 2c depict the battery station, according to embodiments as disclosed herein;

[0011] FIGs. 3a, 3b, 3c and 3d depict example designs of batteries with connectors, wherein the batteries can engage with a corresponding contact in the battery conditioning
15 bays 201, according to embodiments as disclosed herein;

[0012] FIGs. 4a, 4b, 4c and 4d depict examples of the power supply system present in the battery station, according to embodiments as disclosed herein;

[0013] FIG. 5 depicts the modules in the battery station for charging at least one battery, according to embodiments as disclosed herein;

20 [0014] FIGs. 6a and 6b depict the device station, according to embodiments as disclosed herein; and

[0015] FIG. 7 is a flowchart depicting the process of swapping a battery in a swap station, according to embodiments as disclosed herein.

DETAILED DESCRIPTION

[0016] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description.

5 Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments
10 herein.

[0017] The embodiments herein disclose a portable, standardized swap station, wherein devices can swap batteries in the swap station. Referring now to the drawings, and more particularly to FIGS. 1 through 7, where similar reference characters denote corresponding features consistently throughout the figures, there are shown preferred
15 embodiments.

[0018] Embodiments herein use a vehicle as an example of a device that can comprise of at least one battery pack, wherein the at least one battery pack can be a rechargeable battery pack. It may be obvious to a person of ordinary skill in the art that the swap station can enable any device comprising of at least one battery pack to swap battery pack(s).

20 [0019] The vehicles as described herein can be a vehicle comprising of at least one battery pack. Examples of the vehicles can be, but not limited to, cars, vans, trucks, buses, scooters, motorcycles, three wheeled vehicles, and so on. In an embodiment herein, the vehicle can comprise of another mode of propulsion such as an internal combustion engine, fuel cells, and so on.

25 [0020] Embodiments herein disclose a swap station for batteries, where a device can swap a battery that has been discharged partially or completely with a charged battery. The swap station has a modular structure, comprising of a plurality of modular and portable elements, which can be installed in an easy manner. The swap station can also be used as an energy source for at least one external load.

30 [0021] FIGs. 1a–1i depict a swap station comprising of a plurality of portable elements. The swap station 101 can comprise of a plurality of portable elements, such that a battery can be moved from one element to another. The elements herein can be referred to as

containers. In an example herein, the containers can be standard shipping containers of suitable sizes. In an embodiment herein, the containers present in the swap station 101 can be of the same size (for example, 20 foot containers, 40 foot containers, or any other standard size). In an embodiment, the containers present in the swap station 101 can be of different sizes. The containers can be aligned with each other, such that a path exists between the containers. The battery packs can be moved between the containers using this path.

[0022] The portable elements of the swap station 101 can comprise of at least one battery station 102 and at least one device station 103. FIGs. 1a–1i depict example layouts of the swap station 101. Examples of the layouts are, but not limited to the layouts, depicted in FIGs. 1a-1g, wherein the battery station 101 and the device station 103 can be arranged adjoining each other.

[0023] In the examples depicted in FIGs. 1h-1i, the battery station 101 can be located in a structure (such as a parking lot, a multistoried parking lot, factory, and so on) and vehicles/devices present in the structure can swap batteries. Batteries can be carried to/from the battery station 101 using a suitable system such as an elevator/conveyor system, and so on.

[0024] As depicted in FIGs. 2a-2d, the battery station 102 can comprise of racks of battery conditioning bays 201 (hereinafter referred to as battery bays 201 and/or bay(s) 201) that will house the battery packs. The battery packs can dock into the bays for charging and other conditioning (balancing, thermal conditioning, and so on). The battery bays 201 can be scalable and modular in nature. The battery bay 201 can accommodate batteries of varying capacity. The battery bays 201 can accommodate batteries of differing configurations such as parallel connections, series connections, and so on. The battery bay 201 can accommodate batteries of different ranges of voltages. The battery bay 201 can accommodate different battery types (in terms of technology). The battery bay 201 can accommodate different battery sizes and/or shapes. The battery bay 201 can accommodate batteries with differing connector types and/or placements. Each bay can comprise of electrical and/or mechanical connectors, which can dock and disengage with the pack during storage and retrieval respectively. The bays 201 can be different in terms of at least one of size, connectors, voltages, and so on. The battery station 102 can condition each battery, as per their individual requirements simultaneously.

[0025] The controller 206 can manage/control the battery station 102 and the various modules present in the battery station 102.

[0026] The battery station 102 can use at least one of an automated battery swapping system, a semi-automated battery swapping system, and a manual battery swapping system.

5 In the example depicted in FIGs. 2a, 2b and 2c, the battery station 102 can be an automated battery swapping system where a storage and retrieval system 202 can be used to swap batteries between the battery station 102 and at least one other device. The storage and retrieval system 202 that runs between these racks can access any of the bays 201 for storing and retrieval of the packs. The storage and retrieval system 202 can receive battery packs
10 from the device station 103, and store the received battery packs in an available bay. The storage and retrieval system 202 can retrieve a specified battery pack from a bay 201 and move the retrieved battery pack to the device station 103. In an embodiment herein, the battery station 102 can comprise of a means for aligning the storage and retrieval system 202. The means can comprise of at least one sensor and a means for adjusting the position of the
15 storage and retrieval system 202, based on data from the at least one sensor. The controller 206 can perform alignment at periodic intervals and/or on pre-defined events occurring (such as the battery station 102 being moved from a first location to a second location). FIGs. 2b and 2c depict example arrangements of the bays 201 and the storage and retrieval system 202.

[0027] In the example depicted in FIG. 2d, the battery station 102 can be a manual
20 battery swapping system where a user interface 209 (comprising at least one a visual and/or audio means) can provide instructions to a user (wherein the instructions can comprise of the battery bay 201 where the user has to place the battery from his device, how the user can place the battery within the bay 201, the battery bay 201 from where the user can fetch a charged battery, how the user can remove the battery from the battery bay 201 and so on).
25 The user interface 209 can provide additional information such as information related to the battery, and so on.

[0028] The battery station 102 can comprise of a power converter 203. The power converter 203 can be a bidirectional converter, connected on one side to the bays and on other sides to at least one external power supply such as the supply grid/mains, one or more solar
30 generator/cells, green energy sources, or any other electrical power source. The power converter 203 can enable power to be drawn from any of the external sources or power to be fed back to the grid. The power converter 203 can also control transfer of energy stored in the

battery packs to at least one external load. The power converter 203 can also control transfer of energy between the battery bays 201, as required.

[0029] The battery station 102 can comprise of a temperature controller 204, which can control the temperature of the battery station 102 and maintain the temperature inside the station 102 and the batteries at an optimum level. The temperature controller 204 can comprise of one or more thermal elements that can heat and/or cool the batteries to the required level as directed by the controller 206. The thermal elements can be at least one of heater(s), thermoelectric, air cooled systems, air conditioning units, coolers, thermal jackets, and so on. The thermal elements can be used to cool/heat the external surface of the batteries and/or the battery station 102, which in turns cools/heats the cells to maintain the right temperature, or via direct contact (conduction).

[0030] The battery station 102 can comprise of a communication interface 205 for communicating with external entities, such as a remote server, the Cloud, user devices, batteries present externally to the station 102, and so on.

[0031] The battery station 102 can comprise of a power interface 207, which enables the battery station 102 to connect to at least one power source such as the grid. The power converter 203 can control the power interface 207. The power interface 207 can be bi-directional. The battery station 102 can also comprise of a plurality of power supply units 208, which can provide energy to at least one battery. The power supply unit 208 can also draw power from at least one battery present in the bay 201, as required.

[0032] The power supply units 208 can function as multiport, multidirectional converters which can enable power transfer in different directions such as mains to the batteries present in the swap station 101, between batteries present in the swap station 101, the renewable power source(s) to the batteries, the batteries to the mains, the mains to one or more devices connected to the swap station 101, one or more batteries to one or more devices connected to the swap station 101, the renewable power source(s) to one or more devices connected to the swap station 101, and so on. The power supply units 208 can provide power to any load connected to the swap station 101, wherein the load can be at least one of the supply mains, other batteries present in bays in the same swap station or other swap stations, devices connected to the swap station 101 (such as vehicles, mobile phones, tablets, torches, and so on), premises (such as residences, offices, and so on).

[0033] The controller 206 can facilitate multidirectional energy exchange, such as mains grid to battery, battery to mains grid, battery to battery, renewable energy source to battery, and so on, using the power converter 203 and/or the power interface 207. The controller 206 can decide on the energy exchange based on factors comprising of availability of energy source(s), prioritization of energy requirement, optimization of operating efficiency, a preprogrammed schedule/configuration, energy cost, time of the day tariff, arbitration based on communication between components, demand for energy, availability of batteries, and so on.

[0034] The controller 206 can perform authentication of the user, before enabling the user to insert a battery into the battery bay 201 or remove a battery from the battery bay 201. The controller 206 can perform authentication using a suitable means such as a user name password, one time keys, biometric means, and so on. The controller 206 can perform additional checks such as checking whether the user has made a payment for using the battery, any outstanding charges, and so on. The controller 206 can perform authentication in conjunction with external entities, such as servers, user devices, and so on. On successfully performing authentication, the controller 206 can determine a battery for use by the user. In case of an automated station 102, the battery from the device can be fetched and the identified battery can be attached to the device. In case of a manual station 102, the controller 206 can indicate the bay where the used battery has to be placed. On determining that the battery has been placed in the bay and the battery has been authenticated, the controller 206 can unlock the determined new battery and indicate the bay with the unlocked battery to the user.

[0035] The semi-automated battery swapping involves at least one step, which is manual (human intervention or movement/augment required) and at least one step, which is automatic. In an embodiment herein, the user may have to manually align a dispenser present in the swap station 101, before the automatic swapping begins. The automatic part may include accepting a depleted battery from the dispenser and dispensing a fully charged battery to the dispenser, from where the user can remove the battery and insert the battery into his device.

[0036] In an embodiment herein, the swap station 101 can be used as a fast charge station. The power supply units 208 can be configured to directly charge devices connected to

the swap station (using either wired or wireless means) with on board battery systems. This allows the swap station 101 to function as a 'fast charge' station for devices.

[0037] The battery station 102 can be used as an energy source. This is especially of use in second life applications as energy sources. The battery station 102 can be located in locations requiring stationary energy storage. The battery station 102 can transfer energy from the battery present in the bays 201 to external loads. Combined with a solar array 210, the battery station 102 can function as a grid independent power supply system or plug into the grid to support it for back up power. The controller 206 can manage the batteries, based on factors such as the load connected to the battery station 102 and the power available in the batteries. The controller 206 can determine the battery/batteries from which power has to be provided. This ensures a steady supply of cost effective installations of standalone energy sources for rural use. Combined with renewable energy sources, this provides a path for reliable cost effective energy supply to remote and rural areas.

[0038] The modules (the bays 201, the storage and retrieval system 202, the power converter 203, temperature controller 204, communication interface 205, controller 206, power interface 207, the power supply unit 208, the user interface 209, and the solar panel(s) 210) present in the battery station 102 can be modular, wherein the modules can be replaced, as required. Modules can also be added/removed to/from the battery station 102, as required. For example, additional battery bays 201 can be added to the station 102, on determining that demand for the batteries from the station 102 are increasing. For example, additional power controllers 203 can be added to the battery station 102, if additional batteries are added to the battery station 102. For example, additional energy sources such as wind power can be added to the station 102. For example, additional battery bays 201 can be removed from the station 102, on determining that demand for the batteries from the station 102 is decreasing.

[0039] In an embodiment herein, the battery station 102 can comprise of a location monitoring means such as GPS (Global Positioning System), which enables monitoring of the location of the battery station 102. In an embodiment herein, the battery station 102 can be insulated.

[0040] In an embodiment herein, the battery station 102 can comprise of a locking means to lock the modules present in the battery station 102. The locking means can lock the battery into the battery bay 201. The controller 206 can unlock the locking means, on authenticating the user and/or the device. The locking means can prevent the modules from

moving, while the battery station 102 is moving (which can be in a scenario such as when the battery station 102 is being moved from a first location to a second location).

[0041] In an embodiment herein, the battery station 102 can comprise of sensors that can sense pollutants and so on, emitted by the swap station 101 or any other nearby source, which can affect the swap station 101. The sensors can communicate the sensed information to at least one external entity using the communication interface 205.

[0042] In an embodiment herein, the battery station 102 can be connected to other entities, such as a central entity, other battery stations 102. The battery station 102 can exchange data with the other entities, wherein the exchanged data can comprise of data related to the vehicles, batteries, the swap stations and so on.

[0043] FIGs. 3a, 3b, 3c and 3d depict example designs of batteries with connectors, wherein the batteries can engage with a corresponding contact in the battery conditioning bays 201. FIGs. 3a, 3b, 3c and 3d depict example designs of connectors, wherein a battery connector 302a can engage with a bay connector 302b present in the bay 201. The engagement between the connectors can enable power to be fed to the battery, power to be drawn from the battery, capturing information related to the battery (such as a usage, battery condition, and so on), and so on. In an embodiment herein, a clamping and/or locking means can be present to secure the battery 301 in place in the bay 201.

[0044] FIGs. 4a, 4b, 4c and 4d depict examples of the power supply system present in the battery station. The power supply 400 can comprise of a plurality of power supply units 208, each unit comprising of a plurality of power racks 401. The power racks 401 can be bi-directional units; i.e., the racks 401 can provide power supply to a connected battery or the racks 401 can pull power from a connected battery. The controller 206 can control the power supply units 208 and the power racks 401. In an embodiment herein, each power rack can be connected to a single battery (as depicted in the example depicted in FIG. 4a). In an embodiment herein, the power racks 401 can be connected in parallel or series to satisfy higher power/voltage requirements (as depicted in the example depicted in FIG. 4b). In an embodiment herein, the power supply unit 208 can be connected in parallel or series to satisfy higher power/voltage requirements (as depicted in the examples depicted in FIGs. 4c and 4d).

[0045] FIG. 5 depicts the modules in the battery station for charging at least one battery. The power supply unit 208 can comprise of a plurality of charger units 501a, 501b, 501c, and so on with at least one configuration unit 502. The controller 206, as required, can

configure the configuration unit 502. In an embodiment herein, each charger unit 501 can be connected to a single battery. In an embodiment herein, a plurality of charger units 501 can be connected in parallel or series to satisfy higher power/voltage requirements. The batteries can be connected to the controller 206. The batteries can be interconnected to each other, enabling the batteries to interchange power, if required, based on instructions received from the controller 206. The system comprises at least one energy source (such as a mains power, a renewable energy source, and so on).

[0046] FIGs. 6a and 6b depict the device station. A vehicle requiring a battery swap would be driven into the device station 103. At least one side of the device station 103 can be opened to enable the vehicle to drive into/out of the device station 103. In the example in FIG. 6a, two sides of the wall drops down to form a ramp, using a hinged joint. The vehicle can be driven into the device station 103, using the ramp. The device station 103 and/or the battery station 102 can be in communication with the vehicle and/or a user device associated with the vehicle or a user of the vehicle and can perform functions such as identification of the vehicle and/or user, and authentication of the vehicle and/or user.

[0047] The device station 103 can comprise of a battery hoist 601. The device station 103 can comprise of a means to enable the vehicle to park at a designated spot (depending on factors such as the size of the vehicle, location of the battery pack, and so on) (as depicted in FIG. 6b). The device station 103 can comprise of a means to indicate to the vehicle that it is parked in the correct position. The device station 103 can comprise of a locking means to maintain the device stationary. The battery hoist 601 can access the vehicle from under the platform and first aligns itself in position to remove/replace the battery pack present in the vehicle. The hoist 601 can remove the battery pack from the vehicle and can transport the battery pack that has been removed from the vehicle, to the battery station 102. The hoist 601 can also receive a battery pack from the battery station 102 and place the received battery pack into the vehicle. The device station 103 can comprise of a signaling means to indicate to the vehicle that the battery swap is complete and the vehicle can leave the device station 103.

[0048] In an embodiment, the device station 103 can accommodate more than one vehicle at a time, wherein the device station 103 can comprise of a plurality of hoists 601.

[0049] In an embodiment herein, the device station 103 can comprise of a location monitoring means such as GPS (Global Positioning System), which enables monitoring of the

location of the device station 103. In an embodiment herein, the device station 103 can be insulated.

[0050] In an embodiment herein, the device station 103 can comprise of sensors that can sense pollutants and so on, emitted by the swap station 101 or any other nearby source, which can affect the swap station 101. The sensors can communicate the sensed information to at least one external entity.

[0051] In an embodiment, the device station 103 need not be a container, but can be any space adjacent to the battery station 102 and comprising of the hoist 601.

[0052] FIG. 7 is a flowchart depicting the process of swapping a battery in a swap station. On a device arriving (701) at a swap station 101, the swap station 101 receives (702) information related to a user of the device, the battery present in the device, the usage of the device, and so on. The information can also comprise of the user details, such as a unique means to identify the user (such as a user name, email ID, phone number, name, biometric means, and so on), at least one security credential (such as a password, a biometric identification means, and so on), user plans to which this user has subscribed, and so on. The swap station 101 can receive this information before the device reaches the swap station 101, from a device (such as a mobile phone, a smart phone, a tablet, a computer, a wearable computing device, a vehicle system, a vehicle infotainment system, a controller associated with a battery present in the device, and so on). The swap station 101 authenticates (703) the user using the received information. On successful authentication, at least one suitable battery is selected (704) for the user. The swap station 101 can select the battery based on the received user details, the device information, the device/energy usage, the weather, and so on. The user can also select the battery. The swap station 101 charges (705) the user based on the selected battery. On successfully completing the charging of the user, the swap station 101 swaps (706) the battery in the device. The battery can be selected for the device based on parameters such as compatibility with device design, meeting basic requirements of performance for the specific device, preprogrammed user plan, user choice among options of cost/performance presented, and so on. The swapping can be done automatically, where the storage and retrieval system can retrieve the battery from the device, fetch the battery from the bay 201, and place the battery in the device. The swapping can be done manually, where the user can manually insert the battery into an indicated bay and fetch the battery from the indicated bay. On the swapping being completed, the device exits (707) the device station

103. The various actions in method 700 may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some actions listed in FIG. 7 may be omitted.

5 [0053] Consider that a user is using a device comprising one or more battery packs. If the device comprises of two or more battery packs, one of the battery packs is designated as a master and the other battery packs are slaves. If the device comprises of only one battery pack, the battery pack can serve as the master. In the example herein, a device comprising of one master and at least one slave has been considered.

10 [0054] The master can advertise its presence using a wireless broadcast means (using a suitable technology such as Bluetooth, BLE (Bluetooth Low Energy), Wi-Fi, Zigbee, Wi-Fi Direct, and so on). The swap station 101 can continuously scan for masters, with which the swap station 101 can communicate wirelessly.

15 [0055] Using information received from the master, the swap station 101 can determine the intent of the user. The swap station 101 can determine the intent of the user, using information such as the direction of travel of the user, the SoC of the battery packs, the user history, and so on. The swap station 101 can also determine the specific location of the device, using a means such as GPS (Global Positioning System), video surveillance, and so on.

20 [0056] On determining that the user is in a position to swap the battery pack(s) using the determined location of the device, the swap station 101 can enable the user to authenticate himself, using a suitable authentication means. This can comprise of at least one of the user providing a username/password, using biometric details of the user, the user scanning a RFID (Radio frequency Identification) code, and so on.

25 [0057] The master can further connect to the swap station 101 wirelessly. The master can exchange information such as SoC, SoH, temperature, damages (if any), energy usage, usage profiles, and so on, with the swap station 101. The master can also enable the slave(s) to communicate with the swap station 101 wirelessly and provide information such as SoC, SoH, temperature, damages (if any), energy usage, usage profiles, and so on, to the swap station 101.

30 [0058] The swap station 101 can perform service discovery, which can comprise of determining the SoC of the battery packs present in the device, SoH of the battery packs present in the device, the user profile, customization of the battery pack(s) present in the

swap station 101 (based on user preferences, usage, user history, and so on), and so on. The service discovery can be performed using information received from the master and the slave(s). The swap station 101 can then provide an indication to the user, using a suitable means such as an audio means, a visual means, an audio-visual means, a SMS, and so on.

5 [0059] The user can then attempt to unlock one or more battery packs in the device by performing an action, using a means such as pressing a button, pressing a toggle/physical lock. This means can be at least one of a mechanical means or an electronic means. The swap station 101 can receive a notification of the attempt to unlock the battery pack from the master or the slave (via the master). On the swap station 101 confirming that the battery pack
10 can be unlocked (based on the user profile, usage, availability of suitable battery packs in the swap station 101, and so on), the swap station 101 can provide an indication to the master or the slave (via the master) to unlock. The battery pack is then unlocked and the user can remove the battery pack from the device.

 [0060] The swap station 101 can further determine a dock in the swap station 101,
15 where the user can insert the battery into the determined dock. The swap station 101 can further unlock this dock. The swap station 101 can check if the battery pack has been inserted into the dock, by checking if the swap station 101 can communicate with the battery pack using a wired means (such as a CAN (Controller Area Network) bus). In an embodiment herein, the user can insert only one battery pack from his device. In an embodiment herein,
20 the user can insert all the battery pack present in his device. In an embodiment herein, the user can insert two or more of the battery packs from all the battery packs present in the device.

 [0061] On determining that the user has inserted the battery pack(s) into the determined dock(s), the swap station 101 can initiate the billing process for the user, using
25 information such as the energy consumed by the user from the battery pack(s), the user profile, the user plan, and so on.

 [0062] The swap station 101 can further select battery pack(s) for the user, wherein the number of selected battery pack(s) is equal to the number of battery pack(s) inserted into the swap station 101. The selected battery pack(s) can be based on additional factors such as
30 the user profile, user preferences, usage profile, history, and so on. In an embodiment herein, the swap station 101 can enable the user to select and/or modify the selected batteries. The

swap station 101 can unlock the respective dock(s) of the selected battery pack(s). The user can then remove the selected battery pack(s) and insert the battery pack(s) into the device.

[0063] The swap station 101 can be in communication with the selected batteries wirelessly. The swap station 101 can verify that the selected battery pack(s) are present in the correct device/host/user, wherein the host can be the master. On verifying that the selected battery pack(s) are present in the correct device/host/user, the swap station 101 can enable the battery pack(s) to dispense power to the device.

[0064] Embodiments disclosed herein provide standardized swap stations, which can be transported easily and quickly installed at a location (wherein the installation can comprise of aligning and locking the elements and plugging the battery station 102 into at least one power source).

[0065] The foregoing description of the specific embodiments will fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

CLAIMS

We claim:

1. A swap station (101) for swapping at least one battery with a device, the swap station comprising at least one portable battery station (102), the at least one portable battery station (102) comprises:

a plurality of battery conditioning bays (201);

a power converter (203) for enabling the swap station (101) to connect to at least one external power supply through a power interface (207);

at least one bi-directional power supply unit (208) for

providing power to at least one battery pack present in the at least one of the plurality of battery conditioning bays (201) from at least one of

the at least one external power supply; and

at least one other battery pack present in at least one other of the plurality of battery conditioning bays (201);

providing power from the at least one battery pack present in the at least one of the plurality of battery conditioning bays (201) to at least one external load connected to the swap station (101);

a communication interface (205) for enabling the swap station (101) to communicate with at least one external entity; and

a controller (206) configured for:

determining at least one of the plurality of battery conditioning bays (201), where at least one used battery pack from the device is to be placed;

determining at least one new battery pack present in the at least one other of the plurality of battery conditioning bays (201) for use in the device;

unlocking a used battery pack in the device on performing authentication;

conditioning the at least one battery pack in the at least one of the plurality of battery conditioning bays (201); and

swapping the at least one used battery pack and the at least one new battery pack using at least one of an automated system, a semi-automated system; and a manual means.

2. The swap station, as claimed in claim 1, wherein the controller (206) is configured for performing the authentication of a user of the device, the device, and the used battery pack.
3. The swap station, as claimed in claim 1, wherein the plurality of battery conditioning bays (201) is configured for charging the at least one battery pack present in the plurality of battery conditioning bays (201).

4. The swap station, as claimed in claim 1, wherein the plurality of battery conditioning bays (201) is configured for conditioning the at least one battery pack present in the plurality of battery conditioning bays (201).
5. The swap station, as claimed in claim 1, wherein the plurality of battery conditioning bays (201) is configured for transferring energy from the at least one battery pack present in the plurality of battery conditioning bays (201) to at least one external load.
6. The swap station, as claimed in claim 1, wherein the at least one portable battery station (102) further comprises a lock for locking the at least one battery pack in the plurality of battery conditioning bays (201).
7. The swap station, as claimed in claim 1, wherein the at least one portable battery station (102) further comprises a temperature controller (204), which further comprises at least one thermal element.
8. The swap station, as claimed in claim 1, wherein the at least one portable battery station (102) further comprises at least one sensor for sensing pollutants.
9. The swap station, as claimed in claim 1, wherein the at least one portable battery station (102) is connected to at least one renewable energy source.
10. The swap station, as claimed in claim 1, wherein the at least one bi-directional power supply unit (208) further comprises of at least one bi-directional power rack (401) and at least one charger unit (501).

11. The swap station, as claimed in claim 10, wherein the at least one power rack (401) is connected to at least one of a single battery pack, in parallel; and in series.

12. The swap station, as claimed in claim 10, wherein the at least one charger unit (501) is connected to at least one of a single battery pack, in parallel; and in series.

13. The swap station, as claimed in claim 1, wherein the at least one portable battery station (102) further comprises a storage and retrieval system (202), wherein the storage and retrieval system (202) is configured to swap the at least one used battery pack and the at least one new battery pack using the automated system.

14. The swap station, as claimed in claim 13, wherein the controller (206) is configured for aligning the storage and retrieval system (202).

15. The swap station, as claimed in claim 1, wherein the at least one portable battery station (102) further comprises a storage and retrieval system (202), wherein the storage and retrieval system (202) is configured to swap the at least one used battery pack and the at least one new battery pack using the semi-automated system.

16. The swap station, as claimed in claim 15, wherein the controller (206) is configured for aligning the storage and retrieval system (202).

17. The swap station, as claimed in claim 1, wherein the controller (206) is configured for performing billing services.

18. The swap station, as claimed in claim 1, wherein the swap station (101) further comprises at least one device station (103), wherein at least one

path exists between the at least one portable battery station (102) and the at least one device station (103).

19. The swap station, as claimed in claim 1, wherein the swap station (101) comprises of at least one container.

20. The swap station, as claimed in claim 1, wherein the swap station (101) is modular.