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System and method for interchanging power supplies associated with a vehicle utilizing a modular chassis

Abstract

A system and method of interchanging power supplies associated with a vehicle include a first chassis having a front portion, a rear portion, a first center portion, a first front transition portion disposed between the front portion and the first center portion, and a first rear transition portion disposed between the first center portion and the rear portion, the first center portion forming a first power supply compartment, and mounting fixtures supported by at least one of the portions, the mounting fixtures to receive vehicle body components. A first power supply is secured to the first center portion as the vehicle is assembled. The vehicle is disassembled, and the first center portion is replaced with a second center portion, the first front and rear transition portions are replaced with second front and rear transition portions, and the vehicle is reassembled with a second power supply.

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Background/Summary

RELATED APPLICATIONS (1) This application is a continuation in part of U.S. Application No. 18,607,848 filed Mar. 18, 2024, which is a continuation in part of U.S. Application No. 18,457,889, filed Aug. 29, 2023, which is a continuation in part of U.S. application Ser. No. 18/163,004, filed Feb. 1, 2023, which is a continuation in part of U.S. application Ser. No. 29/838,840, filed May 16, 2022, and U.S. application Ser. No. 29/781,864 filed Apr. 30, 2021. All of the foregoing are incorporated by reference in their entireties herein.

FIELD OF THE INVENTION

(1) The disclosure relates generally to the field of electric vehicles. More specifically, the disclosure relates to a system and method of interchanging power supplies of a vehicle utilizing a modular chassis.

BACKGROUND OF THE INVENTION

(2) Electric vehicles are generally known in the art, as are vehicles comprised of a power supply, a propulsion system, a chassis or frame, and a body. An example of one such vehicle is disclosed in U.S. Pat. No. 11,505,265 to Lee, the disclosure of which is incorporated herein, in its entirety, by reference. Lee discloses a multipurpose vehicle system having modular components which may be interchanged by a user for a particular application. Typically, electric vehicles use electrical energy as a source of power as an alternative to traditional fossil fuels. The vehicles are propelled by one or more electric motors, which are connected to a power supply such as a rechargeable battery or battery system. These electric vehicles are equipped with high-capacity batteries which enable the vehicles to travel considerable distance between recharging. These batteries, be it during routine maintenance or for a complete replacement, may need to be removed from the vehicle periodically, which may be a tedious and/or difficult task. It is advantageous, therefore, for an electric vehicle, and in particular the vehicle chassis, to facilitate removal and instillation of the rechargeable battery. In addition, it may be desirable for a vehicle to support either a smaller capacity battery or a larger capacity battery, and accordingly, it is desirable, and a benefit of the present invention, to provide for interchangeable center portions of a chassis, such that the vehicle can be disassembled and reassembled with an alternate center portion, thereby being adaptable to support either a smaller or larger battery depending on the needs and preferences of the operator. In embodiments, the vehicle body components and front and rear portions remain unchanged, wherein just a center portion is interchanged, and accordingly, the system and method of interchanging a power supply improves efficiency.

(3) In addition to rechargeable batteries, electric vehicles may utilize a hydrogen fuel cell as a power source. However, existing solutions do not allow for simple conversion from one power source type (e.g., a hydrogen fuel cell) to another power source type (e.g., a rechargeable battery system) without extensive modifications to the existing vehicle chassis, which may prove time-consuming and expensive, or without the need for a completely different chassis altogether. It therefore may be desirable for a vehicle chassis to accommodate and facilitate timely component changes, as well as being suitable for a wide variety of power supplies and/or other features.

SUMMARY

(4) The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. It is not intended to identify critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented elsewhere herein.

(5) According to an embodiment, the present invention relates to a method of interchanging power supplies associated with a vehicle. Initially, a first chassis is assembled, the first chassis having a front portion, a rear portion, a first center portion, a first front transition portion disposed between the front portion and the first center portion, and a first rear transition portion disposed between the first center portion and the rear portion. The first center portion includes a pair of longitudinal

supports extending between the first front transition portion and the first rear transition portion, the first center portion forms a first power supply compartment having a first dimensional width between the pair of longitudinal supports sized for a first power supply. The first chassis further includes a plurality of mounting fixtures supported by one or more of the front portion, the first front transition portion, the first center portion, the first rear transition portion, and the rear portion. Next in the method, the vehicle is assembled with the first chassis. Assembly of the vehicle includes securing the first power supply to the first center portion and securing a plurality of vehicle body components to the plurality of mounting fixtures. Then in the method, as desired by an operator, the first power supply is interchanged with a second power supply. Interchanging the power supplies includes disassembling the vehicle by removing the plurality of vehicle body components from the plurality of mounting fixtures to expose the first chassis and the first power supply, removing the first power supply, disconnecting the front portion from the first front transition portion, disconnecting the first center portion from the first front transition portion and the first rear transition portion, and disconnecting the rear portion from the first rear transition portion. Interchanging the power supplies further includes selecting a second center portion appropriate for the second power supply, a second front transition portion associated with the second center portion, and a second rear transition portion associated with the second center portion. Then, assembling a second chassis by connecting the front portion to the second front transition portion, connecting the second center portion to the second front transition portion and the second rear transition portion, and connecting the rear portion to the second rear transition portion. Finally, interchanging the power supplies also includes installing the second power supply onto the second center portion, wherein the second center portion has a second dimensional width that is different from the first dimensional width such that the first center portion and the second center portion support different power supplies. Finally in the method, the vehicle is reassembled by installing the plurality of vehicle body components onto a second plurality of mounting fixtures of the second chassis.

(6) According to another embodiment, the present invention relates to a system for interchanging power supplies associated with a vehicle. The system includes a first chassis, the first chassis having a front portion, a rear portion, a first center portion, a first front transition portion disposed between the front portion and the first center portion, and a first rear transition portion disposed between the first center portion and the rear portion. The first center portion has a pair of longitudinal supports extending between the first front transition portion and the first rear transition portion, the first center portion forms a first power supply compartment having a first dimensional width between the pair of longitudinal supports sized for a first power supply, The first chassis further having a plurality of mounting fixtures supported by one or more of the front portion, the first front transition portion, the first center portion, the first rear transition portion, and the rear portion, the plurality of mounting fixtures configured to receive a plurality of vehicle body components to render the vehicle. The front portion can disconnect from the first front transition portion via a first set of mating brackets, the first center portion can disconnect from the first front transition portion via a second set of mating brackets and from the first rear transition portion via a third set of mating brackets, and the rear portion can disconnect from the first rear transition portion via a fourth set of mating brackets. The first power supply is configured to removably secure within the first power supply compartment. The system also includes a second center portion having a second power supply compartment with a second dimensional width appropriate for a second power supply, a second front transition portion associated with the second center portion, and a second rear transition portion associated with the second center portion. A second chassis includes the front portion connected to the second front transition portion, the second center portion connected to the second front transition portion and the second rear transition portion, and the rear portion connected to the second rear transition portion. The second power supply is configured to removably secure within the second power supply compartment. The first center

portion can be interchanged with the second center portion such that the first power supply can be interchanged with the second power supply; and the second center portion has a second dimensional width that is different from the first dimensional width such that the first center portion and the second center portion support different power supplies.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) Illustrative embodiments of the present disclosure are described in detail below with reference to the attached drawing figures.

(2) FIG. **1** is a top view of a first vehicle chassis as part of a vehicle having an interchangeable power supply in accordance with the present invention.

(3) FIG. **2** is a top view of the first vehicle chassis of FIG. **1** with chassis portions separated.

(4) FIG. **3** is a top view of a second vehicle chassis as part of the vehicle having an interchangeable power supply in accordance with the present invention.

(5) FIG. **4** is a top view of the second vehicle chassis of FIG. **3** with the chassis portions separated.

(6) FIG. **5** is a front perspective view of the first vehicle chassis of FIG. **1**.

(7) FIG. **6** is a front perspective view of the second vehicle chassis of FIG. **3**.

(8) FIG. **7** is a top view of the first vehicle chassis of FIG. **1** with a first power supply as part of the vehicle having the interchangeable power supply.

(9) FIG. **8** is a top view of the second vehicle chassis of FIG. **3** with a second power supply as part of the vehicle having an interchangeable power supply.

(10) FIG. **9** is a side view of a vehicle chassis, being either of the first vehicle chassis or second vehicle chassis, showing a plurality of mating brackets connecting the chassis portions.

(11) FIG. **10** is a side view of the vehicle chassis of FIG. **9** showing the chassis portions disconnected at the mating brackets.

(12) FIG. **11** is a perspective view of a mounting fixture as part of the vehicle having an interchangeable power supply.

(13) FIG. **12** is a side view of a front suspension mounting assembly as part of the vehicle having an interchangeable power supply.

(14) FIG. **13** is a perspective view of the front suspension mounting assembly of FIG. **12**.

(15) FIG. **14** is another perspective view of the front suspension mounting assembly of FIG. **12** showing a connection to a brake assembly.

(16) FIG. **15** is a flowchart of a method of interchanging power supplies using the first vehicle chassis and the second vehicle chassis.

LIST OF REFERENCES

(17) **100**—First Vehicle Chassis **102**—Front Portion **104**—First Front Transition Portion **106**—First Center Portion **108**—First Rear Transition Portion **110**—Rear Portion **112**—Arrow **114**—Rear End of the First Front Transition Portion **116**—Rear End of the Rear Portion **118***a-b*—Parallel Longitudinal Supports **119**—First Distance Between Parallel Longitudinal Supports **120**—Front End of the Center Portion **121**—Rear End of the Center Portion **122***a-b*—Outwardly Angled Supports **123**—Cross Bar **124**—Front End of the First Front Transition Portion **126***a—b*—Front Portion Longitudinal Supports **128***a-b*—Rear Transition Portion Parallel Longitudinal Supports **129**—Front End of the First Rear Transition Portion **130**—Rear End of the First Rear Transition Portion **131**—Cross Member **132***a-b*—Rear Portion Longitudinal Supports **134**—Front End of the Rear Portion **136**—Rear Portion Cross Member **138**—First Power Supply Compartment **140***a-f*—Mounting Fixtures **300**—Second Vehicle Chassis **302**—Second Front Transition Portion **304**—Second Center Portion **306**—Second Rear Transition Portion **308***a-b*—Parallel Longitudinal Supports **310***a-b*—Cross Members **312**—Central Longitudinal Member **314**—Second Distance

Between Parallel Longitudinal Supports **316**—Front End of the Center Portion **318**—Rear End of the Center Portion **320***a-b*—Outwardly Angled Supports **322**—Crossbar **324**—Front End of the Front Transition Portion **326**—Rear End of the Front Transition Portion **328***a-b*—Angled Supports **330**—Front End of the Second Rear Transition Portion **332**—Rear End of the Second Rear Transition Portion **334**—Cross Member **336***a-c*—Mounting Fixtures **338**—Power Supply Compartment **500**—Front Grille Receiver **502***a-b*—Side Adapters **504***a-b*—Receivers **506***a-b*—Downwardly-angled Supports **700**—First Power Supply **800**—Second Power Supply **900***a-d*—Connection Brackets **902**—Selected Front Transition Portion **904**—Selected Center Portion **906**—Selected Rear Transition Portion **1100**—Base Mounting Plate **1102**—Fitting **1200**—Front Suspension Mounting Assembly **1202**—Suspension Mounting Frame **1204**—Lower Parallel Longitudinal Supports **1206**—Angular Offset Supports **1208***a-c*—Front Suspension Mounting Brackets **1210***a-b*—Upper Control Arm Mounting Pins **1300**—Lower Parallel Lateral Supports **1302**—Angular Support **1304***a-b*—Pair of Lower Control Arm Mounts **1400**—Upper Control Arm **1402**—Shock Absorber **1404**—Lower Control Arm **1406**—Brake Assembly **1500**—Flow Chart with steps **1502**, **1504**, **1506**, **1508**, **1510**, **1512**

DETAILED DESCRIPTION

(18) The following detailed description intended to be exemplary in nature and is not intended to limit the described embodiments or the application and uses of the described embodiments. As used herein, the words “exemplary” and “illustrative” mean “serving as an example, instance, or illustration.” Any embodiment described herein as “exemplary” or “illustrative” is not necessarily to be construed as preferred or advantageous over other embodiments either inherent or expressly described herein. The embodiments described below are exemplary embodiments provided to enable a skilled artisan to make or use the embodiments of the disclosure and are not intended to limit the scope of the disclosure, which is defined by the claims.

(19) For purposes of description herein, the terms “upper,” “lower,” “left,” “rear,” “right,” “front,” “vertical,” “horizontal,” and derivatives thereof shall relate to the invention as oriented in FIG. **1**, unless otherwise stated. Furthermore, there is no intention to be bound by any expressed or implied theory presented in the preceding technical field, background, brief summary or the following detailed description. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification, are simply exemplary embodiments of the inventive concepts defined in the appended claims. Specific dimensions and other physical characteristics relating to the embodiments disclosed herein are therefore not to be considered as limiting, unless the claims expressly state otherwise.

(20) Vehicles are well known in the art and vary in dimensions, vehicle body components, power supplies, and many other components. The diversity among vehicle makes and models requires extensive engineering and design solutions for each vehicle. Specifically, each vehicle model is generally designed with independent components, such that each component is engineered for that specific vehicle. Accordingly, the ability to interchange components between vehicles is almost non-existent in the industry. Electric vehicles generally use a battery supply to power the necessary components of the vehicle, for example, one or more batteries are generally installed into one or more locations of the vehicle to power the vehicle. Usually, electric vehicles are designed with a specific power supply in mind as part of the vehicle, specifically, a certain battery is installed during manufacturing of the vehicle, and therefore the vehicle is limited to the certain battery.

(21) The present invention provides for a method and system for interchanging power supplies of a vehicle utilizing a modular vehicle chassis. Specifically, the modular chassis has a plurality of portions, which are each independently able to disconnect from other portions, allowing for a single portion to be easily removed and replaced with a new portion. The system and method specifically utilize a plurality of center portions, such that each center portion is appropriate for a specific power supply. This allows for a user, manufacturer, or other personnel to select a center portion and interchange out the center portion to accommodate a different power supply. In embodiments

discussed herein, a center portion of the modular chassis can be changed out, which allows for a power supply compartment to be interchanged. This feature allows for the chassis to be modified easily such that different power supplies can be utilized for the same vehicle. In embodiments, the vehicle body components are removed, the center portion changed out, and the vehicle body components added back such that the same vehicle is rebuilt with a new power supply. Alternatively, different vehicle body components could be utilized to render a new vehicle.

(22) FIGS. **1** and **2** depict a first vehicle chassis **100** and FIGS. **3** and **4** depict a second vehicle chassis **300**. In other words, the first vehicle chassis **100** can be transformed into the second vehicle chassis **300** due to the modularity. These chassis, in combination, create the modular chassis as the core of the present invention. In other words, although each chassis is referred to independently here, the overall modular chassis is the combination of the two, where the components can be interchanged such that the overall resulting chassis of the vehicle is modified.

(23) The first chassis **100** includes a front portion **102** connected to a first front transition portion **104** and a center portion **106** connected to the first front transition portion **104** and also connected to a first rear transition portion **108**. Finally, a rear portion **110** is connected to the first rear transition portion **108**. As shown with arrow **112**, the first chassis **100** is straight from a rear end **114** of the front transition portion **104** to a rear end **116** of the rear portion **110**. In other words, the chassis **100** has a single dimensional width for this entire distance.

(24) The center portion **106** includes a pair of parallel longitudinal supports **118***a-b* extending from a front end **120** of the center portion **106** to a rear end **121** of the center portion **106**. A first distance **119** between the parallel longitudinal supports **118***a-b* defines a first power supply compartment **138**.

(25) The first front transition section **104** is defined by a pair of outwardly angled supports **122***a-b* and a cross bar **123** extending therebetween. The outwardly angled supports **122***a-b* extend from a front end **124** of the first front transition portion **104** to the rear end **114** of the first front transition portion **104**. The rear end **114** of the first front transition **104** is connected to the front end **120** of the center portion **106** in such a manner that allows for the first front transition portion **104** to disconnected easily from the center portion **106**. Similarly, all portions that make up the chassis **100** can be easily disconnected for modularity.

(26) The front portion **102** is defined by a pair of front portion longitudinal supports **126***a-b*. In examples shown herein, the front portion **102** and the rear portion **110** remain consistent throughout the modularity of the chassis. In other words, the center portion, front transition portion, and rear transition portion can all be interchanged, while the front portion **102** and rear portion **110** remain consistent. This allows for not all of the chassis to require changing out or modification, but rather just portions.

(27) The front portion longitudinal supports **126***a-b* connect to the outwardly angled supports **122***a-b* via any means that again allows for easy disconnection, such as mating brackets as discussed below. The supports **126***a-b* connect to the outwardly angled supports **122***a-b* at a first angle A. The first front transition portion **104** is designed such that the front portion **102** and the first center portion **106** are appropriately connected. In other words, depending on the first distance **119**, the first front transition portion **104** must be appropriately selected to connect the first center portion **106** to the front portion **102**.

(28) The first rear transition portion **108** similarly is selected based on the dimensions of the first center portion **106** as needed to connect to the rear portion **110**. Here, in the example shown in FIG. **1**, the first rear transition portion **108** includes a pair of rear transition portion parallel longitudinal supports **128***a-b*. As shown, these supports **128***a-b* are parallel and aligned with the center portion **106** longitudinal supports, as well as rear portion longitudinal supports **132***a-b*. Again, this causes a straight assembly as represented with arrow **112**.

(29) The supports **128***a-b* extend from a front end **129** of the first rear transition portion to a rear end **130** of the first rear transition portion **108**. A cross member **131** extends therebetween. In the

embodiment shown, the cross member **131** is perpendicular to the supports **128***a-b*. The rear end **130** connects to a front end **134** of the rear portion longitudinal supports **132***a-b* such as via a mating bracket. Another perpendicular cross member **136** extends between the rear portion longitudinal supports **132***a-b*.

(30) The chassis **100** supports a plurality of mounting fixtures **140***a-f*. These mounting fixtures can vary, however in the embodiment shown, the mounting fixtures **140***a-f* extend outwardly and substantially perpendicular from one or more portions of the chassis. These mounting fixtures **140***a-f* allow for vehicle body components to be mounted thereto easily. In embodiments, the vehicle body components will include corresponding fixtures, such that the vehicle body components will easily mount to the fixtures.

(31) As shown in FIG. **2**, the portions **102**, **104**, **106**, **108**, **110** can be disconnected from one another, such that portions can be replaced, therefore defining the modularity of the vehicle chassis. As discussed later on, one means of connecting and disconnecting the portions is the use of mating brackets, wherein the brackets are shaped as needed (straight, angled, outwardly/inwardly bent) to secure the portions together.

(32) In FIGS. **3** and **4**, a second chassis **300** is shown. Here, the first vehicle chassis **100** is taken, disassembled, and the first center portion **106**, first front transition portion **104**, and first rear transition portion **108** are all replaced. Those skilled in the art will appreciate that the change can go in reverse as well (i.e. chassis **300** to chassis **100**). The front portion **102** and rear portion **110** remain consistent.

(33) The second chassis **300** includes a second front transition portion **302** connected to the front portion **102**, a second center portion **304** connected to the second front transition portion **302** and a second rear transition portion **306**. The rear portion **110** is reconnected to the second rear transition portion **306**. As discussed with the first chassis **100**, here again, the second front transition portion **302** and the second rear transition portion **306** are selected based on the selected second center portion **304** such that appropriate connection is made between the second center portion **304** and the front portion **102** and rear portion **110**.

(34) The second center portion **304** is similar to the first center portion **106**, having a pair of parallel longitudinal supports **308***a-b* extending from a front end **316** to a rear end **318**. A pair of cross members **310***a-b* extend between the pair of parallel longitudinal supports **308***a-b* and a central longitudinal member **312** extends between the pair of cross members **310***a-b* approximately midway between the longitudinal supports **308***a-b*. Here, a second distance **314** between the parallel longitudinal supports defines a second power supply compartment **338**. The second distance **314** is greater than the first distance **119** and therefore is sized for a second power supply (i.e. a larger battery).

(35) The second front transition portion **302** is defined by a pair of outwardly angled supports **320***a-b* extending from a front end **324** to a rear end **326**, the second front transition portion **302** connecting to the front portion **102** and the front end **316** of the second center portion **304**. Here, the outwardly angled supports **320***a-b* connect with the pair of longitudinal supports **126***a-b* of the front portion **102** creating a second angle B. Those skilled in the art will clearly appreciate that the first angle A of the first chassis **100** is larger than the second angle B of the second chassis **300**. This is due to the second front transition portion **302** being selected specifically as corresponding with the second center portion **304**. In other words, due to the front portion **102** being consistent, the second front transition portion **302** must change to create the continuity between the front portion **102** and the second center portion **304**. A crossbar **322** extends between the outwardly angled supports **320***a-b*.

(36) Similarly, the second rear transition portion **306** is selected based on the center portion **304** as appropriate to connect the second center portion **304** to the rear portion **110**. Here, since the second center portion **304** is wider, the second rear transition portion **306** is now composed of angled supports **328***a-b* that extend from a front end **330** to a rear end **332**. Accordingly, these angled

supports **328***a-b* taper back down to the width of the rear portion **110**. Another cross member **334** extends between the angled supports **328***a-b*.
(37) Again, a plurality of mounting fixtures **336***a-c* are mounted to one or more of the chassis portions. The exact positioning and number of the fixtures may vary, but again provide for adding vehicle components to the chassis. Here, the mounting fixtures **336***a-c* are shown mounted to a top surface of the chassis, as opposed to extending out perpendicular to the chassis. Again, although positioning may vary, in some cases, the distance between the mounting fixtures may remain equal. For example, two corresponding fixtures of the first chassis **100** which extend outward from the chassis, may be spaced apart equally to two corresponding fixtures on the second chassis **300**. This would allow for the same body components to be removed and then added back, as the overall arrangement of the fixtures (i.e. distance apart and positioning) remains unchanged, even though the power supply compartment itself changed.
(38) In FIG. **4**, the second chassis **300** is shown with the portions disassembled for clarity.
(39) FIG. **5** depicts another view of the first chassis **100** while FIG. **6** depicts another view of the second chassis **300**. Again, the differing distances **119**, **314** are shown. In addition, the front portion **102** is shown in more detail, having a front grille receiver **500** positioned at the front end, along with side adapters **502***a-b*, and receivers **504***a-b*. This configuration allows for a grille assembly to be attached or removed from the associated chassis.
(40) In FIG. **7**, the first chassis **100** is shown, having a first power supply **700** supported by the first center portion **106**. In FIG. **8**, the second chassis **300** is shown, having a second power supply **800** supported by the second center portion **304**. Each power supply may be secured by any means appropriate, and can include various ports, wires, or the like as would be known and understood by those skilled in the art.
(41) Now turning to FIG. **9**, a side view depicts 5 portions as part of the overall modular chassis. Specifically, the front portion **102** and the rear portion **110**, along with a selected front transition portion **902**, a selected center portion **904**, and a selected rear transition portion **906**. The selected portions may be from FIG. **1** or **3** above or may be additional portions that further allow for more sizing and modularity of the overall chassis. Here, a first mating bracket **900***a* connects the front portion **102** to the front transition portion **902**. This first mating bracket has a downward angled end to create the connection between the two portions. A second mating bracket **900***b* connects the front transition portion **902** to the center portion **904**. Again, this bracket **900***b* has an appropriate angle and bend to create the necessary connection. Third and fourth mating brackets **900***c-d* connect the center portion **904** to the rear transition portion **906** and the rear transition portion **906** to the rear portion **110** respectively. In some embodiments, these mating brackets are the sole connecting structural component between the portions, which allows for easy disassembly and reconnection between the portions. In FIG. **10**, a side view accordingly depicts the portions disconnected for clarity. As would be understood by those skilled in the art, corresponding mating brackets connect the opposing side of the portions together.
(42) As also shown in FIG. **9**, in some embodiments, the chassis has varying heights. Specifically, in at least some embodiments, the center portion **904** is at a first vertical position, the front portion **102** is at a second vertical position, and the rear portion **110** is at a third vertical position, the second vertical position being higher than the first vertical position, and the third vertical position being higher than the first and second vertical positions.
(43) In FIG. **11**, one embodiment of a mounting fixture **140** is shown. Here, a base mounting plate **1100** is used to attach a fitting **1102** to an associated portion of the chassis. The base mounting plate **1100** may extend out perpendicular to a side surface of the chassis (e.g. FIG. **1**), or alternatively may be mounted to a top surface of the chassis (e.g. FIG. **3**). In some embodiments, the fitting **1102** is specifically a press-fit fitting or may be another type of fitting now known or later developed for such a purpose. The base mounting plate **1100** may be substantially U-shaped, and the fitting **1102** is configured to receive and secure an exterior body panel. One of skill in the art will appreciate

that the number of body mounting fixtures, as well as the exact location and distribution of said fixtures, may vary depending on the size and specific geometry of the chassis and/or the body panels themselves, without departing from the scope of the invention.

(44) In FIGS. **12** through **14**, a front suspension mounting assembly **1200** as part of the front portion **102** is shown. The front suspension mounting assembly **1200** includes lower parallel longitudinal supports **1204** and angular offset supports **1206**, the lower parallel longitudinal supports **1204** are dropped to a lower vertical position via angular supports **1302**. The assembly **1200** further includes a plurality of front suspension mounting brackets **1208***a-c* which are configured to hold various elements to the front suspension assembly **1200**. The front suspension mounting brackets **1208***a-c* are generally affixed to and project upward from a front portion longitudinal support **126***b*. The front suspension mounting brackets **1208***a-c* may be substantially vertical, or may be angularly offset from the vertical as shown in the illustrated embodiment. Front suspension mounting brackets **1208***a* and **1208***c* are generally configured to secure an upper control arm **1400** of the front suspension (as shown in FIG. **14**), and as such the upper control arm mounting pins (which may be in the form of bolts or similar mechanical fasteners as illustrated) **1210***a*-**1210***b* are preferably substantially coaxial. The central bracket **1208***b* is configured to secure an end of a shock absorber **1402**. The central bracket **1208***b* may be substantially parallel to the upper control arm mounting brackets **1208***a*, **1208***c*, or may be offset as shown in the illustrated embodiment.

(45) In addition to the upper control arm **1400** and shock absorber **1402**, the front suspension assembly **1200** further includes a lower control arm **1404** and a front disc brake assembly **1406**. The lower control arm **1404**, best shown in FIG. **14**, may be generally describes as being wishbone- or delta-shaped in nature. The lower control arm **1404** is securable to the chassis by a pair of lower control arm mounts **1304***a-b* disposed on the front suspension mounting frame **1202** which slidingly engage with a proximal end of the lower control arm **1404**, and the lower control arm **1404** is attachable to the brake assembly **1406** at a distal end. The lower control arm **1404** also includes a mount **1304***b* for a second end of the shock absorber **1402**, which may be in the form of a spherical rod end bearing or similar pivotable mount. The front suspension and brake assembly **1406** allow for selective attachment of a suitable wheel to allow the vehicle to move as desired by the user.

(46) In FIG. **15**, a flowchart **1500** summarizes the method of interchanging a vehicle power supply as part of the present invention.

(47) At step **1502**, the vehicle is first assembled having a first chassis and a first power supply compartment, wherein the first power supply compartment **138** is determined based on selected portions of the first chassis. Using the chassis **100**, **300** discussed above, either the first center portion **106** or the second center portion **304** may be initially selected. The selected center portion will further define the power supply compartment, and associated front and rear transitional portions are also selected to correspond to the center portion.

(48) At step **1504**, if desired, the vehicle is disassembled. Disassembly will include removing vehicle body components from the plurality of mounting fixtures to expose the first chassis and the first power supply.

(49) At step **1506**, the first power supply is removed from the first center portion of the first chassis.

(50) At step **1508**, the first chassis is disassembled by disconnecting the portions making up the first chassis. Specifically, the front portion is disconnected from the first front transition portion by disconnecting a first set of mating brackets connecting the two portions together. The first center section is disconnected from the first front transition portion and the first rear transition section via second and third sets of mating brackets. And the rear portion is disconnected from the first rear transition section via a fourth set of mating brackets.

(51) At step **1510**, a second center portion is selected based on a new power supply. For example, a

larger center portion is selected to increase the size of a power supply that can be added to the chassis. Then a second chassis is assembled with the new center portion. Selecting a new center portion also requires selecting corresponding front and rear transition portions. The second chassis is assembled with the front portion now connected to a second front transition portion, the second center portion connected to the second front transition portion and the second rear transition portion, and the rear portion is connected to the second rear transition portion.

(52) At step **1512**, the vehicle is reassembled by adding the second power supply to the second center portion and reattaching vehicle body components to fittings of the second chassis.

(53) Many different arrangements of the various components depicted, as well as components not shown, are possible without departing from the spirit and scope of the present disclosure. Embodiments of the present disclosure have been described with the intent to be illustrative rather than restrictive. Alternative embodiments will become apparent to those skilled in the art that do not depart from its scope. A skilled artisan may develop alternative means of implementing the aforementioned improvements without departing from the scope of the present disclosure.

(54) It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations and are contemplated within the scope of the claims. Not all steps listed in the various figures need be carried out in the specific order described.

Claims

1. A method of interchanging power supplies associated with a vehicle, the method comprising: assembling a first chassis, the first chassis having: a front portion, a rear portion, a first center portion, a first front transition portion disposed between the front portion and the first center portion, and a first rear transition portion disposed between the first center portion and the rear portion; the first center portion having a pair of longitudinal supports extending between the first front transition portion and the first rear transition portion, the first center portion forms a first power supply compartment having a first dimensional width between the pair of longitudinal supports sized for a first power supply; a first plurality of mounting fixtures supported by one or more of the front portion, the first front transition portion, the first center portion, the first rear transition portion, and the rear portion; and a first cross member extending between a pair of rear longitudinal supports, a second cross member extending between a first side of the first rear transition portion and a second side of the first rear transition portion, and one or more downwardly-angled supports extending between the first cross member and the second cross member; assembling the vehicle with the first chassis, wherein assembling the vehicle includes: securing the first power supply to the first center portion; and securing a plurality of vehicle body components to the first plurality of mounting fixtures; interchanging the first power supply with a second power supply, wherein interchanging the first power supply with the second power supply includes: disassembling the vehicle by removing the plurality of vehicle body components from the plurality of mounting fixtures to expose the first chassis and the first power supply, removing the first power supply, disconnecting the front portion from the first front transition portion, disconnecting the first center portion from the first front transition portion and the first rear transition portion, and disconnecting the rear portion from the first rear transition portion; selecting a second center portion appropriate for the second power supply, a second front transition portion associated with the second center portion, and a second rear transition portion associated with the second center portion; assembling a second chassis by connecting the front portion to the second front transition portion, connecting the second center portion to the second front transition portion and the second rear transition portion, and connecting the rear portion to the second rear transition portion; and installing the second power supply onto the second center portion; wherein the second center portion has a second dimensional width that is different from the first dimensional width

such that the first center portion and the second center portion support different power supplies; reassembling the vehicle by installing the plurality of vehicle body components onto a second plurality of mounting fixtures of the second chassis.

2. The method of claim 1, wherein the first chassis further comprises the front portion having a pair of longitudinal supports extending from a front end of the first chassis to the first front transition portion.

3. The method of claim 1, wherein disassembling the vehicle further comprises: disconnecting the front portion from the first front transition portion by disconnecting a first set of mating brackets that extends between the front portion and the first front transition portion; disconnecting the first center portion from the first front transition portion and the first rear transition portion by disconnecting a second set of mating brackets that extends between the first center portion and the first front transition portion and by disconnecting a third set of mating brackets that extends between the first center portion and the first rear transition portion; and disconnecting the rear portion from the first rear transition portion by disconnecting a fourth set of mating brackets that extends between the rear portion and the first rear transition portion; wherein the first, second, third, and fourth sets of mating brackets are the only structural components holding associated portions together.

4. The method of claim 1, wherein assembling the first chassis further comprises: positioning the first center portion at a first vertical position, the front portion at a second vertical position, and the rear portion at a third vertical position, the second vertical position being higher than the first vertical position, and the third vertical position being higher than the first and second vertical positions.

5. The method of claim 1, wherein the first chassis further comprises: a front suspension mounting assembly positioned between a pair of longitudinal supports as part of the front portion, the front suspension mounting assembly having: a suspension mounting frame secured to the pair of longitudinal supports via a plurality of angular supports, the plurality of angular supports extending the suspension mounting frame to a position below the pair of longitudinal supports, the suspension mounting frame being substantially rectangular; a plurality of mounts extending outwardly from the suspension mounting frame, the plurality of mounts configured to engage with one or more control arms for supporting one or more brake assemblies.

6. The method of claim 1, wherein the first plurality of mounting fixtures further comprises at least one mounting fixture extending from an exterior surface of the first center portion, the at least one mounting fixture includes a base mounting plate that extends substantially perpendicular from the exterior surface and a fitting that extends upward from the base mounting plate.

7. The method of claim 6, wherein the at least one mounting fixture is a press-fit style fitting.

8. The method of claim 1, wherein the second plurality of mounting fixtures further comprises at least one mounting fixture extending from a top surface of the second center portion, the at least one mounting fixture having a base mounting plate positioned on the top surface and a fitting that extends upward from the base mounting plate.

9. The method of claim 8, wherein the at least one mounting fixture is a press-fit style fitting.

10. The method of claim 1, wherein: the first plurality of mounting fixtures further comprises a first mounting fixture attached to a first longitudinal support of the first center portion and a second mounting fixture attached to a second longitudinal support of the first center portion; and the second plurality of mounting fixtures further comprises a third mounting fixture attached to a first longitudinal support of the second center portion and a fourth mounting fixture attached to a second longitudinal support of the second center portion; wherein a distance between the first mounting fixture and the second mounting fixture is equal to a distance between the third mounting fixture and the fourth mounting fixture such that a single vehicle component can attach to either the first and second mounting fixtures or the third and fourth mounting fixtures without any alterations to the vehicle component.

11. A system for interchanging power supplies associated with a vehicle, the system comprising: a first chassis, the first chassis having: a front portion, a rear portion, a first center portion, a first front transition portion disposed between the front portion and the first center portion, and a first rear transition portion disposed between the first center portion and the rear portion; the first center portion having a pair of longitudinal supports extending between the first front transition portion and the first rear transition portion, the first center portion forms a first power supply compartment having a first dimensional width between the pair of longitudinal supports sized for a first power supply; and a first plurality of mounting fixtures supported by one or more of the front portion, the first front transition portion, the first center portion, the first rear transition portion, and the rear portion, the first plurality of mounting fixtures configured to receive a plurality of vehicle body components to render the vehicle; wherein the front portion can disconnect from the first front transition portion via a first set of mating brackets, the first center portion can disconnect from the first front transition portion via a second set of mating brackets and from the first rear transition portion via a third set of mating brackets, and the rear portion can disconnect from the first rear transition portion via a fourth set of mating brackets; the first power supply configured to removably secure within the first power supply compartment; a second center portion having a second power supply compartment with a second dimensional width appropriate for a second power supply and a second plurality of mounting fixtures; a second front transition portion associated with the second center portion; a second rear transition portion associated with the second center portion; a second chassis having the front portion connected to the second front transition portion, the second center portion connected to the second front transition portion and the second rear transition portion, and the rear portion connected to the second rear transition portion; the second power supply configured to removably secure within the second power supply compartment; wherein the first plurality of mounting fixtures further comprises a first mounting fixture attached to a first longitudinal support of the first center portion and a second mounting fixture attached to a second longitudinal support of the first center portion; the second plurality of mounting fixtures further comprises a third mounting fixture attached to a first longitudinal support of the second center portion and a fourth mounting fixture attached to a second longitudinal support of the second center portion; and wherein a distance between the first mounting fixture and the second mounting fixture is equal to a distance between the third mounting fixture and the fourth mounting fixture such that a single vehicle component can attach to either the first and second mounting fixtures or the third and fourth mounting fixtures without any alterations to the vehicle component; wherein the first center portion can be interchanged with the second center portion such that the first power supply can be interchanged with the second power supply; and wherein the second center portion has a second dimensional width that is different from the first dimensional width such that the first center portion and the second center portion support different power supplies.

12. The system of claim 11, wherein the first center portion is positioned at a first vertical position, the front portion is positioned at a second vertical position, and the rear portion is positioned at a third vertical position, the second vertical position being higher than the first vertical position, and the third vertical position being higher than the first and second vertical positions.

13. The system of claim 11, wherein the first chassis further comprises: a front suspension mounting assembly positioned between a pair of longitudinal supports as part of the front portion, the front suspension mounting assembly having: a suspension mounting frame secured to the pair of longitudinal supports via a plurality of angular supports, the plurality of angular supports extending the suspension mounting frame to a position below the pair of longitudinal supports, the suspension mounting frame being substantially rectangular; a plurality of mounts extending outwardly from the suspension mounting frame, the plurality of mounts configured to engage with one or more control arms for supporting one or more brake assemblies.

14. The system of claim 11, wherein the first chassis further comprises a first cross member

extending between a pair of rear longitudinal supports, a second cross member extending between a first side of the first rear transition portion and a second side of the first rear transition portion, and one or more downwardly-angled supports extending between the first cross member and the second cross member.

15. The system of claim 11, wherein the second plurality of mounting fixtures further comprises at least one mounting fixture extending from a top surface of the second center portion, the at least one mounting fixture having a base mounting plate positioned on the top surface and a fitting that extends upward from the base mounting plate.

16. The system of claim 15, wherein the at least one mounting fixture is a press-fit style fitting.

17. The system of claim 11, wherein the first plurality of mounting fixtures further comprises at least one mounting fixture extending from an exterior surface of the first center portion, the at least one mounting fixture includes a base mounting plate that extends substantially perpendicular from the exterior surface and a fitting that extends upward from the base mounting plate.

18. The system of claim 17, wherein the at least one mounting fixture is a press-fit style fitting.