

PORTABLE BATTERY PACK

FIELD OF THE INVENTION

[0001] The present invention relates to portable batteries, more particularly, it relates a portable battery pack for use with batteries in transport vehicles.

BACKGROUND

[0002] Batteries used in transport vehicles are typically rechargeable lead acid storage batteries which provide cranking power to start the vehicle. These vehicle batteries are also the only source of power to continue to maintain the lights or other devices in operation when the vehicle ignition has been turned off. A situation may occur where the vehicle battery charge is weak or depleted so that the battery is incapable of starting the vehicle. Such a situation may arise when the operator of the vehicle has inadvertently left the lights, radio, or other energy consuming device or accessory running in the vehicle after the ignition has been turned off, or may occur when the battery has simply weakened due to prolonged use.

[0003] Frequently, a jumper cable may be used to provide cranking energy to start the vehicle under such conditions. The jumper cable includes a pair of heavy gauge, insulated wires of various lengths, with alligator clips at each end. The cables are color coded to prevent electrical short circuits and are marked by black and red to represent the negative and positive polarity of the vehicle battery's Direct Current (DC) polarity system. The jumper cables are connected from the battery of another vehicle to the affected vehicle battery to provide the required cranking energy. Interchanging the polarities may cause damage to one or both vehicles, resulting in blown electrical fuses and circuit boards and in the most extreme of cases, causing the vehicle battery to explode. Alternatively, portable jump starter kits are also widely available to jump start an affected vehicle. These portable jump starter devices typically include a built-in pre-charged battery (or lead acid battery) and two booster clamps coupled to the built-in pre-charged battery. The booster clamps are coupled to the weak or depleted vehicle battery in order to provide the cranking energy to jump start the vehicle. While these portable jump starter kits are useful in that it does not require assistance of another vehicle, there are some problems associated with these kits.

The portable jump starter kits are heavy and bulky, some weighing as much as 30 pounds. They also require regular maintenance since the built-in pre-charged battery needs to be recharged when it is weak or depleted. The portable jump starter kit may also simply be depleted from lack of use after a considerable time or from lack of maintenance.

[0004] Another problem of the afore-mentioned portable jump starter kits is the inconvenience to the operator of the vehicle in performing the steps of jump starting the vehicle battery. Such disadvantages may pose a risk to the operator's life in certain situations. For example, the operator of the vehicle may not be able to safely perform the steps of jumpstarting the vehicle battery in inclement weather conditions such as rain, snow, and extreme heat. Similarly, in a potentially dangerous environment such as in the wild where the presence of wild animals is prevalent, or in a dangerous neighborhood where the crime rate is high, performing the normal steps of jumpstarting a vehicle using the jump starter kit may pose a risk to the operator's life.

[0005] With the advances in automotive technology, vehicle manufacturers are increasingly adding sophisticated electronic systems to vehicles to improve convenience, comfort and productivity for the operator of the vehicle. Such electronic systems may, for example, be in the form of park assist systems, adaptive cruise control, electronic brake systems, GPS navigational systems, state of the art audio systems, front and rear seat electronic controls and others. In order to power these sophisticated electronic systems, an increased constant and dynamic load demand on the vehicles is required which in turn increases the demand for energy from the vehicle battery. It is estimated that the constant load demand on a vehicle increases on an average of between 100W to 150W per year and the dynamic load demand on the vehicle has increased from 2 kW in the 1980s to over 10kW today. However, the advances in technology of rechargeable lead-acid vehicle batteries have not progressed as fast as these electronic systems, leading to a less than optimum power source from the vehicle battery for these electronic systems, and thereby resulting in a decreased lifespan of the vehicle battery.

[0006] Therefore, the object of the invention is to provide a solution that overcomes the above disadvantages or at least provide a device that addresses the above problems.

SUMMARY OF INVENTION

[0007] According to a first aspect of the invention, there is provided a portable battery pack for use with a battery of a transport vehicle, the portable battery pack comprising a housing which includes a cable outlet for connecting a positive and a negative connector for coupling with positive and negative terminals of the battery of the transport vehicle. An energy storage pack is arranged to provide starting energy to the vehicle when an electrical connection is made between the energy storage pack and the battery. The housing also includes a charger unit for receiving a supply voltage from an external power source to provide a charging voltage to charge the energy storage pack. The housing includes a circuit having a switch configured to open and close the circuit and a processor unit arranged for connection with the charger unit and the energy storage pack, wherein the processor unit controls the switch to operate between a charging mode in which the switch is open to allow the charger unit to provide charging voltage to charge the energy storage pack and a jump start mode in which the switch is closed to allow the energy storage pack to provide starting energy to the battery.

[0008] According to a second aspect of the invention, there is provided a method of supplying electrical energy to a battery of a transport vehicle, the method comprising: providing a portable battery pack for coupling with the battery of the transport vehicle, the portable battery pack including: a cable outlet for connecting a positive and a negative connector for coupling with a positive and negative terminals of the battery of the transport vehicle; an energy storage pack arranged to provide starting energy to the vehicle when an electrical connection is made between the energy storage pack and the battery; a charger unit for receiving a supply voltage from an external power source to provide a charging voltage to charge the energy storage pack; a circuit having a switch configured to operate between a charging mode and a jump start mode, a processor unit arranged for connection with the charger unit and the energy storage pack; a push button coupled to the processor unit; wherein depressing the push button causes the switch to activate the charging mode in which the switch is open to allow the charger unit to provide charging voltage to charge the energy storage pack and a jump start mode in which the switch is closed to allow the energy storage pack to provide starting energy to the battery.

[0009] The invention will now be described in detail with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying figures illustrate disclosed embodiment(s) and serve to explain principles of the disclosed embodiment(s). It is to be understood, however, that these drawings are presented for purposes of illustration only, and not for defining limits of the application.

[0011] Fig. 1a is a rear perspective view of the portable battery pack;

[0012] Fig. 1b is a front perspective view of the portable battery pack;

[0013] Figure 2 is simplified block diagram of the portable battery pack in connection with the vehicle battery, alternator and other vehicle components.

[0014] Figure 3 is a block diagram illustrating the circuitry, energy storage unit and components of the portable battery pack in accordance with an embodiment of the present invention;

[0015] Figure 4 is a block diagram illustrating the circuitry, energy storage unit and components of the portable battery pack in accordance with another embodiment of the present invention;

[0016] Figure 5 is a block diagram illustrating the circuitry, energy storage unit and components of the portable battery pack in accordance with another embodiment of the present invention;

[0017] Figure 6 is a block diagram illustrating the circuitry, energy storage unit and components of the portable battery pack in accordance with another embodiment of the present invention;

[0018] Figures 7(a), 7(b) and 7(c) illustrate the various type of cables used for connecting the portable battery pack to the vehicle battery.

[0019] Exemplary, non-limiting embodiments of the present application will now be described with references to the above-mentioned figures.

DETAILED DESCRIPTION

[0020] In the following description, a portable battery pack for use with transport vehicles is described herein. The term ‘transport vehicles’ is understood to include not only automobile vehicle such as cars, trucks, campervans but also to other forms of vehicles used in other mediums of transport which utilises an engine or motor of sorts, such as light aircrafts and power boats. It shall be apparent to those skilled in the art, however, that the embodiments are not intended to be limiting to the embodiments described. Some details of the components are not described at length so as not to obscure the present invention.

[0021] Figures 1a and 1b illustrate perspective rear and front views respectively, of the portable battery pack 10 according to an embodiment of the invention. In Figure 1a, the portable battery pack 10 has a housing 12 that includes an energy storage pack (not shown), which will be described in detail below, that can provide starting energy to a weak or depleted vehicle battery. The housing 12 includes a cable outlet 14 for connecting cables from the energy storage pack to the vehicle battery. The cables include positive and negative connectors to connect the portable battery pack 10 to the respective terminals of the vehicle battery. It also includes a push button 21 for allowing the operator of the vehicle to depress to initiate the jump start process once the cables have been connected. The push button 21 provides the operator of the vehicle a convenient way to initiate the jumpstarting process. The housing also includes a DC input terminal 16 for connection with a DC power source for allowing the energy storage pack located within to be charged. In Figure 1b, the housing 12 includes a light display indicator 18. The light display indicator 18 provides a user an indication of the current status of the portable battery pack 10. Different coloured lights or intermittent flashing lights will therefore provide an indication of the various operational modes the portable battery pack 10 is in, and the details will be provided below. The portable battery pack may also include a manual switch (not shown) on the housing 12 for switching between various voltages to be charged. For example, the manual switch may

allow a user to switch between 12V or 24V or 36V or 48V for different configurations of lead acid batteries.

[0022] Figure 2 is a simplified block diagram showing the connection of the portable battery pack 10 with the vehicle battery 30, the alternator 31 and other vehicle components in an embodiment of the present invention. The portable battery pack 10 is electrically connected in parallel to the vehicle battery 30 and to the alternator 31. This provides both the starting energy and an improved power supply to the vehicle components. The vehicle components are also connected in parallel to the portable battery pack 10, the alternator 31 and the vehicle battery 30. The vehicle components include the starter motor 32, the spark plugs 33, the fuel injector pump 34, the audio amplifier 35, and other miscellaneous components 36. By connecting the portable battery pack 10 in the aforesaid manner, the energy storage pack located within the portable battery pack 10 provides minimal electrical resistance between the power supply and electrical load. This effectively lowers the output impedance, and increases the capacitance of the power supply (which includes the vehicle battery 30 and the alternator 31). In effect, the electrical power supply to the vehicle is enhanced when the voltage is stabilized. In addition, due to the improved power supply provided by the portable battery pack 10 to the spark plugs 33, the spark plugs burn air/fuel mixture more completely, reducing fuel wastage. At the same time, improved power supply to the fuel injectors 34 causes optimal injection of fuel into the combustion chambers and the engine control unit (ECU) can control the air/fuel mixture more efficiently and accurately according to its preset conditions. This in turn, leads to an improved fuel economy for the vehicle.

[0023] Another advantage provided by the parallel connection of the portable battery pack 10 with the vehicle battery 30 and the alternator 31 is an extension of the vehicle's battery life. Battery manufacturers typically warn against over-discharging the battery in order to maintain battery life. When the portable battery pack is connected in the aforesaid manner, the peak cranking load or current is shared with the energy storage pack therein, thereby reducing the load/current to the vehicle battery. The lowest cranking voltage is kept relatively higher than without the portable battery pack 10. Excessive ripple currents are harmful to the battery life. It is known that there are ripple currents in the vehicle electronics system due to fuel injectors, spark plugs, or to the internal combustion engine system. The

energy storage pack within the portable battery pack reduces the ripple currents by having a low internal resistance and high capacitance, which aid in extending the vehicle battery life.

[0024] Due to the improved power supply to the audio amplifier 35 by the connection of the portable battery pack 10 with the vehicle battery 30 and the alternator 31, the power supply to the audio amplifier 35 is boosted. The portable battery pack 10 delivers ultra high capacitance resulting in improvements in signal to noise ratio, the amplifier output dynamic range while minimizing audio clipping and distortion. This results in a more dynamic and pleasurable listening experience for the driver and passengers within the vehicle.

[0025] Figure 3 shows a simplified diagram of a circuitry 20 and its components within the housing 12 of the portable battery pack 10 in accordance with an embodiment of the present invention. The portable battery pack 10 is connected via cables to the vehicle battery 30 through the cable outlet 14 of the housing 12. The cable outlet 14 is represented by nodes 22 and the connector (not shown) connects the nodes 22 via a pair of cables. The circuitry 20 includes the energy storage pack 23 coupled to the nodes 22 and controlled by a switch 24 in series. The circuitry 20 includes the charger 19 and a processor unit 17, each of which is connected with the energy storage pack 23 for generating starting energy to the vehicle. An example of the processor unit 17 is a micro-controller unit (MCU). The processor unit 17 monitors the voltage of the vehicle battery 30 and the voltage of the energy storage pack 23 in its various operational modes. The switch 24 is controlled by the processor unit 17 and the switch 24 opens and closes the circuitry 20 as and when it is required. The circuitry 20 also includes a voltage regulator 26 coupled to the processor unit 17 and connected in series with the processor unit 17. The voltage regulator 26 stabilizes and maintains the output voltages and current generated by the circuitry 20. Voltage regulators are well known in the art and for these purposes, the components of voltage regulators will not be described so as not to obscure the invention. The circuitry 20 includes LED diodes 29 for the light display indicator 18. The LED diodes 29 are controlled by the processor unit 17 and provide the status of the portable battery pack 10. To avoid reverse polarity connections due to short circuit connections or to prevent excessive discharge or charge between the portable battery pack 10 and the vehicle battery 30 or an external power source, a short circuit detector 25 is provided. In such situations, the processor unit 17 detects the short circuit and opens switch 25 immediately.

[0026] The circuitry 20 also includes a DC input terminal 16 for connection with a DC power source 50. When the DC power source 50 is connected, the energy storage pack 23 can be charged up via the charger 19. When the portable battery pack 10 is in a charging mode, the processor unit 17 will open switch 24 and a DC terminal connector (not shown) will automatically disconnect the vehicle battery 30 connection to the charger 19. A diode 28 connected in series with the DC output terminal protects the charger 19 against reverse polarity connections. When the energy storage pack 23 is fully charged, the charger 19 is disabled and the switch 24 is closed after a delay.

[0027] The energy storage pack 23 is an electro-chemical capacitor which may be symmetric or asymmetric or a hybrid super capacitor with batteries in a single pack. A super capacitor has low internal resistance and is capable of yielding high energy and high current density over considerable time periods and may be conveniently fabricated by lamination of electrode and separator films prepared from polymeric compositions comprising activated carbon and ion-conductive electrolyte. In general, a super capacitor can hold a very high charge which can be released relatively quickly, thereby making it suitable for jump starting a vehicle, since the vehicle requires high cranking energy for a very short period of time. Super capacitors are relatively small in size compared to lead acid type vehicle batteries and this provides ultra portability in the form of the portable battery pack 10. In the embodiments of the invention described, the energy storage pack 23 includes a single super capacitor pack. However, it is envisaged that the energy storage pack 23 can include more than one single super capacitor pack to cater for increased load demand.

[0028] Figure 4 shows a simplified diagram of a circuitry 20 and its components within the housing 12 of the portable battery pack 10 similar to Figure 3. The circuitry 20 and its components operate in the same manner as those shown in Figure 3 and explained above. In this embodiment, however, a separate active battery unit 27 is used in the case where the vehicle battery 30 is extremely weak. In this case, the voltage of the vehicle battery 30 may be below the weak voltage threshold and the energy storage pack 23 may not provide sufficient starting energy to jump start the vehicle battery 30. The active battery unit 27 may for example be a lithium pack. The charger 19 or another built-in charger (not shown) may be provided to charge the active battery unit 27. A switch matrix 29 is used to route the output of the charger 19 to the active battery unit 27 when it is needed to recharge

the active battery unit 27. When it is required to charge the energy storage pack 23, the switch matrix re-routes the output of the charger to charge the energy storage pack 23.

[0029] Figure 5 shows a simplified diagram of a circuitry 20 and its components within the housing 12 of the portable battery pack 10 similar to Figure 3. The circuitry 20 and its components operate in the same manner as those shown in Figure 3 and explained above. In this embodiment, however, vehicle signals 52, 54 are provided to initiate a charging mode and jump start mode in the portable battery pack 10. The portable battery pack 10 is coupled to the vehicle battery 23 and to a starter motor 50 of the vehicle. The starter motor 50 is activated when the driver of the vehicle turns the ignition key to start the engine of the vehicle thereby sending a vehicle signal 52, 54. When the vehicle battery is weak, the portable battery pack 10 automatically detects the weak vehicle battery. The automatic detection may be done via a sensor or an instrument such as a voltmeter or an ammeter to detect that the vehicle battery is weak and will therefore not start when the driver attempts to start the engine. In this case, when the driver of the vehicle turns the ignition key to start the engine of the vehicle, this vehicle signal 52, 54 is sent to the processor unit 17 and initiates the charging mode and jump start mode of the portable battery pack 10. When the charging mode is activated, the charger 19 charges the energy storage pack 23 and when the energy storage pack 23 is fully charged, the jump start mode will be activated to supply electrical energy to the vehicle battery. Once the vehicle engine has started, the vehicle signals 52, 54 are disabled accordingly.

[0030] The portable battery pack 10 can be in various operational modes. For example, the portable battery pack 10 can be in a charging mode or a jump-starting mode. In a charging mode, the processor unit 17 is programmed to automatically open switch 24 to allow the charger 19 to charge the energy storage pack 23. Due to the properties of the energy storage pack 23, which has low internal resistance and high current density, the energy storage pack 23 can be recharged in a very short time relatively to a lead acid battery. The energy storage pack is charged to the same voltage level as that of the lead acid vehicle battery. For example, if the vehicle battery is of a 12V configuration, the energy storage pack will similarly be charged to a voltage compatible to a 12V system. When in a charging mode, the power source to charge the energy storage pack 23 can be from the vehicle battery 30 or an external DC power source (not shown). Some examples of the external DC power source can be separate external battery packs, cigarette igniter sockets of vehicles or an

adapter unit for connection to a power socket. In the case of an external DC power source, the DC power source is connected to the DC input terminal 16, which automatically disconnects the vehicle battery 23 connections to the charger 19. Once the energy storage pack 23 is fully charged, the charger 19 is disabled and the switch 24 is closed after a delay to provide improved power supply to the vehicle components.

[0031] In a jump starting mode, the portable battery pack 10 is in a mode that allows it to jump start a weak or depleted vehicle battery 30. It can also be used to jump start the weak or depleted vehicle battery of another vehicle by disconnecting the cables from the portable battery pack 10 and using separate jump start cables to connect to another vehicle battery. Typically, a vehicle will not start when the vehicle battery is below a voltage threshold. To jump start the vehicle battery, once the desired cable connections from portable battery pack 10 to the vehicle battery 30 have been made, the operator of the vehicle depresses the push button 21 momentarily. The processor unit 17 detects the depressed push button 21 and initiates charging of the energy storage pack 23 by activating the charger 19. The activation of the charger 19 occurs when the processor unit 17 opens the switch 24, which allows the energy storage pack 23 to be charged by the charger 19. The power source for charging the energy storage pack 23 can be provided by the DC power source or the vehicle battery 30. It may be possible for a weak vehicle battery to provide the power source for charging the energy storage pack 23.

[0032] Referring back to Figure 1b, the light display indicator 18 displays the various operational modes of the portable battery pack 10. The light display indicator 18 is controlled by the processor unit 17 and includes light-emitting diode (LED) lamps. The LED lamps provide indication to the user as to the status of the portable battery pack 10. For example, when the portable battery pack 10 is in the charging mode, the light display indicator is continuously red. When the device is in a jump starting mode, the light display indicator 18 shows a rapid intermittent flash of green. When the device is in normal operation mode, the light display indicator 18 is a slow intermittent flash of green. When the vehicle battery is weak, the light display indicator 18 displays an intermittent flash of red. Combinations of the red and green LED lamps, whether by color or by flashing, is not limited to the above combinations but can be used in other colors to display various operational modes.

[0033] As mentioned previously, the portable battery pack 10 can be used in various modes of operation. The portable battery pack 10 can be installed in the vehicle such that it is easily accessible from the passenger cabin. In this mode, the portable battery pack 10 is installed within the vehicle and coupled to the vehicle battery 30 via cables running through the vehicle's engine firewall and into the passenger cabin. The portable battery pack 10 may be placed for example, in the glove compartment of the vehicle or other easily accessible locations within the passenger cabin. In this way, the operator of the portable battery pack 10 can easily and quickly initiate the jump starting process to provide cranking energy in the passenger cabin without having to exit the vehicle. This allows the operator of the vehicle to jump start the car conveniently and safely in the comfort of the passenger cabin. This is especially critical when the vehicle is in the wilderness in the presence of wild animals and there is a danger that wild animals may attack while the operator of the vehicle is jump starting the car from outside the vehicle. Alternatively, the portable battery pack 10 can also be quickly and easily disconnected from the vehicle battery 30 and used separately from the vehicle for jump starting another vehicle battery. The operator of the vehicle simply disconnects the cables from the cable output of the portable battery pack 10, re-connect a separate set of cables from the cable output of the portable battery pack 10 to the vehicle battery of a separate vehicle.

[0034] Figures 7a-c show the various types of cables and connectors that couples the portable battery pack 10 to the vehicle battery 30. Figure 7a is an installation cable 60 for coupling between the portable battery pack 10 and the vehicle battery when the portable battery pack 10 is installed semi-permanently in the vehicle. The installation cable 60 includes a pair of elongated cables 61, each cable 61 having one end coupled to each polarity of the vehicle battery, and at the other end ending in a connector 62 for coupling to the portable battery pack 10. When used in this manner, the portable battery pack 10 is coupled parallel to the vehicle battery 30 via the installation cable 60 which passes through the vehicle firewall and through to the interior of the passenger cabin of the vehicle. For example, AWG4 Grade copper wires can be used. The installation cable 60 ends with the connector 62 for connecting to the portable battery pack 10. The connector 62 can be a military grade, ceramic based connector which provides a robust and secure connection to the portable battery pack 10.

[0035] Figure 7b shows a crocodile clip cable 70 for coupling to a second vehicle battery from the portable battery pack 10. Similar to the installation cable 60, the crocodile clip cable 70 includes a pair of elongated cables 71, each cable having one end including a crocodile clip 72 for coupling to one of the polarities of the vehicle battery and the other end terminating together with the other cable in a single connector 73 for connecting to the portable battery pack 10. The crocodile clip cable 70 is used when the portable battery pack 10 is used for jump starting another vehicle whose vehicle battery is weak or depleted. In this case, the installation cable 60 is quickly and easily disconnected by disconnecting the connector 62 from the portable battery pack 10. This is easily done because the portable battery pack 10 is within access to the operator of the vehicle. The connector 73 of the crocodile clip cable is connected to the portable battery pack 10 and at the other end the crocodile clips 72 are connected to the polarities of the second vehicle battery pack. Once connected, a person can activate the jump starting process by pushing the push button 21 located on the portable battery pack 10.

[0036] Figure 7c shows an igniter socket cable 80 for coupling with a cigarette igniter socket of a vehicle. The cable 80 includes a plug, adapter or coupler 81 for connecting to the cigarette igniter socket at one end and a DC output terminal 82 at the other end for connecting to the portable battery pack 10. When connected in this manner, the DC power source provides power to activate the charger 19 to charge the energy storage pack 23 and to provide starting energy to a weak vehicle battery. It will be apparent to a skilled person that various other modifications and adaptations of the cables are possible. For example, in the case of jump starting a weak battery of airplanes or boats, the cables and connector used will be adapted to suit the input or output terminals of the airplane or boat.

[0037] It will be apparent that various other modifications and adaptations of the application will be apparent to the person skilled in the art after reading the foregoing disclosure without departing from the spirit and scope of the application and it is intended that all such modifications and adaptations come within the scope of the appended claims.

CLAIMS

1. A portable battery pack for use with a battery of a transport vehicle, the portable battery pack comprising a housing including:
 - a cable outlet for connecting a positive and a negative connector for coupling with positive and negative terminals of the battery of the transport vehicle;
 - an energy storage pack arranged to provide starting energy to the vehicle when an electrical connection is made between the energy storage pack and the battery;
 - a charger unit for receiving a supply voltage from an external power source to provide a charging voltage to charge the energy storage pack;
 - a circuit having a switch configured to operate between a charging mode and a jump start mode,
 - a processor unit arranged for connection with the charger unit and the energy storage pack;
 - a push button coupled to the processor unit;wherein depressing the push button causes the switch to activate the charging mode in which the switch is open to allow the charger unit to provide charging voltage to charge the energy storage pack and a jump start mode in which the switch is closed to allow the energy storage pack to provide starting energy to the battery.
2. A method of supplying electrical energy to a battery of a transport vehicle, the method comprising:
 - providing a portable battery pack for coupling with the battery of the transport vehicle, the portable battery pack including:
 - a cable outlet for connecting a positive and a negative connector for coupling with positive and negative terminals of the battery of the transport vehicle;
 - an energy storage pack arranged to provide starting energy to the vehicle when an electrical connection is made between the energy storage pack and the battery;
 - a charger unit for receiving a supply voltage from an external power source to provide a charging voltage to charge the energy storage pack;

a circuit having a switch configured to operate between a charging mode and a jump start mode,

a processor unit arranged for connection with the charger unit and the energy storage pack;

a push button coupled to the processor unit;

wherein depressing the push button causes the switch to activate the charging mode in which the switch is open to allow the charger unit to provide charging voltage to charge the energy storage pack and a jump start mode in which the switch is closed to allow the energy storage pack to provide starting energy to the battery.