

ELECTRIC POWER SYSTEM OF ELECTRIC MOTORCYCLE

BACKGROUND OF THE INVENTION

Technical Field

[0001] The present invention is related to an electric vehicle, and more particularly to an electric power system of an electric motorcycle.

Description of Related Art

[0002] The development of the vehicle industry is gradually moving towards more pollution-free power sources such as high efficiency, energy-saving, and clean. Therefore, the power source of vehicles has been developed from early fuel engines to electric power motors in order to reduce exhaust gas and achieve the purpose of sustainable development and environmental protection. Especially for fuel-engine motorcycles, which exhaust more exhaust gas than cars do, so that the development of electric motorcycles has become a trend.

[0003] The conventional rechargeable batteries of electric motorcycles are divided into two types: replaceable and fixed. When the replaceable rechargeable battery is to be replaced, the rechargeable battery is drawn out from a body of the electric motorcycle and replaced at a battery exchange station. Fixed rechargeable batteries are charged by an external charging device, such as a charging station, or a home charger.

[0004] A charging connector is disposed on a body of a fixed-charging electric motorcycle and is adapted to be connected to both of a connector of a charging station and a connector of a home charger. In order to connect the connector of the home charger to the charging connector on the body, the connector of the home charger must be the same as the connector of the charging station. However, a charging current supplied by the charging station is higher than that of the home charger, so that an electrical characteristic required by a material of the connector is relatively high for withstanding the higher current of the connector of the charging cable, which causes a higher cost. For being used

with the charging connector on the body, the connector of the home charger must take the same specification as that of the connector of the charging station, increasing the cost of the home charger. In addition to the cost of the connector, the charging station has to communicate with a communication module in the electric motorcycle before charging, so that the home charger also needs to add a communication component to communicate with the communication module before charging, which also increases the cost of the home charger.

BRIEF SUMMARY OF THE INVENTION

[0005] In view of the above, the purpose of the present invention is to provide an electric power system of an electric motorcycle, which has two charging connectors respectively for being connected to two types of charging devices.

[0006] The present invention provides an electric power system of an electric motorcycle including a first charging connector, a second charging connector, a rechargeable battery, a communication module, a diode, a battery management module, and a battery on-off control module.

[0007] The first charging connector is adapted to be connected to a first connector of a first charging device, wherein the first charging connector has a first charging input port, a first power input port, and a first communication port. When the first charging connector is connected to the first charging device, a first charging power comes from the first charging device is outputted through the first charging input port. The first charging power has a first current.

[0008] The second charging connector is adapted to be connected to a second connector of a second charging device, wherein the second charging connector has a second charging input port and a second power input port. When the second charging connector is connected to the second charging device, a second charging power come from

the second charging device is outputted through the second charging input port. The second charging power has a second current smaller than the first current.

[0009] The communication module is electrically connected to the first power input port and the first communication port and communicates with the first charging device via the first communication port.

[0010] The diode has an anode and a cathode, wherein the anode is electrically connected to a positive terminal of the first power input port, and the cathode is electrically connected to a positive terminal of the second power input port.

[0011] The battery management module has a first connecting port, a second connecting port, a second communication port, and a conducting control port, wherein the first connecting port is electrically connected to the first charging input port and the second charging input port. The second connecting port is electrically connected to the rechargeable battery. The second communication port is electrically connected to the communication module, and the battery management module communicates with the first charging device via the communication module. When the conducting control port receives a trigger, the first connecting port and the second connecting port are connected, while when the trigger is released, the first connecting port and the second connecting port are disconnected.

[0012] The battery on-off control module is electrically connected to the conducting control port and the second power input port and electrically connected to the first power input port via the diode, wherein when either the first power input port or the second power input port outputs a predetermined power come from the first charging device or the second charging device, the battery on-off control module generates the trigger to the conducting control port, and the first charging power outputted by the first charging input port or the second charging power outputted by the second charging input

port is supplied to the rechargeable battery through the battery management module for charging.

[0013] When the first power input port outputs the predetermined power, the diode is forwarded, so that the predetermined power is outputted to the battery on-off control module, while when the second power input port outputs the predetermined power, the diode is reversely cut off, so that the predetermined power is blocked by the diode and is not supplied to the first power input port and the communication module.

[0014] By providing both of the first charging connector and the second charging connector, the user could choose to use either the first charging device or the second charging device to charge the rechargeable battery. In addition, when using the second charging device to charge, the communication module would not be affected. Moreover, since the second current is smaller than the first current, the second connector and the second charging connector could use the lower-cost material to reduce the cost of the second charging device.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0015] The present invention will be best understood by referring to the following detailed description of some illustrative embodiments in conjunction with the accompanying drawings, in which

[0016] FIG. 1 is a schematic view of the electric power system of the electric motorcycle according to a first embodiment of the present invention; and

[0017] FIG. 2 is a schematic view of the electric power system of the electric motorcycle according to a first embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] An electric power system 1 of an electric motorcycle according to an embodiment of the present invention is illustrated in FIG. 1, and includes a first charging connector 10, a second charging connector 12, at least one rechargeable battery 14, a

communication module 16, a diode 18, a battery management module 20, and a battery on-off control module 22, wherein the electric power system 1 is adapted to supply electricity to a control device 100 which includes a motor driving unit 100a and an electrical control unit 100b. The motor driving unit 100a is adapted to control a power motor 100c of the electric motorcycle to operate. The electrical control unit 100b is adapted to control a plurality of low-load powered components 100d which could be, for example, displays, indicator lights, headlights, brake lights, etc.

[0019] The first charging connector 10 is a fast-charging connector for being connected to a first charging device 200, wherein the first charging device 200 is a fast-charging device (e.g. a charger), and a first connector 200a (e.g. a charging cable) of the first charging device 200 could be connected to the first charging connector 10. The first charging connector 10 has a first charging input port 102, a first power input port 104, and a first communication port 106. When the first charging connector 10 is connected to the first charging device 200, the first charging device 200 outputs a first charging power to the first charging input port 102, thereby the first charging input port 102 outputs the first charging power, wherein the first charging power has a first voltage and a first current. In the current embodiment, the first voltage is 75V, and the first current is 60A. In addition, the first charging device 200 could output a predetermined power to the first power input port 104, thereby the first power input port 104 outputs the predetermined power. In the current embodiment, the predetermined power has a voltage which is 12V as an example and is smaller than the first voltage of the first charging power.

[0020] The second charging connector 12 is a general charging connector for being connected to a second charging device 300 which could be, for example, a home charger, wherein a second connector 300a of the second charging device 300 could be connected to the second charging connector 12. The second charging connector 12 has a second charging input port 122 and a second power input port 124. When the second

charging connector 12 is connected to the second charging device 300, the second charging device 300 could output a second charging power to the second charging input port 122, thereby the second charging input port 122 outputs the second charging power, wherein the second charging power has a second voltage and a second current. The second voltage is smaller than the first voltage and the voltage of the predetermined power, and the second current is smaller than the first current. In the current embodiment, the second voltage is 73V, and the second current is 4A. In other embodiments, the second voltage could be equal to the first voltage. In addition, the second charging device 300 could output the predetermined power to the second power input port 124, thereby the second power input port 124 outputs the predetermined power.

[0021] In the current embodiment, the rechargeable battery 14 is a 66V rechargeable battery as an example. In other embodiments, the rechargeable battery 14 could include a plurality of rechargeable batteries.

[0022] The communication module 16 is electrically connected to the first power input port 104 and the first communication port 106, and communicates with the first charging device 200 via the first communication port 106, wherein when the communication module 16 establishes a communication with the first charging device 200, the first charging device 200 outputs the predetermined power to the first power input port 104 of the first charging connector 10, thereby the first power input port 104 outputs the predetermined power. The communication module 16 could be an EV Communication Controller (EVCC). After the communication module 16 receives the predetermined power, a leakage detection process is performed. When a leakage is detected, the communication module 16 sends an abnormal message to the first charging device 200, and the first charging device 200 displays an abnormal status via a display (not shown), and the first charging device 200 stops outputting the predetermined power. When there is no leakage being detected, the communication module 16 sends a normal message to the

first charging device 200, and the first charging device 200 outputs the first charging power.

[0023] An anode of the diode 18 is electrically connected to a positive terminal of the first power input port 104, and a cathode of the diode 18 is electrically connected to a positive terminal of the second power input port 124.

[0024] The battery management module 20 has a first connecting port 202, a second connecting port 204, a second communication port 206, and a conducting control port 208, wherein the battery management module 20 is adapted to manage charging and discharging of the rechargeable battery 14 and detect a state of the rechargeable battery 14, such as power, voltage, current, temperature, etc. The first connecting port 202 is electrically connected to the first charging input port 102 and the second charging input port 122. The second connecting port 204 is electrically connected to the rechargeable battery 14. The second communication port 206 is electrically connected to the communication module 16, and the battery management module 20 communicates with the first charging device 200 via the communication module 16, thereby transmitting a state of the battery management module 20 and the state of the rechargeable battery 14 to the first charging device 200. When the conducting control port 208 receives a trigger, the first connecting port 202 is connected to the second connecting port 204, while when the trigger is released, the first connecting port 202 and the second connecting port 204 are disconnected. In the current embodiment, the trigger is, but not limited to, short-circuit. In other embodiments, a change in electric potential could also be used as the trigger. In the current embodiment, when the communication module 16 receives the predetermined power but fails to establish a communication with the first charging device 200, the abnormal message is transmitted to the second communication port 206, and the battery management module 20 accordingly cuts off a connection between the first connecting port 202 and the second connecting port 204. The battery management module 20 could

be electrically connected to the control device 100 to transmit the state of the rechargeable battery 14 to the control device 100.

[0025] The battery on-off control module 22 is electrically connected to the conducting control port 208 and the second power input port 124 and is electrically connected to the first power input port 104 via the diode 18. When either the first power input port 104 or the second power input port 124 outputs the predetermined power, the battery on-off control module 22 accordingly generates the trigger to the conducting control port 208, and the first charging power outputted by the first charging input port 102 or the second charging power outputted by the second charging input port 122 is supplied to the rechargeable battery 14 via the battery management module 20 for charging. When the first power input port 104 outputs the predetermined power, the diode 18 is forwarded (i.e. current flows through the diode from the anode to the cathode), so that the predetermined power outputted by the first power input port 104 is outputted to the battery on-off control module 22, and the battery on-off control module 22 correspondingly generates the trigger to the conducting control port 208, and the first connecting port 202 of the battery management module 20 and the second connecting port 204 are connected, thereby the first charging power outputted by the first charging input port 102 is supplied to the rechargeable battery 14 for charging. When the second power input port 124 outputs the predetermined power, the predetermined power outputted by the second power input port 124 is outputted to the battery on-off control module 22, and the battery on-off control module 22 correspondingly generates the trigger to the conducting control port 208, and the first connecting port 202 of the battery management module 20 and the second connecting port 204 are connected, thereby the second charging device 300 outputs the second charging power to charge the rechargeable battery 14; at the same time, the diode 18 is reversely cut off, and the predetermined power is blocked by the diode 18 and is not outputted to the first power input port 104 and the communication module 16,

thereby avoiding affecting an operation of the communication module 16, for example, it could prevent the communication module 16 from incorrectly determining that the first charging device 200 is connected to the first charging connector 10 but fails to communicate with the first charging device 200, causing an abnormality and cannot charge.

[0026] In the current embodiment, the battery on-off control module 22 is a battery on-off relay 24 which has a control port 242 and two pins 244, wherein the control port 242 is electrically connected to the cathode of the diode 18 and the second power input port 124, and the two pins 244 are electrically connected to the conducting control port 208. The two pins 244 are in a normally-open state (i.e., the two pins 244 are normally disconnected), wherein when the control port 242 of the battery on-off relay 24 receives the predetermined power, the two pins 244 are connected to form the trigger, and the two pins 244 return to the normally-open state after the predetermined power is released. In other embodiments, the battery on-off control module 22 could be an electronic switch, such as transistors, solid relays, etc, which could generate the trigger as well.

[0027] In the current embodiment, the electric power system 1 could further include a motor power control module 26 for controlling whether electricity is outputted to the motor driving unit 100a of the control device 100. The motor power control module 26 has a control port 26a, an input port 26b, and an output port 26c, wherein the control port 26a is electrically connected to the second power input port 124 and is electrically connected to the first power input port 104 via the diode 18. The input port 26b is electrically connected to the first connecting port 202 of the battery management module 20, and the output port 26c is electrically connected to the motor driving unit 100a. When either the first power input port 104 or the second power input port 124 outputs the predetermined power, the control port 26a receives the predetermined power, and the motor power control module 26 cuts off an electrical connection between the input port

26b and the output port 26c, so that the first charging power or the second charging power does not be supplied to the motor driving unit 100a. In this way, the motor driving unit 100a could be prevented from consuming too much electricity and affecting charging and wrongly controlling the operation of the power motor which may cause danger.

[0028] In the current embodiment, the motor power control module 26 includes a first relay 28 and a second relay 30, wherein the first relay 28 has a first control port 282, a first input port 284, and a first output port 286. The first control port 282 has a first control pin 282a and a second control pin 282b, wherein the first control pin 282a is electrically connected to a positive terminal of the first connecting port 202 of the battery management module 20. In the current embodiment, at least one overload protector is selectively disposed between the first control pin 282a and the first connecting port 202, wherein the positive terminal of the first connecting port 202 is electrically connected to the first control pin 282a and the electrical control unit 100b via the overload protector. In the current embodiment, two overload protectors, which are respectively a circuit breaker 32 and a fuse, are provided. The first input port 284 constitutes the input port 26b, and the first output port 286 constitutes the output port 26c. The second relay 30 has a second control port 302, a first pin 304, and a second pin 306, wherein the second control port 302 constitutes the control port 26a, and the first pin 304 is electrically connected to the second control pin 282b of the first relay 28, and the second pin 306 is electrically connected to a negative terminal of the first connecting port 202 of the battery management module 20. When the second control port 302 receives the predetermined power, an open circuit occurs between the first pin 304 and the second pin 306, so that the first control port 282 cannot receive the first charging power or the second charging power and therefore cannot be excited, making an open circuit occur between the first input port 284 and the first output port 286. In this way, a purpose of not supplying power to the motor driving unit 100a during charging is achieved, and the first charging power or the

second charging power could still be supplied to the electrical control unit 100b for controlling the low-load powered components 100d (e.g. the state of the rechargeable battery 14 displayed on the display is current electrical quantity and is in charging).

[0029] When the first charging device 200 does not be connected to the first charging connector 10 or the second charging device 300 does not be connected to the second charging connector 12, the second control port 302 does not receive the predetermined power, so that the first pin 304 and the second pin 306 are in a normally-closed state. The second relay 30 further has a third pin 308, wherein the third pin 308 and the second pin 306 are in a normally-open state.

[0030] For increasing a safety of using the second charging device 300, in the current embodiment, the second charging connector 12 further has an activating pin 126 electrically connected to the third pin 308, wherein the second charging device 300 detects a state of the activating pin 126 to determine whether to output the second charging power. When the second control port 302 receives the predetermined power, the second pin 306 is connected to the third pin 308, thereby the activating pin 126 is connected to a negative terminal of the second charging input port 122 (i.e., the activating pin 126 is connected to the negative terminal of the first connecting port 202 of the battery management module 20). When the second charging device 300 detects that the activating pin 126 is connected to the negative terminal of the second charging input port 122, which represents that the second charging device 300 is securely connected, the second charging power is outputted to charge the rechargeable battery 14.

[0031] In the current embodiment, the electric power system 1 could further include an activating switch, wherein the activating switch could be turned on by a key or by a wireless way. The activating switch 36 is electrically connected to the conducting control port 208 of the battery management module 20 and is connected in parallel with

the two pins 244 of the battery on-off relay 24. In a condition that the first charging device 200 does not be connected to the first charging connector 10 and the second charging device 300 does not be connected to the second charging connector 12, the activating switch 36 is turned on to be short-circuit to form the trigger, thereby an electricity of the rechargeable battery 14 is outputted via the first connecting port 202 of the battery management module 20 and is transmitted to the first control port 282 of the first relay 28, so that the first input port 284 and the first output port 286 are short-circuited, and the electricity of the rechargeable battery 14 could be outputted to the motor driving unit 100a via the first relay 28 to provide the electricity for the motor driving unit 100a. In addition, the electricity of the rechargeable battery 14 is also supplied to the electrical control unit 100b for controlling the low-load powered components 100d.

[0032] An electric power system 2 of an electric motorcycle according to a second embodiment of the present invention is illustrated in FIG. 2, which has almost the same structures as that of the first embodiment, except that the first input port 284 of the first relay 28 is electrically connected to the first connecting port 202 of the battery management module 20 via the at least one overload protector (e.g. the circuit breaker 32 and/or the fuse 34), thereby providing an overload protection for the motor driving unit 100a.

[0033] With the aforementioned design, by providing two different types of charging connectors, a user could choose to use either the first charging device 200 or the second charging device 300 to charge the rechargeable battery 14. When using the second charging device 300 to charge, the reversely blocking effect of the diode 18 could prevent the predetermined voltage outputted by the second power input port 124 from affecting the communication module 16. It is worth mentioning that, since the second current flows through the second connector 300a of the second charging device 300 is smaller, an electrical characteristic requirement of a material of the second connector 300a is lower

than that of the first connector 200a, thereby reducing a cost of the second charging device 300. Moreover, the second charging device 300 does not need to communicate with the communication module 16, the cost of the second charging device 300 could be further reduced.

[0034] It must be pointed out that the embodiments described above are only some embodiments of the present invention. All equivalent structures which employ the concepts disclosed in this specification and the appended claims should fall within the scope of the present invention.

WHAT IS CLAIMED IS:

1. An electric power system of an electric motorcycle, comprising:

a first charging connector adapted to be connected to a first connector of a first charging device, wherein the first charging connector has a first charging input port, a first power input port, and a first communication port; when the first charging connector is connected to the first charging device, a first charging power come from the first charging device is outputted through the first charging input port; the first charging power has a first current;

a second charging connector adapted to be connected to a second connector of a second charging device, wherein the second charging connector has a second charging input port and a second power input port; when the second charging connector is connected to the second charging device, a second charging power come from the second charging device is outputted through the second charging input port; the second charging power has a second current smaller than the first current;

a rechargeable battery;

a communication module electrically connected to the first power input port and the first communication port and communicating with the first charging device via the first communication port;

a diode having an anode and a cathode, wherein the anode is electrically connected to a positive terminal of the first power input port, and the cathode is electrically connected to a positive terminal of the second power input port;

a battery management module having a first connecting port, a second connecting port, a second communication port, and a conducting control port, wherein the first connecting port is electrically connected to the first charging input port and the second charging input port; the second connecting port is electrically connected to the rechargeable battery; the second communication port is electrically connected to the communication module, and

the battery management module communicates with the first charging device via the communication module; when the conducting control port receives a trigger, the first connecting port and the second connecting port are connected, while when the trigger is released, the first connecting port and the second connecting port are disconnected; and

a battery on-off control module electrically connected to the conducting control port and the second power input port and electrically connected to the first power input port via the diode, wherein when either the first power input port or the second power input port outputs a predetermined power coming from the first charging device or the second charging device, the battery on-off control module generates the trigger to the conducting control port, and the first charging power outputted by the first charging input port or the second charging power outputted by the second charging input port is supplied to the rechargeable battery through the battery management module for charging;

wherein when the first power input port outputs the predetermined power, the diode is forwarded, so that the predetermined power is outputted to the battery on-off control module, while when the second power input port outputs the predetermined power, the diode is reversely cut off, so that the predetermined power is blocked by the diode and is not supplied to the first power input port and the communication module.

2. The electric power system of claim 1, further comprising a motor power control module, wherein the motor power control module has a control port, an input port, and an output port; the control port is electrically connected to the second power input port and is electrically connected to the first power input port via the diode; the input port is electrically connected to the first connecting port of the battery management module; the output port is electrically connected to a motor driving unit; when either the first power input port or the second power input port outputs the predetermined power, the control port receives the predetermined power, and the motor power control module cuts off an electrical connection between the input port and the output port.

3. The electric power system of claim 2, wherein the motor power control module comprises a first relay and a second relay; the first relay has a first control port, a first input port, and a first output port; the first control port has a first control pin and a second control pin; the first control pin is electrically connected to a positive terminal of the first connecting port of the battery management module; the first input port constitutes the input port; the first output port constitutes the output port; the second relay has a second control port, a first pin, and a second pin; the second control port constitutes the control port; the first pin is electrically connected to the second control pin; the second pin is electrically connected to a negative terminal of the first connecting port of the battery management module; when the second control port receives the predetermined power, an open circuit occurs between the first pin and the second pin, and an open circuit occurs between the first input port and the first output port.

4. The electric power system of claim 3, wherein when the second control port does not receive the predetermined power, the first pin and the second pin are in a normally-closed state.

5. The electric power system of claim 4, further comprising an activating switch electrically connected to the conducting control port, wherein when the first charging connector does not be connected to the first charging device and the second charging connector does not be connected to the second charging device, the activating switch turns on to form the trigger, thereby an electricity of the rechargeable battery is outputted to the motor driving unit via the battery management module and the first relay.

6. The electric power system of claim 4, wherein the second charging connector has an activating pin which is adapted to be detected by the second charging device to determine whether to output the second charging power; the second relay has a third pin electrically connected to the activating pin; when the second control port receives the predetermined power, the second pin and the third pin are connected; when the second charging device

detects that the activating pin and the negative terminal of the first connecting port of the battery management module are connected, the second charging power is outputted.

7. The electric power system of claim 4, wherein the first control pin is electrically connected to the positive terminal of the first connecting port of the battery management module via at least one overload protector.

8. The electric power system of claim 7, wherein the positive terminal of the first connecting port of the battery management module is electrically connected to an electrical control unit via the at least one overload protector.

9. The electric power system of claim 7, wherein the first input port is electrically connected to the first connecting port of the battery management module via the at least one overload protector.

10. The electric power system of claim 1, wherein the battery on-off control module comprises a battery on-off relay which has a control port and two pins; the control port is electrically connected to the cathode of the diode and the second power input port; the two pins are electrically connected to the conducting control port; when the control port receives the predetermined power, the two pins are connected to form the trigger.

11. The electric power system of claim 10, further comprising an activating switch electrically connected to the two pins, wherein the trigger is formed when the activating switch is turned on.