

EMERGENCY SELF-PROPELLED TRACTION SYSTEM FOR MULTIPLE-UNIT TRAIN

[0001] The present application claims the priorities to Chinese Patent Application
5 No.201811482759.2, titled "EMERGENCY SELF-PROPELLED TRACTION SYSTEM
FOR MULTIPLE-UNIT TRAIN", filed on December 5, 2018 with the Chinese Patent Office,
and Chinese Patent Application No.201822038030.8, titled "EMERGENCY
SELF-PROPELLED TRACTION SYSTEM FOR MULTIPLE-UNIT TRAIN", filed on
December 5, 2018 with the Chinese Patent Office, both of which are incorporated herein by
10 reference in their entireties.

FIELD

[0002] The present disclosure relates to the technical field of multiple-unit trains, and in
particular to an emergency self-propelled traction system for a multiple-unit train.

BACKGROUND

[0003] At present, the traction system for a multiple-unit train obtains electric energy from
a power supply catenary via a pantograph, to drive a traction motor. In a case that no power is
supplied from the power supply catenary, the current traction system for a multiple-unit train
20 can only maintain functions such as emergency lighting and ventilation with a storage battery,
but cannot maintain the normal operation of the traction system for a multiple-unit train.

[0004] Therefore, a technical problem urgently to be solved by those skilled in the art is
how to provide an emergency self-propelled traction system for a multiple-unit train, which
can maintain the propelling of the traction system for a multiple-unit train in a case that no
25 power is supplied from the power supply catenary.

SUMMARY

[0005] An emergency self-propelled traction system for a multiple-unit train is provided
according to the embodiments of the present disclosure, to maintain the propelling of the

traction system for a multiple-unit train in a case that no power is supplied from a power supply catenary.

[0006] To achieve the above object, the following technical solutions are provided according to the embodiments of the present disclosure.

5 **[0007]** An emergency self-propelled traction system for a multiple-unit train includes: a four-quadrant rectifier, a traction inverter, a traction motor, a high frequency isolated bidirectional DC/DC converter, a bidirectional DC/DC converter, and a power battery.

[0008] An input terminal of the four-quadrant rectifier is electrically connected to an external alternating-current power grid, and an output terminal of the four-quadrant rectifier is
10 connected to an input terminal of the traction inverter and a first terminal of the bidirectional DC/DC converter, a second terminal of the bidirectional DC/DC converter is connected to the power battery, and an output terminal of the traction inverter is connected to the traction motor.

[0009] If power is supplied from the external alternating-current power grid normally, the
15 four-quadrant rectifier is configured to convert an alternating-current voltage supplied from the external alternating-current power grid into a first direct-current voltage, and the traction inverter is configured to convert the first direct-current voltage into a target alternating-current voltage, and supply power to the traction motor by using the target alternating-current voltage. The high frequency isolated bidirectional DC/DC converter is
20 configured to convert the first direct-current voltage into a second direct-current voltage, and the bidirectional DC/DC converter is configured to charge the power battery by using the second direct-current voltage.

[0010] If no power is supplied from the external alternating-current power grid, the power battery is configured to supply power to the traction inverter via the bidirectional DC/DC
25 converter and the high frequency isolated bidirectional DC/DC converter, to supply power to the traction motor.

[0011] Specifically, the system further includes: an auxiliary inverter and an auxiliary load.

[0012] An input terminal of the auxiliary inverter is connected to a second terminal of the high frequency isolated bidirectional DC/DC converter, and the auxiliary load is connected to
30 an output terminal of the auxiliary inverter.

[0013] Specifically, the system further includes: a DC/DC converter, a direct-current load, and a storage battery.

[0014] An input terminal of the DC/DC converter is connected to the output terminal of the four-quadrant rectifier, and an output terminal of the DC/DC converter is connected to the direct-current load and the storage battery.

[0015] Specifically, the first direct-current voltage ranges from 2700V to 3850V, the target alternating-current voltage is 2800V, the second direct-current voltage is 700V, the alternating-current voltage of the external alternating-current grid is 25 kV, and an output voltage of the power battery is a direct-current voltage of 650V.

[0016] Specifically, a voltage at the output terminal of the auxiliary inverter is an alternating-current voltage of 380V.

[0017] Specifically, an output voltage of the storage battery is a direct-current voltage of 110V.

[0018] Based on the above technical solutions, an emergency self-propelled traction system for a multiple-unit train is provided according to the embodiments of the present disclosure. The system includes a four-quadrant rectifier, a traction inverter, a traction motor, a high frequency isolated bidirectional DC/DC converter, a bidirectional DC/DC converter, and a power battery. An input terminal of the four-quadrant rectifier is electrically connected to an external alternating-current power grid, and an output terminal of the four-quadrant rectifier is connected to an input terminal of the traction inverter and a first terminal of the bidirectional DC/DC converter, a second terminal of the bidirectional DC/DC converter is connected to the power battery, and an output terminal of the traction inverter is connected to the traction motor. If power is supplied from the external alternating-current power grid normally, the four-quadrant rectifier is configured to convert an alternating-current voltage supplied from the external alternating-current power grid into a first direct-current voltage, and the traction inverter is configured to convert the first direct-current voltage into a target alternating-current voltage, and supply power to the traction motor by using the target alternating-current voltage. The high frequency isolated bidirectional DC/DC converter is configured to convert the first direct-current voltage into a second direct-current voltage, and the bidirectional DC/DC converter is configured to charge the power battery by using the second direct-current voltage. If no power is supplied from the external alternating-current

power grid, the power battery is configured to supply power to the traction inverter via the bidirectional DC/DC converter and the high frequency isolated bidirectional DC/DC converter, to supply power to the traction motor. That is, with the emergency self-propelled traction system for a multiple-unit train according to the embodiments of the present disclosure, the propelling of the traction system for a multiple-unit train can be maintained in a case that no power is supplied from a power supply catenary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The drawings to be used in the description of the embodiments or the conventional technology are described briefly as follows, so that the technical solutions according to the embodiments of the present disclosure or according to the conventional technology become clearer. It is apparent that the drawings in the following description only illustrate some embodiments of the present disclosure. For those skilled in the art, other drawings may be obtained according to these drawings without any creative work.

[0020] Figure 1 is a schematic structural diagram of an emergency self-propelled traction system for a multiple-unit train according to an embodiment of the present disclosure;

[0021] Figure 2 is a schematic structural diagram of an emergency self-propelled traction system for a multiple-unit train according to another embodiment of the present disclosure;

[0022] Figure 3 is a schematic structural diagram of an emergency self-propelled traction system for a multiple-unit train according to another embodiment of the present disclosure; and

[0023] Figure 4 is a specific schematic structural diagram of an emergency self-propelled traction system for a multiple-unit train according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0024] Reference is made to Figure 1, which is a schematic structural diagram of an emergency self-propelled traction system for a multiple-unit train according to an embodiment of the present disclosure. The traction system for a multiple-unit train includes: a four-quadrant rectifier 11, a traction inverter 12, a traction motor 13, a high frequency isolated bidirectional DC/DC converter 14, a bidirectional DC/DC converter 15, and a power battery

16.

[0025] An input terminal of the four-quadrant rectifier is electrically connected to an external alternating-current power grid, and an output terminal of the four-quadrant rectifier is connected to an input terminal of the traction inverter and a first terminal of the bidirectional DC/DC converter, and a second terminal of the bidirectional DC/DC converter is connected to the power battery, and an output terminal of the traction inverter is connected to the traction motor.

[0026] If power is supplied from the external alternating-current power grid normally, the four-quadrant rectifier is configured to convert an alternating-current voltage supplied from the external alternating-current power grid into a first direct-current voltage, and the traction inverter is configured to convert the first direct-current voltage into a target alternating-current voltage, and supply power to the traction motor by using the target alternating-current voltage. The high frequency isolated bidirectional DC/DC converter is configured to convert the first direct-current voltage into a second direct-current voltage, and the bidirectional DC/DC converter is configured to charge the power battery by using the second direct-current voltage.

[0027] If no power is supplied from the external alternating-current power grid, the power battery is configured to supply power to the traction inverter via the bidirectional DC/DC converter and the high frequency isolated bidirectional DC/DC converter, to supply power to the traction motor.

[0028] That is, with the emergency self-propelled traction system for a multiple-unit train according to the embodiment of the present disclosure, the propelling of the traction system for a multiple-unit train can be maintained in a case that no power is supplied from a power supply catenary.

[0029] It is to be noted that, in the embodiment, the first direct-current voltage ranges from 2700V to 3850V, the target alternating-current voltage is 2800V, the second direct-current voltage is 700V, the alternating-current voltage of the external alternating-current power grid is 25 kV, and an output voltage of the power battery is a direct-current voltage of 650V.

[0030] Based on the above embodiment, as shown in Figure 2, an emergency self-propelled traction system for a multiple-unit train is further provided according to an embodiment,

which further includes: an auxiliary inverter 21 and an auxiliary load 22.

[0031] An input terminal of the auxiliary inverter is connected to a second terminal of the high frequency isolated bidirectional DC/DC converter, and the auxiliary load is connected to an output terminal of the auxiliary inverter. A voltage at the output terminal of the auxiliary inverter is an alternating-current voltage of 380V.

[0032] Based on the above embodiment, as shown in Figure 3, an emergency self-propelled traction system for a multiple-unit train is further provided according to an embodiment, which further includes: a DC/DC converter 31, a direct-current load 32, and a storage battery 33.

[0033] An input terminal of the DC/DC converter is connected to the output terminal of the four-quadrant rectifier, and an output terminal of the DC/DC converter is connected to the direct-current load and the storage battery. An output voltage of the storage battery may be a direct-current voltage of 110V.

[0034] Based on the above embodiments, as shown in Figure 4, which is a specific schematic structural diagram of an emergency self-propelled traction system for a multiple-unit train according to an embodiment of the present disclosure. With the emergency self-propelled traction system for a multiple-unit train according to the embodiment, the traction motor and the auxiliary devices can be supplied with power even if no power is supplied from the external power grid. In addition, the traction motor is a permanent magnet traction motor, in which a bidirectional charger is connected to a high-frequency auxiliary DC/AC module, and then is connected to an intermediate direct-current part of a converter to supply power to the traction inverter, which has a high efficiency.

[0035] It is to be noted that a high-frequency bidirectional auxiliary inverter is adopted, which may fully take the advantage of soft switching, thus reducing the system loss. In addition, the high-frequency bidirectional auxiliary inverter is more efficient, and the permanent magnet traction motor is adopted, such that the traction system is more efficient during a low-speed section, thus saving the energy.

[0036] In summary, an emergency self-propelled traction system for a multiple-unit train is provided according to the embodiments of the present disclosure. The system includes a four-quadrant rectifier, a traction inverter, a traction motor, a high frequency isolated

bidirectional DC/DC converter, a bidirectional DC/DC converter, and a power battery. An input terminal of the four-quadrant rectifier is electrically connected to an external alternating-current power grid, and an output terminal of the four-quadrant rectifier is connected to an input terminal of the traction inverter and a first terminal of the bidirectional DC/DC converter, a second terminal of the bidirectional DC/DC converter is connected to the power battery, and an output terminal of the traction inverter is connected to the traction motor. If power is supplied from the external alternating-current power grid normally, the four-quadrant rectifier is configured to convert an alternating-current voltage supplied from the external alternating-current power grid into a first direct-current voltage, and the traction inverter is configured to convert the first direct-current voltage into a target alternating-current voltage, and supply power to the traction motor by using the target alternating-current voltage. The high frequency isolated bidirectional DC/DC converter is configured to convert the first direct-current voltage into a second direct-current voltage, and the bidirectional DC/DC converter is configured to charge the power battery by using the second direct-current voltage. If no power is supplied from the external alternating-current power grid, the power battery is configured to supply power to the traction inverter via the bidirectional DC/DC converter and the high frequency isolated bidirectional DC/DC converter, to supply power to the traction motor. That is, with the emergency self-propelled traction system for a multiple-unit train according to the embodiments of the present disclosure, the propelling of the traction system for a multiple-unit train can be maintained in a case that no power is supplied from a power supply catenary.

[0037] The embodiments in this specification are described in a progressive way, each of which emphasizes the differences from others, and the same or similar parts among the embodiments can be referred to each other. Since the devices disclosed in the embodiments corresponds to the method therein, the description thereof is relatively simple, and for relevant matters references may be made to the description of the method.

[0038] It may be known by those skilled in the art that, units and steps in each example described in conjunction with the embodiments disclosed herein can be realized by electronic hardware, computer software or a combination thereof. In order to clearly illustrate interchangeability of the hardware and the software, steps and composition of each embodiment have been described generally in view of functions in the above specification. Whether the function is executed in a hardware way or in a software way depends on

application of the technical solution and design constraint condition. Those skilled in the art can use different method for each application to realize the described function, and this is not considered to be beyond the scope of the application.

5 **[0039]** The steps of the methods or algorithms described in conjunction with the embodiments of the present disclosure can be implemented with hardware, software modules executed by a processor, or a combination thereof. The software modules may reside in a Random Access Memory (RAM), an internal memory, a Read Only Memory (ROM), an Electrically Programmable ROM, an Electrically-Erasable Programmable ROM, a register, a hard disk, a removable disk drive, CD-ROM, or other types of storage media well known in
10 the technical field.

15 **[0040]** With the above descriptions of the disclosed embodiments, the skilled in the art may practice or use the present disclosure. Various modifications to the embodiments are apparent for the skilled in the art. The general principle suggested herein can be implemented in other embodiments without departing from the spirit or scope of the disclosure. Therefore, the present disclosure should not be limited to the embodiments disclosed herein, but has the widest scope that is conformity with the principle and the novel features disclosed herein.

CLAIMS

1. An emergency self-propelled traction system for a multiple-unit train, comprising: a four-quadrant rectifier, a traction inverter, a traction motor, a high frequency isolated
5 bidirectional DC/DC converter, a bidirectional DC/DC converter, and a power battery, wherein

an input terminal of the four-quadrant rectifier is electrically connected to an external alternating-current power grid, and an output terminal of the four-quadrant rectifier is connected to an input terminal of the traction inverter and a first terminal of the bidirectional
10 DC/DC converter, a second terminal of the bidirectional DC/DC converter is connected to the power battery, and an output terminal of the traction inverter is connected to the traction motor, and wherein

if power is supplied from the external alternating-current power grid normally,

the four-quadrant rectifier is configured to convert an alternating-current voltage
15 supplied from the external alternating-current power grid into a first direct-current voltage, and the traction inverter is configured to convert the first direct-current voltage into a target alternating-current voltage, and supply power to the traction motor by using the target alternating-current voltage; and

the high frequency isolated bidirectional DC/DC converter is configured to convert
20 the first direct-current voltage into a second direct-current voltage, and the bidirectional DC/DC converter is configured to charge the power battery by using the second direct-current voltage, and

if no power is supplied from the external alternating-current power grid,

the power battery is configured to supply power to the traction inverter via the
25 bidirectional DC/DC converter and the high frequency isolated bidirectional DC/DC converter, to supply power to the traction motor.

2. The emergency self-propelled traction system for a multiple-unit train according to claim 1, further comprising: an auxiliary inverter and an auxiliary load, wherein

an input terminal of the auxiliary inverter is connected to a second terminal of the high
30 frequency isolated bidirectional DC/DC converter, and the auxiliary load is connected to an

output terminal of the auxiliary inverter.

3. The emergency self-propelled traction system for a multiple-unit train according to claim 1, further comprising: a DC/DC converter, a direct-current load, and a storage battery, wherein

5 an input terminal of the DC/DC converter is connected to the output terminal of the four-quadrant rectifier, and an output terminal of the DC/DC converter is connected to the direct-current load and the storage battery.

4. The emergency self-propelled traction system for a multiple-unit train according to claim 1, wherein

10 the first direct-current voltage ranges from 2700V to 3850V, the target alternating-current voltage is 2800V, the second direct-current voltage is 700V, the alternating-current voltage of the external alternating-current power grid is 25 kV, and an output voltage of the power battery is a direct-current voltage of 650V.

15 5. The emergency self-propelled traction system for a multiple-unit train according to claim 2, wherein

a voltage at the output terminal of the auxiliary inverter is an alternating-current voltage of 380V.

6. The emergency self-propelled traction system for a multiple-unit train according to claim 3, wherein

20 an output voltage of the storage battery is a direct-current voltage of 110V.