

DESCRIPTION

TITLE OF INVENTION

MOBILE POWER SUPPLY VEHICLE

FIELD

[0001]

The present invention relates to a mobile power supply vehicle.

BACKGROUND

[0002]

A mobile power supply vehicle includes, for example, electric power supply equipment such as a power generator and a power storage device, and is configured to be capable of charging an external power storage device and supplying electric power to an external electric device or the like by using the electric power supply equipment (Patent Literature 1).

[0003]

A mobile power supply vehicle is also expected to serve as an emergency power supply source at a disaster site. At a disaster site (disaster-affected area) where a power supply grid has been damaged, there are diverse power supply needs for various electric devices, and mobile power supply vehicles that can provide support as a power supply source in response to such diverse needs have been considered.

[0004]

As a mobile power supply vehicle, there has been proposed a mobile power supply vehicle including a diesel engine for traveling and for DC power generation and an LPG engine for AC power generation, in which DC electric power is generated by driving the diesel engine and AC electric power is generated by driving the LPG engine (Patent Literature 2).

[CITATION LIST]

[PATENT LITERATURE]

[0005]

[PTL 1] JP2013-027194A

[PTL 2] JP2023-083185A

SUMMARY

[TECHNICAL PROBLEM]

[0006]

However, in the prior art such as Patent Literature 2, since the rotational speed of the diesel engine for traveling is unstable, if AC power is to be generated by rotating an AC generator through driving of the diesel engine, the rotational speed of the generator becomes unstable, and therefore the voltage of the generated AC power cannot be kept constant. Accordingly, DC power has been generated and AC power has been generated via a DC/AC inverter. Further, in order to directly generate AC power, a separate power source such as an LPG engine has been required. When DC power is generated and then converted into AC power, a DC/AC inverter is separately required, which correspondingly requires installation space and increases cost, and losses also occur during conversion from DC to AC. Further, when a separate power source such as an LPG engine is required, fuel therefor is also required together with the power source, which correspondingly requires installation space and increases cost.

[0007]

The present invention has been made in view of the above circumstances, and an object thereof is to provide a mobile power supply vehicle capable of generating AC power having a substantially constant voltage by driving an AC generator through driving of a diesel engine for traveling.

[SOLUTION TO PROBLEM]

[0008]

The gist of the present invention is as follows.

(1) A mobile power supply vehicle comprising:

a base vehicle capable of traveling;

a diesel engine mounted on the base vehicle and a choke controller connected to the diesel engine;

a PTO connected to the diesel engine;

an AC generator;

a first pulley connected to the PTO;

a second pulley connected to the AC generator and connected to the first pulley via a belt;

an automatic voltage regulator connected to the AC generator and the diesel engine; and

a power generation control circuit connected to the AC generator,

wherein the diesel engine is used both for traveling of the base vehicle and for power generation by the AC generator,

the power generation control circuit is configured to supply AC power generated by the AC generator driven by the diesel engine to a power-receiving-side device,

the AC generator is configured such that a rotational speed of the AC generator is changeable so that an output voltage and an output frequency of the AC generator approach a voltage and a

frequency set by the automatic voltage regulator in accordance with a load fluctuation of the power-receiving-side device, and

the choke controller increases or decreases an engine rotational speed of the diesel engine in accordance with a command from the automatic voltage regulator for maintaining the rotational speed of the AC generator at a prescribed rotational speed.

(2) The mobile power supply vehicle according to (1) above, wherein the first pulley, the second pulley, or both are configured to be replaceable with pulleys having a shaft diameter, a number of belts, or both adapted to an output of the diesel engine and power generation capability of the AC generator.

(3) The mobile power supply vehicle according to (1) or (2) above, wherein the power generation control circuit is configured to output power in a single-phase three-wire system, a three-phase three-wire system, or a combination thereof.

(4) The mobile power supply vehicle according to (1) or (2) above, wherein the power generation control circuit is configured to output 100 V/200 V in a single-phase three-wire system and 200 V in a three-phase three-wire system, 100 V/200 V in a single-phase three-wire system and 200 V/400 V in a three-phase three-wire system, or 200 V/400 V in a three-phase three-wire system.

(5) The mobile power supply vehicle according to any one of (1) to (4) above, further comprising a storage battery, wherein the storage battery is configured to store DC power obtained from an external power source and to supply AC power to the power-receiving-side device.

[ADVANTAGEOUS EFFECTS OF INVENTION]

[0009]

According to the present invention, it is possible to provide a mobile power supply vehicle capable of generating AC power having a substantially constant voltage by driving an AC generator through driving of a diesel engine for traveling.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a schematic view illustrating an example of a mobile power supply vehicle 100 including a diesel engine 10, a PTO 20, a first pulley 31, a second pulley 32, a belt 40, and an AC generator 50 mounted on a base vehicle 1.

FIG. 2 is a schematic view as viewed in a downward direction on the sheet of FIG. 1 from the cross section A-A' of FIG. 1.

FIG. 3 is a block diagram illustrating a configuration relating to power supply of the mobile power supply vehicle.

FIG. 4 illustrates examples of power-receiving-side devices for AC power supplied by the mobile power supply vehicle.

FIG. 5 is a block diagram illustrating a configuration of a power storage device including a storage battery that may be provided in the mobile power supply vehicle.

FIG. 6 is a photograph showing an example of a state in which six belts are wound around a second pulley connected to the AC generator.

FIG. 7 is a photograph of a graph display screen of an oscilloscope showing measurement results obtained when the mobile power supply vehicle outputs a specified voltage of 400 V in a three-phase three-wire system.

FIG. 8 shows measurement results obtained when the graph of FIG. 7 was measured.

FIG. 9 is a graph showing results of a load endurance test of the AC generator included in the mobile power supply vehicle using a load tester (LE-330).

DESCRIPTION OF EMBODIMENTS

[0011]

The present disclosure is directed to a mobile power supply vehicle comprising: a base vehicle capable of traveling; a diesel engine mounted on the base vehicle and a choke controller connected to the diesel engine; a PTO connected to the diesel engine; an AC generator; a first pulley connected to the PTO; a second pulley connected to the AC generator and connected to the first pulley via a belt; an automatic voltage regulator connected to the AC generator and the diesel engine; and a power generation control circuit connected to the AC generator, wherein the diesel engine is used both for traveling of the base vehicle and for power generation by the AC generator, the power generation control circuit is configured to supply AC power generated by the AC generator driven by the diesel engine to a power-receiving-side device, the AC generator is configured such that a rotational speed of the AC generator is changeable so that an output voltage and an output frequency of the AC generator approach a voltage and a frequency set by the automatic voltage regulator in accordance with a load fluctuation of the power-receiving-side device, and the choke controller increases or decreases an engine rotational speed of the diesel engine in accordance with a command from the automatic voltage regulator for maintaining the rotational speed of the AC generator at a prescribed rotational speed.

[0012]

In the mobile power supply vehicle of the present disclosure (hereinafter also referred to as “the present mobile power supply vehicle”), the AC generator is configured to generate AC power by obtaining rotational energy from the driving energy of the diesel engine mounted on the base vehicle. Specifically, the AC generator can obtain rotational energy from the driving energy of the diesel engine mounted on the base vehicle via a PTO (power take-off) and a pulley to generate AC power, and the generated AC power can be supplied to a power-receiving-side device (secondary side) via the power generation control circuit.

[0013]

The present mobile power supply vehicle can use the diesel engine for power generation as well as for traveling and generate AC power having a substantially constant voltage by driving the AC generator through driving of the diesel engine. The present mobile power supply vehicle can directly utilize the AC power generated by the AC generator and exhibit excellent effectiveness as an emergency power supply source under various situations, such as at a disaster site where a power supply grid has been damaged. In this way, the present mobile power supply vehicle can supply, to the secondary side, AC power generated by driving the AC generator through driving of the diesel engine that also serves for traveling, and therefore does not require additional installation space for a separate power source for power generation, is low in cost, and also does not require conversion from DC to AC, so that no loss occurs in conversion from DC to AC.

[0014]

FIG. 3 is a block diagram illustrating a configuration relating to power supply of the present mobile power supply vehicle. The present mobile power supply vehicle includes a diesel engine mounted on the base vehicle, a choke controller connected to the diesel engine, a PTO connected to the diesel engine, an AC generator, a first pulley connected to the PTO, a second pulley connected to the AC generator and connected to the first pulley via a belt, an automatic voltage regulator (AVR) connected to the AC generator and the diesel engine, and a power generation control circuit connected to the AC generator.

[0015]

The present mobile power supply vehicle may include a voltage/current control panel. The voltage/current control panel may include an AVR, a power generation control circuit, a down transformer, and a multimeter. The AVR, the power generation control circuit, the down transformer, and the multimeter may be connected within the voltage/current control panel. The AC generator may be connected to the voltage/current control panel. The power generation control circuit may include the multimeter. By using the multimeter, information relating to power generation and discharge can be obtained for voltage (V), current (A), frequency (Hz), electric capacity (kWh), and operating time (h). The power generation control circuit may include the down transformer. The down transformer may be used when different voltages are used, for example, when power generated at 400 V is desired to be partially used at 200 V.

[0016]

The diesel engine is used both for traveling of the base vehicle and for power generation by the AC generator, and the AC generator is configured to generate AC power by driving of the diesel engine. The power generation control circuit is configured to supply AC power generated by the AC generator to the power-receiving-side device. According to the load of the power-receiving-side device, the choke controller increases or decreases the engine rotational speed of the diesel engine based on a command from the AVR for maintaining the rotational speed of the AC generator at a prescribed rotational speed so that the set voltage of the AC generator is maintained by the AVR.

The choke controller can maintain the rotational speed of the diesel engine at a desired rotational speed or in the vicinity thereof.

[0017]

When the load of the power-receiving-side device (secondary side) changes, the output voltage of the AC generator may change. The AVR attempts to maintain the output voltage of the AC generator at a constant level and thus attempts to maintain the rotational speed of the AC generator at the prescribed rotational speed. In response to a request from the AVR for maintaining the rotational speed of the AC generator at the prescribed rotational speed, the rotational speed of the diesel engine may become excessive or insufficient. This excessive or insufficient state is detected by an engine control unit provided in the base vehicle, and the engine control unit transmits a signal to the choke controller so as to adjust the rotational speed of the diesel engine. The maintenance request from the AVR for maintaining the rotational speed of the AC generator at the prescribed rotational speed may be information on excess or deficiency of the rotational speed relative to the prescribed rotational speed of the AC generator, information on excess or deficiency of the rotational speed of the diesel engine for rotating the AC generator at the prescribed rotational speed, or both. Accordingly, the rotational speed of the diesel engine is adjusted, and the rotational speed of the AC generator can be maintained at the prescribed rotational speed. In the engine control unit, the automatic engine output setting of the base vehicle may be set such that the rotational speed of the AC generator is the prescribed rotational speed, for example, 1500 rpm, and a command may be issued to the choke controller to adjust the engine rotational speed.

[0018]

The engine control unit may include a processing device, a storage device capable of reading and writing data, and a communication device that exchanges data with the choke controller, the diesel engine, the PTO, and the AVR. The processing device has one or more processors and associated peripheral circuits. The processing device centrally controls the overall operation of the engine control unit and is, for example, a CPU (Central Processing Unit). Communication by the communication device can be performed by CAN communication, which is a serial communication protocol, between ECUs (Electronic Control Units) that may be provided in the engine control unit, the AVR, the choke controller, the diesel engine, and the PTO.

[0019]

The storage device stores programs such as a driver program, an operating system program, and an application program. The storage device may store a program for performing signal transmission and reception processing with the AVR, the choke controller, the diesel engine, and the PTO. The storage device may include a program for switching the choke controller ON and OFF in accordance with a command from the AVR to maintain the rotational speed of the AC generator. When the choke controller is turned ON, the rotational speed of the diesel engine can be increased and decreased so as to maintain the rotational speed of the AC generator at the prescribed rotational

speed. The choke controller can increase and decrease the rotational speed of the diesel engine such that the rotational speed of the AC generator is maintained preferably within $\pm 7\%$ of the prescribed rotational speed, more preferably within $\pm 5\%$ thereof, still more preferably within $\pm 3\%$ thereof, even more preferably within $\pm 1\%$ thereof, and further more preferably substantially equal to the prescribed rotational speed.

[0020]

The processing device can execute various types of processing based on programs stored in the storage device (such as the driver program, the operating system program, and the application program). Further, the processing device may execute a plurality of programs (such as application programs) in parallel.

[0021]

FIG. 4 illustrates examples of power-receiving-side devices for AC power supplied by the present mobile power supply vehicle. Examples of the power-receiving-side devices include a lighting panel board and a power panel board of a building, a lighting panel board and a power panel board at a construction site or event, equipment for business continuity plan (BCP) measures, an EV charger, medical-related equipment, and the like.

[0022]

Diesel fuel, which is fuel for the diesel engine, is stored in a fuel tank mounted on the base vehicle and supplied to the diesel engine.

[0023]

The AC generator in the present mobile power supply vehicle may be an AC generator having performance selected in accordance with power generation requirements such as the load of the power-receiving-side device (secondary side), which is a destination to which generated power is supplied, for example, the power generation requirements of an elevator (registered trademark), a lighting fixture, or the like, and may be a 200 V type generator or a 400 V type generator. The AC generator may be, for example, a 200 V type generator for supplying power to power equipment in factories, warehouses, construction sites, or the like, and may be a 400 V type generator for supplying power to an elevator (registered trademark) or the like. The AC generator in the present mobile power supply vehicle may also be an AC generator having an output corresponding to the load.

[0024]

The AC generator may be a commercially available generator used for AC power generation, or an AC generator obtained by modifying a commercially available generator. The AC generator is preferably a brushless AC generator. The AC generator is, for example, a brushless AC generator (synchronous generator, LX-E 46B2, 160/190 kVA) manufactured by Taiyo Electric Co., Ltd., and is capable of generating single-phase 100 V/200 V power and three-phase 200 V/400 V power.

[0025]

By driving the AC generator at the prescribed rotational speed of the AC generator, rated power can be generated. For example, in the case of a brushless AC generator (synchronous generator, LX-E 46B2) manufactured by Taiyo Electric Co., Ltd., AC current of AC 415 V and 223 A can be generated at 50 Hz by maintaining driving at 1500 rpm, and AC current of 415 V and 264 A can be generated at 60 Hz by maintaining driving at 1800 rpm.

[0026]

The diesel engine is connected to the PTO, and the AC generator is connected to the PTO via pulleys. The pulleys include a first pulley connected to the PTO and a second pulley connected to the AC generator, and the first pulley and the second pulley are connected by a belt for transmitting power between the pulleys.

[0027]

The AVR is connected to the AC generator. The connection between the AVR and the AC generator may be such that the AVR and the AC generator exist separately and are connected, or may be such that the AVR is incorporated in the AC generator and connected thereto. The AVR has an adjustment mechanism capable of adjusting the voltage of electric power generated by the AC generator to a desired voltage. The AVR also has an adjustment mechanism capable of adjusting the frequency of electric power generated by the AC generator to a desired frequency, for example, 50 Hz or 60 Hz.

[0028]

The AVR may be a conventional AVR, and may be a sine-wave inverter type AVR capable of raising and lowering the output voltage of the AC generator.

[0029]

The AVR monitors the rotational speed of the AC generator so as to maintain the rotational speed of the AC generator at the prescribed rotational speed while maintaining the frequency and voltage set by the AVR when the load of the power-receiving-side device fluctuates. In order to maintain the rotational speed of the AC generator at the prescribed rotational speed, the choke controller adjusts the engine output (rotational speed) of the diesel engine based on a maintenance command from the AVR.

[0030]

Although the rotational speed of the diesel engine is unstable, the engine rotational speed can be adjusted according to an increase or decrease in the rotational speed of the AC generator by combining the diesel engine with the choke controller.

[0031]

In the present mobile power supply vehicle, the PTO is connected to the engine control unit of the base vehicle, and the rotational speed of the diesel engine can be controlled during operation of the PTO. At the time when the diesel engine is switched from traveling use to driving use for the AC generator by the PTO, the diesel engine is rotated at a rotational speed preset by the choke

controller. Switching from traveling use to driving use for the AC generator by the PTO can be performed by electronic control using a changeover switch provided in the base vehicle while the gear is in neutral.

[0032]

The diesel engine may be rotated at a rotational speed higher than the prescribed rotational speed of the AC generator in consideration of losses. The diesel engine is rotated at a rotational speed preferably 50 to 150 rpm higher, more preferably 70 to 130 rpm higher, and still more preferably 90 to 110 rpm higher than the prescribed rotational speed of the AC generator. For example, when an AC generator having a prescribed rotational speed of 1500 rpm is used, the diesel engine may be rotated at 1600 rpm in consideration of losses, whereby the AC generator can be rotated at 1500 rpm to generate rated AC power.

[0033]

Information transmitted from the PTO to the engine control unit may include environmental information such as temperature of the PTO. The PTO may have a protection circuit. For example, when the temperature of the PTO reaches a predetermined temperature, the PTO can be brought into a neutral state for protection of the equipment. Further, for example, when the PTO falls below a predetermined rotational speed or exceeds a predetermined rotational speed, the PTO can be brought into a neutral state for protection of the equipment. In this way, even when a voltage change (low voltage, high voltage) occurs on the secondary side, protection of the secondary side can be performed. Communication between the PTO and the engine control unit can be performed via wired communication and can be transmitted using a voltage output between DC 0 V and DC 12 V. The content of communication may be changed depending on the voltage value. For example, 0 V may indicate neutral, 1 V may indicate an increase in rotational speed, 2 V may indicate a decrease in rotational speed, and 3 V may indicate an abnormal temperature of the PTO.

[0034]

The present mobile power supply vehicle may include a cooling radiator for the PTO. The cooling radiator is driven by the diesel engine. By including the cooling radiator, an increase in temperature of the PTO can be suppressed, and the present mobile power supply vehicle can supply power more stably.

[0035]

The rotational speed and output voltage of the AC generator tend to fluctuate according to the load of the power-receiving-side device. For example, when the load is large, such as when a large machine such as an elevator is operated, the rotational speed of the AC generator tends to decrease and becomes lower than the prescribed rotational speed, for example, 1500 rpm. When the rotational speed falls below the prescribed rotational speed, the frequency and output voltage also fluctuate. Therefore, a request arises to maintain the rotational speed of the AC generator at the prescribed rotational speed so as to maintain the frequency and output voltage set by the AVR, and in response

to this request to maintain the rotational speed of the AC generator, the engine rotational speed of the diesel engine can be increased by the choke controller to increase the rotational speed of the AC generator toward the prescribed rotational speed. However, since the secondary-side voltage tends to decrease with an increase in load of the power-receiving-side device, it is preferable to use the AC generator within a range in which the rated output voltage, for example, 400 V or more, can be obtained even when the engine rotational speed is increased.

[0036]

When the load is small, the rotational speed of the AC generator tends to increase and tends to exceed the prescribed rotational speed, for example, 1500 rpm. When the rotational speed exceeds the prescribed rotational speed, the frequency and output voltage also fluctuate. Therefore, a request arises to maintain the rotational speed of the AC generator at the prescribed rotational speed so as to maintain the frequency and output voltage set by the AVR, and in response to this request to maintain the rotational speed of the AC generator, the engine rotational speed of the diesel engine can be reduced by the choke controller to reduce the rotational speed of the AC generator toward the prescribed rotational speed.

[0037]

The PTO may be a conventional PTO, for example, a transmission-side PTO. The transmission-side PTO can operate when the base vehicle is stopped. The PTO is disposed between the diesel engine and the AC generator, and may be a PTO having a predetermined output capable of satisfying both a requirement for engine output (kW) of the diesel engine and a requirement for generator output (kVA) of the AC generator, for example, a PTO having a maximum output of 40 kW.

[0038]

FIG. 1 is a schematic view illustrating an example of the mobile power supply vehicle 100 including the diesel engine 10, the PTO 20, the first pulley 31, the second pulley 32, the belt 40, and the AC generator 50 mounted on the base vehicle 1.

[0039]

FIG. 2 is a schematic view as viewed in a downward direction on the sheet of FIG. 1 from the cross section A-A' of FIG. 1. In FIG. 2, the first pulley 31 connected to the PTO disposed under the base vehicle and the second pulley 32 connected to the AC generator disposed in a cargo compartment of the base vehicle are connected by the belt 40.

[0040]

The mobile power supply vehicle 100 may be configured based on a base vehicle capable of traveling by a pair of left and right front wheels 2 and rear wheels 3 disposed at front and rear of the base vehicle 1. The base vehicle is preferably a truck. The base vehicle 1 is provided with a cargo compartment, and various power supply devices may be accommodated in the cargo compartment.

[0041]

Preferably, the first pulley, the second pulley, or both are configured to be replaceable with pulleys having a shaft diameter, a number of belts, or both adapted to the output of the diesel engine and the power generation capability of the AC generator.

[0042]

The shaft diameters of the first pulley and the second pulley and the number of belts can be adjusted so that the AC generator rotates at a predetermined rotational speed.

[0043]

A preferable shaft diameter of the first pulley may be determined based on the torque (Nm), maximum rotational speed (rpm), and operating angle (deg) of the PTO so that the PTO disposed between the diesel engine and the AC generator can be driven (rotated) with sufficient output in order to satisfy both the requirement for engine output (kW) of the diesel engine and the requirement for generator output (kVA) of the AC generator. Further, the maximum value of the shaft diameter of the first pulley may also be determined depending on the space available in the frame of the base vehicle, for example, 2WD or 4WD. The shaft diameter of the first pulley is preferably 30 to 400 mm, more preferably 40 to 320 mm, and still more preferably 50 to 150 mm. When the preferable shaft diameter of the first pulley is within the above preferable range, a desired engine output of the diesel engine can be obtained more stably, and the AC generator can be driven more stably at a predetermined rotational speed by the engine output of the diesel engine transmitted via the PTO.

[0044]

The shaft diameter of the second pulley is preferably 30 to 400 mm, more preferably 40 to 320 mm, and still more preferably 50 to 150 mm. The shaft diameter of the second pulley may be, for example, 280 to 320 mm. A preferable shaft diameter of the second pulley is determined based on the engine output of the diesel engine and the power generation capability of the AC generator. By interposing a pulley having the above preferable shaft diameter between the AC generator and the PTO, the AC generator can be driven more stably at a predetermined rotational speed by the engine output of the diesel engine transmitted via the PTO.

[0045]

The number of belts disposed on the first pulley and the second pulley may be one or a plurality, and is preferably a plurality. The number of belts is more preferably 2 to 10, still more preferably 3 to 9, even more preferably 4 to 8, and further more preferably 5 to 7. A preferable number of belts is determined based on the engine output of the diesel engine and the power generation capability of the AC generator. When a plurality of belts or the above preferable number of belts are used, the AC generator can be driven more stably at a desired rotational speed, and replacement of the belts can be facilitated while reducing the cost of the belts. When a plurality of belts are used, the respective belts are arranged in parallel on the first pulley and the second pulley. FIG. 6 is a photograph showing an example of a state in which six belts are wound around the second pulley connected to the AC generator.

[0046]

The belt may be a conventional belt and is preferably a V-belt. Examples of the V-belt include a standard V-belt, a narrow-width V-belt (wedge type), and a multi-type V-belt. A belt suitable for high-horsepower transmission and having heat resistance, oil resistance, flame retardancy, and antistatic performance is preferable. For example, a Red V-belt manufactured by Mitsuboshi Belting Ltd. can be used.

[0047]

The present mobile power supply vehicle includes a power generation control circuit. Electric power generated by the AC generator may be transmitted to the power-receiving-side device via the power generation control circuit. The power generation control circuit may include a changeover switch (COS) for switching whether power is supplied to the power-receiving-side device.

[0048]

Preferably, the power generation control circuit is configured to output in a single-phase three-wire system, a three-phase three-wire system, or a combination thereof.

[0049]

More preferably, the power generation control circuit is configured to output 100 V/200 V in a single-phase three-wire system and 200 V in a three-phase three-wire system, 100 V/200 V in a single-phase three-wire system and 200 V/400 V in a three-phase three-wire system, or 200 V/400 V in a three-phase three-wire system. When outputting 100 V/200 V in a single-phase three-wire system and 200 V/400 V in a three-phase three-wire system, 100 V/200 V can be obtained by generating power at 400 V and stepping down the voltage to 200 V by the down transformer. Since a 400 V-type AC generator can also support 100 V/200 V through use of a down transformer, the present mobile power supply vehicle equipped with the 400 V-type AC generator can be used for multiple purposes with only one vehicle and can cope with a wider range of applications.

[0050]

According to the above output format, the present mobile power supply vehicle may also function as a power feeding vehicle or as a hybrid of a mobile power supply vehicle and a power feeding vehicle. When the present mobile power supply vehicle outputs, for example, 200 V/400 V in a three-phase three-wire system, the present mobile power supply vehicle can function as a power feeding vehicle and supply generated power to an electric vehicle (EV) charger. When the mobile power supply vehicle is used as a power feeding vehicle, the present mobile power supply vehicle may include the EV charger shown in FIG. 4.

[0051]

The present mobile power supply vehicle may also include a high-voltage AC generator, for example, a 6600 V AC generator. Examples of the 6600 V AC generator include an AC generator manufactured by Taiyo Electric Co., Ltd. When a 6600 V AC generator is used, the power generation control circuit may include a high-voltage electrical circuit.

[0052]

The power generation control circuit may also have a protection circuit for cutting off the circuit and providing protection when a malfunction occurs on the primary side or the secondary side (power-receiving-side device). The present mobile power supply vehicle may include a power source switching panel, and the power source switching panel may include the power generation control circuit and may include an earth leakage breaker as a protection circuit.

[0053]

The AC power that can be generated by the present mobile power supply vehicle may have a substantially regular and uniform sine-wave form. The electricity generated by the AC generator is a sine wave, but the AC waveform may vary, together with active power, reactive power, and apparent power, depending on the load of the power-receiving-side device. The power generation control circuit can respond to the above changes and bring the waveform closer to an ideal sine-wave curve. FIG. 7 is a photograph of an oscilloscope graph display screen obtained by measuring electricity when the present mobile power supply vehicle was used to output a specified voltage of 400 V in a three-phase three-wire system. From the graph of FIG. 7, it can be seen that a substantially regular and uniform sine wave is obtained.

[0054]

FIG. 8 shows measurement results obtained when the waveform shown in FIG. 7 was measured. From the measurement results of FIG. 8, it can be seen that power is stably generated at 398 V with respect to the specified voltage of 400 V. Thus, the AC power that can be generated by the present mobile power supply vehicle has a stable and clean sine-wave form, and therefore electricity generated by the present mobile power supply vehicle can also be used for electronic devices such as computers, and the present mobile power supply vehicle is also applicable to business continuity planning (BCP) in the event of a disaster.

[0055]

FIG. 9 is a graph showing results of a load endurance test of the AC generator included in the present mobile power supply vehicle using a load tester (LE-330). Since the AC generator can generate power by rotating the shaft of the AC generator using rotational energy from the driving force (PTO) of the diesel engine mounted on the base vehicle, the power generation capability changes depending on the engine output (kW) of the diesel engine mounted on the base vehicle. Therefore, this load test was conducted in order to determine an appropriate load value (voltage, current) for the combination of the diesel engine output (kW) mounted on the base vehicle and the AC generator and verify the effective maximum capability of the AC generator.

[0056]

For the load test, a mobile power supply vehicle based on a 3-ton truck (2KG-XZU712M, displacement 4.00 L) including an N04C diesel engine manufactured by Hino Motors was used.

[0057]

The AC generator mounted on the mobile power supply vehicle was a brushless AC generator (synchronous generator, LX-E 46B2) manufactured by Taiyo Electric Co., Ltd. A difference between the capacity (A) obtained at 1500 rpm (50 Hz) and the capacity (A) obtained at 1800 rpm (60 Hz) was examined. The rated output when operating this AC generator at the prescribed rotational speeds of 1500 rpm and 1800 rpm was 160 kVA (50 Hz) / 190 kVA (60 Hz), voltage 415 V, and current 223 A (50 Hz) / 264 A (60 Hz). The automatic engine output setting of the base vehicle was 1500 rpm, and when driving at 1800 rpm, the accelerator pedal was depressed to increase the rotational speed by 300 rpm and maintain 1800 rpm.

[0058]

In the 1500 rpm (50 Hz) test, when simulated load capacity (A) was gradually applied to the AC generator from 20 A to 120 A, the load at which a voltage of 400 V or more was obtainable was 70 A or less. From the load test results, it can be seen that, when obtaining a voltage of 400 V or more using this diesel engine output, the maximum usable load is at most 70 A. In the 1800 rpm (60 Hz) test, when simulated load capacity (A) was gradually increased from 20 A, at 90 A and 1602 rpm, belt abnormality and flutter occurred. This is because the output of the diesel engine was insufficient for the simulated load capacity (A) required by the load device (LE-3000), resulting in irregular rotation of the pulley and belt and causing flutter, which in turn caused irregular rotation of the shaft connected to the PTO.

[0059]

The present mobile power supply vehicle may further include a storage battery. The storage battery can store DC power obtained from an external power source and is configured to be able to supply AC power to the power-receiving-side device (secondary-side load).

[0060]

FIG. 5 is a block diagram illustrating a configuration of a power storage device including a storage battery that may be provided in the present mobile power supply vehicle. The external power source is, for example, one or more external power sources capable of generating electric power, such as solar panels, and may be one or more other external power sources. DC power generated by the external power source is stored in the storage battery via a power conditioner. DC power from the diesel engine may also be stored in the storage battery via the power conditioner. Power stored in the storage battery may be supplied as AC power to the power-receiving-side device (secondary-side load). The power conditioner is preferably a hybrid PCS, in which DC 12 V or 24 V is input on the input side (solar panel, alternator, etc.) and AC 100 V/200 V can be output on the output side.

[0061]

By including the storage battery in this manner, the present mobile power supply vehicle can, in addition to supplying power generated by the AC generator to the power-receiving-side device, also supply power stored in the power storage device to the power-receiving-side device.

[0062]

The present mobile power supply vehicle may also store AC power generated by the AC generator in the storage battery through the power generation control circuit and the power conditioner.

[REFERENCE SIGNS LIST]

[0063]

- 1 Base vehicle
- 2 Front wheel
- 3 Rear wheel
- 10 Diesel engine
- 20 PTO
- 31 First pulley
- 32 Second pulley
- 40 Belt
- 50 AC generator
- 100 Mobile power supply vehicle

CLAIMS

[Claim 1]

A mobile power supply vehicle comprising:

a base vehicle capable of traveling;

a diesel engine mounted on the base vehicle and a choke controller connected to the diesel engine;

a PTO connected to the diesel engine;

an AC generator;

a first pulley connected to the PTO;

a second pulley connected to the AC generator and connected to the first pulley via a belt;

an automatic voltage regulator connected to the AC generator and the diesel engine; and

a power generation control circuit connected to the AC generator,

wherein the diesel engine is used both for traveling of the base vehicle and for power generation by the AC generator,

the power generation control circuit is configured to supply AC power generated by the AC generator driven by the diesel engine to a power-receiving-side device,

the AC generator is configured such that a rotational speed of the AC generator is changeable so that an output voltage and an output frequency of the AC generator approach a voltage and a frequency set by the automatic voltage regulator in accordance with a load fluctuation of the power-receiving-side device, and

the choke controller increases or decreases an engine rotational speed of the diesel engine in accordance with a command from the automatic voltage regulator for maintaining the rotational speed of the AC generator at a prescribed rotational speed.

[Claim 2]

The mobile power supply vehicle according to claim 1, wherein the first pulley, the second pulley, or both are configured to be replaceable with pulleys having a shaft diameter, a number of belts, or both adapted to an output of the diesel engine and power generation capability of the AC generator.

[Claim 3]

The mobile power supply vehicle according to claim 1 or 2, wherein the power generation control circuit is configured to output power in a single-phase three-wire system, a three-phase three-wire system, or a combination thereof.

[Claim 4]

The mobile power supply vehicle according to claim 1 or 2, wherein the power generation control circuit is configured to output 100 V/200 V in a single-phase three-wire system and 200 V in

a three-phase three-wire system, 100 V/200 V in a single-phase three-wire system and 200 V/400 V in a three-phase three-wire system, or 200 V/400 V in a three-phase three-wire system.

[Claim 5]

The mobile power supply vehicle according to claim 1 or 2, further comprising a storage battery, wherein the storage battery is configured to store DC power obtained from an external power source and to supply AC power to the power-receiving-side device.