Claims

1. A wireless electric vehicle charging system, comprising:

(a) a modular converter or modular inverter comprising a plurality of modules each configured to receive power from a power source and to output power in the form of alternating current,

(b) a plurality of transmitters each configured to receive power from the modular converter/inverter and to wirelessly transmit power, and

(c) a plurality of cables,

wherein each module is switchable between:

(i) a first module mode wherein the module is configured to output power to one of the transmitters via one of the cables, the cable being connected to the one transmitter but not to the other transmitters, and

(ii) a second module mode wherein the module is configured to output power to one or more of the transmitters via one of the cables, the cable being connected to all of the plurality of transmitters, and

wherein each transmitter is switchable between:

(i) a first transmitter mode wherein the transmitter is configured to receive power from one of the modules, the module being in the first module mode, via the cable connected to the one transmitter but not to the other transmitters, and

(ii) a second transmitter mode wherein the transmitter is configured to receive power from one or more of the modules, each being in the second module mode, via the cable connected to all of the plurality of transmitters.

2. A wireless electric vehicle charging system as claimed in claim 1, wherein:

(i) each module in the second module mode is configured to output power to all of the plurality of transmitters, each being in the second transmitter mode, and

(ii) each transmitter in the second transmitter mode is configured to receive power from all of the plurality of modules, each being in the second module mode.

3. A wireless electric vehicle charging system as claimed in claim 1, wherein:

(i) each module in the second module mode is configured to output power to a subset of the plurality of transmitters, each being in the second transmitter mode, and wherein the other transmitter(s) is/are each in the first transmitter mode, and

(ii) each transmitter in the second transmitter mode is configured to receive power from a subset of the plurality of modules, each being in the second module mode, and wherein the other module(s) is/are each in the first module mode.

4. A wireless electric vehicle charging system as claimed in any one of claims 1 to 3, comprising a power management system having:

(a) a receiver configured to receive data from one or more electric vehicle(s),

(b) a processor configured to determine, according to the data:

(i) for each module individually, whether the module is required to operate in the first module mode or the second module mode, and

(ii) for each transmitter individually, whether the transmitter is required to operate in the first transmitter mode or the second transmitter mode, and

(c) a controller configured to switch, according to the determination:

(i) each module individually to the first module mode or the second module mode, and

(ii) each transmitter individually to the first transmitter mode or the second transmitter mode.

5. A wireless electric vehicle charging system as claimed in claim 4, wherein the data from the one or more electric vehicle(s) are data about a charging requirement of each electric vehicle.

6. A wireless electric vehicle charging system as claimed in claim 5, wherein the charging requirement comprises whether the electric vehicle has an active rectifier or a passive rectifier.

7. A wireless electric vehicle charging system as claimed in any one of claims 1 to 6, wherein each module in the first module mode is configured to output an amount of power to the one transmitter determined by the modular converter/inverter in response to a request by an electric vehicle parked at, or approaching, the one transmitter.

8. A wireless electric vehicle charging system as claimed in any one of claims 1 to 7, wherein each module in the second module mode is configured to respectively output an amount of power to each of the one or more transmitter(s) requested by an electric vehicle parked at, or approaching, the transmitter.

9. A wireless electric vehicle charging system as claimed in any one of claims 1 to 8, wherein each module in the first module mode is configured to output power having a dynamically variable voltage, current, and/or frequency.

10. A wireless electric vehicle charging system as claimed in any one of claims 1 to 9, wherein each module in the first module mode is configured to output power in the form of alternating current having a variable frequency.

11. A wireless electric vehicle charging system as claimed in any one of claims 1 to 10, wherein each module in the second module mode is configured to output power having (i) a fixed voltage and a variable current or (ii) a variable voltage and a fixed current.

12. A wireless electric vehicle charging system as claimed in any one of claims 1 to 11, wherein the cable connected to the one transmitter but not to the other transmitters is a capacitive cable having:

(a) a first conductor connected to the modular converter/inverter but not to the one transmitter,

(b) a second conductor connected to the one transmitter but not to the modular converter/inverter, and

(c) a dielectric material between the first conductor and the second conductor.

13. A wireless electric vehicle charging system as claimed in any one of claims 1 to 12, wherein the cable connected to all of the plurality of transmitters is a capacitive cable having:

(a) a first conductor connected to the modular converter/inverter but not to the plurality of transmitters,

(b) a second conductor connected to all of the plurality of transmitters but not to the modular converter/inverter, and

(c) a dielectric material between the first conductor and the second conductor.

14. A wireless electric vehicle charging system as claimed in claim 13, comprising an impedance management system configured to modify an impedance of the cable connected to all of the plurality of transmitters.

15. A power management system for a wireless electric vehicle charging system as claimed in any one of claims 4 to 14, comprising:

(a) a receiver for receiving data from one or more electric vehicle(s),

(b) a processor for determining, according to the data:

(i) for each module of the wireless electric vehicle charging system individually, whether the module is required to operate in the first module mode or the second module mode, and

(ii) for each transmitter of the wireless electric vehicle charging system individually, whether the transmitter is required to operate in the first transmitter mode or the second transmitter mode, and

(c) a controller configured to switch, according to the determination:

(i) each module individually to the first module mode or the second module mode, and

(ii) each transmitter individually to the first transmitter mode or the second transmitter mode.

16. A modular converter or modular inverter for a wireless electric vehicle charging system as claimed in any one of claims 1 to 14, comprising a plurality of modules each for receiving power from a power source and for outputting power in the form of alternating current, wherein each module is switchable between:

(i) a first module mode wherein the module is for outputting power to a transmitter via a cable connected to the transmitter but not to any other transmitters, and

(ii) a second module mode wherein the module is for outputting power to one or more transmitters via a cable connected to each of a plurality of transmitters.

17. A vehicle park comprising a wireless electric vehicle charging system as claimed in any one of claims 1 to 14.

18. Use of a power management system as claimed in claim 15 in a wireless electric vehicle charging system as claimed in any one of claims 4 to 14.

19. Use of a modular converter or modular inverter as claimed in claim 16 in a wireless electric vehicle charging system as claimed in any one of claims 1 to 14.

20. Use of a transmitter in a wireless electric vehicle charging system as claimed in any one of claims 1 to 14, wherein the transmitter is for receiving power from a modular converter or modular inverter and for wirelessly transmitting power, and wherein the transmitter is switchable between:

(i) a first transmitter mode wherein the transmitter is for receiving power from a module of the modular converter/inverter via a cable connected to the transmitter but not to any other transmitters, and

(ii) a second transmitter mode wherein the transmitter is for receiving power from one or more modules of the modular converter/inverter via a cable connected to each of a plurality of transmitters.

21. A method of charging a battery of an electric vehicle parked at a transmitter of a wireless electric vehicle charging system as claimed in any one of claims 1 to 14, comprising:

(a) receiving data from the electric vehicle,

(b) determining, according to the data:

(i) for each module of the wireless electric vehicle charging system individually, whether the module is required to operate in the first module mode or the second module mode,

(ii) whether the transmitter is required to operate in the first transmitter mode or the second transmitter mode,

(c) switching, according to the determination:

(i) each module individually to the first module mode or the second module mode, and

(ii) the transmitter to the first transmitter mode or the second transmitter mode,

(d) outputting power from the modular converter/inverter of the wireless electric vehicle charging system to the transmitter,

(e) wirelessly transmitting power from the transmitter to the electric vehicle, and

(f) using the power transmitted to the electric vehicle to charge a battery of the electric vehicle.