TITLE OF THE INVENTION

MOVABLE MAGNETIC CORE WIRELESS CHARGERS APPLICABLE FOR ELECTRICAL VEHICLES

FIELD OF INVENTION

The application relates to a wireless charger for electrical vehicles.

BACKGROUND OF INVENTION

Wireless Power Consortium (WPC) provides a standard for non-contact or inductive chargers with a single inductive charging pad that comprises a primary coil for charging various types of product terminals. The product terminal is connected to a secondary coil. The primary coil is also called a charging pad. The terminal can have different housings with varying dimensions. The standard requires a gap between coils of 2.5 millimeter (mm).

US 20120200254 A1 discloses a system for inductive charging of an electronic device. The system includes a charging pad that comprises a first coil and an electronic device that includes a second coil. The first coil generates a magnetic field when power is applied. The second coil charges a battery using an induced current induced in the second coil as the first coil generates the magnetic field. The charging pad performs data communication with the electronic device and moves the electronic device so that the maximum charging value is induced in the second coil. The data communication between the charging pad and the electronic device is fed back in real time, so that the electronic device can be disposed at a position where optimal charging efficiency can be exhibited.

SUMMARY

It is an object of the application to provide an improved wireless charger for vehicles.

The application provides an improved inductive charging assembly for a vehicle, such as an electric vehicle.

The inductive charging assembly provides wireless electrical charging of a rechargeable battery of the vehicle. The vehicle is used for transporting people and/or goods. The battery stores electric charges and provides the electrical charges to components of the vehicle.

The inductive charging assembly includes a transmitter and a receiver. The transmitter is often installed in a charging station while the receiver is often installed in the vehicle.

The transmitter includes a primary coil. The primary coil is provided for generating an alternating magnetic field when an alternating current electrical power is applied to the primary coil. The alternating current electrical power provides an alternating electrical current that flows to the primary coil. The alternating electrical current in the primary coil then generates an alternating magnetic field.

The receiver comprises a secondary coil with a secondary magnetic core. The secondary coil is provided many times around the secondary magnetic core. The secondary magnetic core acts to gather nearby magnetic field into the secondary magnetic core and provides a path for the magnetic field inside the secondary magnetic core.

The secondary coil with the secondary magnetic core is provided for electrical charging of the rechargeable battery of the vehicle when the alternating magnetic field from the primary coil induces an alternating electrical current in the secondary coil. The induced alternating electrical current then flows from the secondary coil to the battery.

The battery acts to store electrical charges. In particular, the battery has a rectification function. The battery acts to receive an alternating electrical current, which periodically reverses direction, and serves to change the alternating electrical current to a direct electrical current, which flows in only one direction. The battery also then serves to store electrical charges of the converted direct electrical current.

The inductive charging assembly further comprises a pair of movable connection magnetic cores. The movable connection magnetic cores act to gather nearby magnetic field from the transmitter to inside of the connection magnetic cores. Each connection magnetic core also acts to provide a path for the magnetic field that is inside the connection magnetic core.

The movable connection magnetic cores are movable between a charging position and a standby position. In the charging position, parts of the movable connection magnetic cores are provided in the vicinity of the primary coil while another parts of the movable connection magnetic cores are provided in the vicinity of the secondary magnetic core. This arrangement allows the magnetic field to extend between the primary coil and the said parts, to extend between the said parts and the corresponding said other parts, and to extend between the said other parts and the secondary magnetic core.

In other words, this arrangement provides a magnetic circuit for transferring the alternating magnetic field from the primary coil to the connection magnetic cores, and from the connection magnetic cores to the secondary magnetic core. The alternating magnetic field in the secondary magnetic core then induces an alternating electric current in the secondary coil that flows to the battery for charging the battery.

The movable connection magnetic cores are provided near the primary coil and also near the secondary magnetic core for effective transfer of the magnetic field from the primary coil to the secondary coil. This arrangement is also easy to implement, unlike other methods.

The application also provides an improved vehicle. The vehicle includes a receiver and a pair of movable connection magnetic cores.

The receiver comprises a secondary coil with a secondary magnetic core for charging a battery of the vehicle. The secondary coil is provided many times around the secondary magnetic core.

The movable connection magnetic cores act to gather nearby magnetic field from a magnetic field transmitter to inside of the movable connection magnetic cores. Each connection magnetic core also acts to provide a path for the magnetic field that is inside the connection magnetic core.

The movable connection magnetic cores are movable between a charging position and a standby position. In the charging position, first parts of the movable connection magnetic cores are intended for providing in the vicinity of the magnetic field transmitter while second parts of the movable connection

magnetic cores are provided in the vicinity of the secondary magnetic core. This structure allows a magnetic field to extend between the magnetic field transmitter and the said first parts, to extend between the said first parts and the corresponding said second parts, and to extend between the said second parts and the secondary magnetic core.

The secondary magnetic core receives the alternating magnetic field, wherein the alternating magnetic field in the secondary magnetic core induces an alternating current in the secondary coil for charging the battery of the vehicle.

The application also provides an inductive charging station for vehicles. The inductive charging station includes a transmitter and a pair of movable connection magnetic cores.

The transmitter includes a primary coil for generating an alternating magnetic field when an alternating electrical power is applied to the primary coil.

The movable connection magnetic cores act to gather nearby magnetic field from the transmitter to inside of the movable connection magnetic cores. Each connection magnetic core also acts to provide a path for the magnetic field that is inside the connection magnetic core.

The movable connection magnetic cores are movable between a charging position and a standby position. In the charging position, parts of the movable connection magnetic cores are provided in the vicinity of the primary coil for receiving the magnetic field and further parts of the movable connection magnetic cores are intended for providing in the vicinity of a magnetic field receiver. This allows a magnetic field to extend between the primary coil and the said parts, to extend

between the said parts and the said further parts, and to extend between the said further parts and the magnetic field receiver.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 illustrates a schematic view of an embodiment of an Inductive Power Transfer (IPT) assembly with movable connection magnetic cores, wherein the IPT assembly is placed in a charging position,

Fig. 2 illustrates a side cross-sectional view of the IPT assembly of Fig. 1,

Fig. 3 illustrates a top cross-sectional view of the IPT assembly of Fig. 1,

Fig. 4 illustrates a perspective view of the IPT module of Fig. 1,

Fig. 5 illustrates another perspective view of the IPT assembly of Fig. 1, wherein top surfaces of the movable connection magnetic cores are placed next to an inner portion of an inductive receiver,

Fig. 6 illustrates a schematic view of the IPT assembly of Fig. 1, wherein the IPT assembly is placed in a non-charging position,

Fig. 7 illustrates a top view of an inductive transmitter of the IPT assembly of Fig. 6,

Fig. 8 illustrates a perspective view of the inductive transmitter of Fig. 7,

Fig. 9 illustrates a perspective view of the IPT assembly of Fig. 1, wherein the top surfaces of the movable connection magnetic cores are placed next to outer portions of an inductive receiver,

Fig. 10 illustrates a top cross-sectional view of the IPT assembly of Fig. 9,

Fig. 11 illustrates a perspective view of another embodiment of the IPT assembly with movable connection magnetic cores, wherein the IPT assembly is placed in a charging position,

Fig. 12 illustrates a side cross-sectional view of the IPT assembly of Fig. 11,

Fig. 13 illustrates a schematic view of a further embodiment of the IPT assembly with movable connection magnetic cores, wherein the IPT assembly is placed in a charging position, and

Fig. 14 illustrates a schematic view of the IPT assembly of Fig. 13, wherein the IPT assembly is placed in a non-charging position.

DETAILED DESCRIPITION OF THE ILLUSTRATED EMBODIMENTS

In the following description, details are provided to describe embodiments of the application. It shall be apparent to one skilled in the art, however, that the embodiments may be practiced without such details.

Some parts of the embodiments have similar parts. The similar parts may have the same names or similar part numbers. The description of one part applies by reference to another similar part, where appropriate, thereby reducing repetition of text without limiting the disclosure.

Fig. 1 shows an Inductive Power Transfer (IPT) assembly 10 for electric vehicles.

The IPT assembly 10 includes an inductive transmitter 12 with an inductive receiver 17 and a pair of vertical movable connection magnetic cores 25 and 27.

The inductive transmitter 12 is installed in the ground of an inductive power charging station 14 while the inductive receiver 17 is mounted in an electric vehicle 19.

The movable connection magnetic cores 25 and 27 are installed in the ground of the inductive power charging station 14.

Referring to the inductive transmitter 12, it comprises a fixed primary induction coil 22 with a horizontal fixed primary magnetic core 23, as seen in Fig. 2. The primary induction coil 22 is also called a primary coil. The fixed primary induction coil 22 is wrapped many times around the movable connection magnetic cores 25 and 27 and is placed above the fixed primary magnetic core 23. The fixed primary induction coil 22 is connected to an electrical alternating current (AC) power source 30 of the charging station 14, as shown in Fig. 1. The fixed primary induction coil 22 and the fixed primary magnetic core 23 are embedded in the charging station 14.

The inductive receiver 17 comprises a horizontal fixed secondary magnetic plate 40 with a fixed secondary induction coil 43, as illustrated in Fig. 2. The secondary induction coil 43 is also called a secondary coil. The secondary induction coil 43 is wrapped many times around the fixed secondary magnetic plate 40. The secondary induction coil 43 is electrically connected to a rechargeable battery 45 of the electric vehicle 19, as shown in Fig. 1.

The fixed secondary magnetic plate 40 has large charging surfaces 47 and 49 that are placed at a lower side of outer parts of the fixed secondary magnetic plate 40, as shown in Fig. 2. The charging surfaces 47 and 49 are large in comparison to upper surfaces of the movable connection magnetic cores 25 and 27.

The connection magnetic core 25 is placed in the vicinity of a first end portion of the fixed primary magnetic core 23, as illustrated in Figs. 2, 4 and 5. In practice, a small circular gap 32 separates the connection magnetic core 25 from the first end portion of the fixed primary magnetic core 23, as best seen in Fig. 2. This gap 32 is configured to be as small as possible and it exists because of parts tolerance.

Similarly, the connection magnetic core 27 is placed in the vicinity of a second end portion of the fixed primary magnetic core 23, as depicted in Figs. 2, 4 and 5. A small gap 35 separates the connection magnetic core 27 from the second end portion of the fixed primary magnetic core 23, as shown in Fig. 2.

The movable connection magnetic cores 25 and 27 are arranged such that they are movable between a charging position, as shown in Fig. 1 and a non-charging position, as shown in Fig. 6. The charging position is called a charging state while the non-charging position is called a non-charging state. The non-charging position is also called a standby position.

In the charging position, top surfaces 28 and 29 respectively of the connection magnetic cores 25 and 27 protrude from the ground such that they are placed next to the inductive receiver 17. Parts of the connection magnetic cores 25 and 27 are placed next to the fixed primary magnetic core 23 of the inductive transmitter 12.

In practice, a small gap 52 can separate the top surface 28 from the inductive receiver 17, as seen Fig. 2. A protective cover, such as plastic, over the top surface 28 can cause the small gap 52, although this gap 52 should be eliminated. Simi-

larly, a small gap 54 can also separate the top surface 29 from the inductive receiver 17.

In the non-charging position, the connection magnetic cores 25 and 27 are retracted into the ground. The top surfaces 28 and 29 of the connection magnetic cores 25 and 27 are flushed with the ground while parts of the magnetic cores 25 and 27 are placed next to the inductive transmitter 12. This position allows the electric vehicle 19 to leave the charging station 14.

During the movement of the connection magnetic cores 25 and 37 between the charging position and the non-charging position, the gap 32 between the connection magnetic core 25 and the fixed primary magnetic core 23 remain small. Similarly, the gap 35 between the connection magnetic core 37 and the fixed primary magnetic core 23 also remain small.

The horizontal fixed primary magnetic core 23, the vertical movable connection magnetic cores 25 and 27, and the horizontal fixed secondary magnetic plate 40 comprise ferro-magnetic material, such as iron and nickel. The ferro-magnetic material has high permeability, wherein permeability is a measure of the ability of the material to support the formation of a magnetic field within material. The ferro-magnetic material also acts to gather nearby magnetic field into the ferro-magnetic material and serves as a path for the magnetic field.

In a general sense, the IPT assembly 10 is a form of an inductive charging assembly. The secondary magnetic plate 40 is a form of a secondary coil.

The primary induction coil 22 can also be adapted such that the primary induction coil 22 is not fixed and that the primary induction coil 22 moves together with the connection mag-

netic cores 25 and 27 for improving magnetic coupling between the primary induction coil 22 and secondary induction coil 43.

Different alternatives of the IPT assembly 10 are possible. The electric vehicle 19 can be replaced by other types of vehicle. The transmitter 12 can be placed on the ground or in the ground of the inductive power charging station 14. The inductive receiver 17 can also be placed inside the electric vehicle 19 instead of being installed at a lower part of the vehicle 19.

In use, the electric vehicle 19 is used for transporting people or goods. The electric vehicle 19 uses one or more electric motors or traction motors for propulsion.

The charging station 14 is intended for providing electrical energy to the battery 45 of the electric vehicle 19.

The battery 45 acts to store the electrical energy and to provide the electrical energy to the electric vehicle 19.

In particular, the battery includes a converter unit and an electrical charge storage unit.

The converter unit serves to receive an alternating electrical current, which periodically reverses direction, and serves to change the alternating electrical current to a direct electrical current, which flows in only one direction. The alternating electrical current is also called an electrical alternating current (AC). The direct electrical current is also called an electrical direct current (DC).

The electrical charge storage unit receives the converted direct electrical current to store electrical charges of the converted direct electrical current.

The electrical AC power source 30, when electrically connected to the inductive transmitter 12, provides an alternating electrical current to the inductive transmitter 12.

The transmitter 12 receives the alternating electrical current from the AC power source 30, wherein the alternating electrical current generates an alternating magnetic field.

The receiver 17 receives the alternating magnetic field from the transmitter 12, wherein the alternating magnetic field induces an alternating electrical current that flows from the receiver 17 to the battery 45 to charge the battery 45.

In particular, the primary induction coil 22 receives an alternating electrical current from the electrical AC power source 30, wherein the alternating electrical current generates an alternating magnetic field.

The fixed primary magnetic core 23 acts to gather most of the nearby magnetic field to inside of the fixed primary magnetic core 23. The fixed primary magnetic core 23 also serves as a path for the magnetic field.

The small gap 32 acts as a path for the magnetic field that extends between the primary magnetic core 23 and the connection magnetic core 25.

The connection magnetic core 25 serves to gather the nearby magnetic field to inside of the connection magnetic core 25. It also serves as a path for the magnetic field.

The small gap 52 serves as a path for the magnetic field extending between the top surface 28 of the connection magnetic core 25 and the large charging surface 47 of the secondary magnetic plate 40.

In like manner, the small gap 35 acts as a path for the magnetic field, wherein the magnetic field extends between the primary magnetic core 23 and the connection magnetic core 27.

The connection magnetic core 27 acts to gather the nearby magnetic field to inside of the connection magnetic core 27. It also serves as a path for the magnetic field.

The small gap 54 serves as a path for the magnetic field, which extends between the top surface 29 of the connection magnetic core 27 and the large charging surface 49 of the secondary magnetic plate 40.

Referring to the secondary magnetic plate 40, it acts as path for the magnetic field. The magnetic field in the secondary magnetic plate 40 then induces an electrical current in the secondary induction coil 43. The induced electrical current later flows from the secondary induction coil 43 to the battery 45 to charge the battery 45.

The IPT assembly 10 provides several advantages.

The gap 32 is arranged to be small to provide an effective transfer of the magnetic field between the primary magnetic core 23 and the connection magnetic core 25. In other words, the little magnetic field is lost during the said transfer. Similarly, the gap 35 is also arranged to be small to provide

an effective transfer of the magnetic field between the primary magnetic core 23 and the connection magnetic core 27.

The gap 52 is configured to be small to provide an effective transfer of the magnetic field between the connection magnetic core 25 and the secondary magnetic plate 40. Likewise, the gap 54 is configured to be small to provide an effective transfer of the magnetic field between the connection magnetic core 27 and the secondary magnetic plate 40.

During charging, the charging surface 47 provides a large surface for easy positioning of the top surface 28 of the connection magnetic core 25 to the charging surface 47. The charging surface 49 also provides a large surface to provide for easy positioning of the top surface 29 of the connection magnetic core 27 to the charging surface 49.

In practice, the top surfaces 28 and 29 of the movable connection magnetic cores 25 and 27 can be placed next to different areas of the secondary magnetic plate 40 because of mechanical variations. The top surfaces 28 and 29 can be placed next to inner portions of the secondary magnetic plate 40, as shown in Figs. 3 and 5, and can be placed next to outer portions of the secondary magnetic plate 40, as shown in Figs. 9 and 10.

The large charging surfaces 47 and 49 allow these movements while maintaining effective transfer of magnetic field between the movable connection magnetic cores 25 and 27 and the secondary magnetic plate 40.

In short, the IPT assembly 10 serves as a magnetic circuit, wherein the magnetic field extends among the primary magnetic core 23, the movable connection magnetic core 25, the second-

ary magnetic plate 40, and the movable magnetic core 27, and the secondary induction coil 43.

A method of operating the IPT assembly 10 is described below.

The method includes a step of placing the connection magnetic cores 25 and 27 in the non-charging position for receiving the electric vehicle 19.

A user then drives the electric vehicle 19 to the charging station 14 such that the inductive receiver 17 is positioned above the inductive transmitter 12.

After this, the connection magnetic cores 25 and 27 are placed in the charging position for allowing efficient transfer of magnetic field between the inductive receiver 17 and the inductive transmitter 12.

The electrical AC power source 30 is later electrically connected to the primary induction coil 22 of the inductive transmitter 12, wherein an alternating electrical current flows from the AC power source 30 to the primary induction coil 22.

The primary induction coil 22 afterward generates an alternating magnetic field.

The alternating magnetic field later extends from the primary induction coil 22 to the primary magnetic core 23, to the connection magnetic cores 25 and 27, and to the secondary magnetic plate 40.

The alternating magnetic field in the secondary magnetic plate 40 then induces an alternating electrical current in the sec-

ondary induction coil 43, wherein the induced alternating electrical current then flows to the battery 45 of the electrical vehicle 19 for charging the battery 45.

The connection magnetic cores 25 and 27, in the charging position, allows for efficient transfer of magnetic field from the primary induction coil 22 to the secondary magnetic plate 40.

Figs. 11 and 12 show another IPT assembly 10a a with movable connection magnetic cores.

The IPT assembly 10a comprise includes an inductive transmitter 12a with an inductive receiver 17a and a pair of vertical movable connection magnetic cores 25a and 27a.

Referring to the inductive transmitter 12a, it includes a fixed primary induction coil 22a with a horizontal fixed primary magnetic core 23a. The fixed primary induction coil 22a is wrapped many times around the fixed primary magnetic core 23a.

The inductive receiver 17a comprises a horizontal fixed secondary magnetic plate 40a with a fixed secondary induction coil 43a. The secondary induction coil 43a is wrapped many times around the fixed secondary magnetic plate 40a.

In a general sense, the inductive transmitter 12a can be adapted such that it includes the primary induction coil 22a without the primary magnetic core 23a. In other words, the transmitter 12a can work without the primary magnetic core 23a.

Fig. 13 shows a further IPT assembly 10b with movable connection magnetic cores.

The IPT assembly 10b includes an inductive transmitter 12b with an inductive receiver 17b and a pair of vertical movable connection magnetic cores 25b and 27b. The inductive transmitter 12b is installed in the ground of an inductive power charging station 14b while the inductive receiver 17b is mounted in an electric vehicle 19b. The movable connection magnetic cores 25b and 27b are installed in the electric vehicle 19b.

The movable connection magnetic cores 25b and 27b are movable between a charging position, as shown in Fig. 13 and a non-charging position, as shown in Fig. 14. In the charging position, the connection magnetic cores 25b and 27b protrude from a bottom of the electric vehicle 19b such that they are placed next to the inductive transmitter 12b. In the non-charging position, bottom surfaces of the connection magnetic cores 25b and 27b are retracted into the electric vehicle 19b.

In short, the embodiments show an improved IPT assembly 10 for a vehicle. The IPC assembly 10 also called inductive charging assembly.

The inductive charging assembly 10 includes an inductive transmitter 12 and an inductive receiver 17. The transmitter 12 is often installed in a charging station while the receiver 17 is often installed in the vehicle.

The transmitter 12 includes a primary induction coil 22. The primary induction coil 22 is also called a primary coil. The primary coil 22 is provided for generating an alternating magnetic field when an alternating current electrical power is applied to the primary coil 22. The alternating current electrical power provides an alternating electrical current that

flows to the primary coil 22. The alternating electrical current in the primary coil 22 then generates an alternating magnetic field.

The receiver 17 comprises a secondary induction coil 43 with a secondary magnetic plate 40. The secondary induction coil 43 is also called a secondary coil. The secondary magnetic plate 40 is also called a secondary magnetic core. The secondary coil 43 is provided many times around the secondary magnetic core 40. The secondary magnetic core 40 acts to gather nearby magnetic field into the secondary magnetic core 40 and provides a path for the magnetic field inside the secondary magnetic core 40.

The secondary coil 43 with the secondary magnetic core 40 is provided for electrical charging of the rechargeable battery of the vehicle when the alternating magnetic field from the primary coil 22 induces an alternating electrical current in the secondary coil 43. The induced alternating electrical current then flows from the secondary coil 43 to the battery to charge the battery.

The inductive charging assembly 10 further comprises a pair of movable connection magnetic cores 25 and 27.

The movable connection magnetic cores 25 and 27 are movable between a charging position and a standby position. In the charging position, parts of the movable connection magnetic cores 25 and 27 are provided in the vicinity of the primary coil 22 while another parts of the movable connection magnetic cores 25 and 27 are provided in the vicinity of the secondary magnetic core 40. This arrangement allows the magnetic field to extend between the primary coil 22 and the said parts, to extend between the said parts and the corresponding said other

parts, and to extend between the said other parts and the secondary magnetic core 40.

In other words, this arrangement provides a magnetic circuit for transferring the alternating magnetic field from the primary coil 22 to the connection magnetic cores 25 and 27, and from the connection magnetic cores 25 and 27 to the secondary magnetic core 40. The alternating magnetic field in the secondary magnetic core 40 then induces an alternating electric current in the secondary coil 43 that flows to the battery for charging the battery.

The movable connection magnetic cores 25 and 27 are provided near the primary coil 22 and also near the secondary magnetic core 40 for effective transfer of the magnetic field from the primary coil 22 to the secondary coil 43. This arrangement is also easy to implement, unlike other methods.

In one implementation, in the standby position, the movable connection magnetic cores 25 and 27 are retracted into the vehicle.

In another implementation, in the standby position, the movable connection magnetic cores 25 and 27 are retracted into the ground of the charging station.

The movable connection magnetic cores 25 and 27 are often provided in the vicinity of ends of the secondary magnetic core 40 for effective transfer of the magnetic field.

The inductive charging assembly 10 often includes a primary magnetic core 23. The movable connection magnetic cores 25 and 27 are provided in the vicinity of ends of the primary magnetic core 23.

Different implementations of the primary coil 22 are possible. The primary coil 22 can be provided around the primary magnetic core 23 or be provided around one or both of the movable connection magnetic cores 25 and 27.

The movable connection magnetic cores 25 and 27 are often arranged such that they are movable essentially in a vertically direction.

The primary coil 22 can be provided in the ground of a charging station. The primary coil 22 can also be provided on or above the ground of a charging station for easy installation.

The secondary coil 43 is often provided in a bottom part of the vehicle.

The embodiments also show an improved vehicle 19.

The vehicle 19 includes a receiver 17 and a pair of movable connection magnetic cores 25 and 27.

The receiver 17 comprises a secondary coil 43 with a secondary magnetic core 40 for charging a battery of the vehicle 19. The secondary coil 43 is provided many times around the secondary magnetic core 40.

The movable connection magnetic cores 25 and 27 are movable between a charging position and a standby position. In the charging position, first parts of the movable connection magnetic cores 25 and 27 are intended for providing in the vicinity of the magnetic field transmitter while second parts of the movable connection magnetic cores 25 and 27 are provided in the vicinity of the secondary magnetic core 40. This struc-

ture allows a magnetic field to extend between the magnetic field transmitter and the said first parts, to extend between the said first parts and the corresponding said second parts, and to extend between the said second parts and the secondary magnetic core 40.

The secondary magnetic core 40 receives the alternating magnetic field, wherein the alternating magnetic field in the secondary magnetic core 40 induces an alternating current in the secondary coil 43 for charging the battery of the vehicle 19.

In the charging position, the movable connection magnetic cores 25 and 27 are often provided in the vicinity of ends of the secondary magnetic core 40 for easy design.

In the standby position, the movable connection magnetic cores 25 and 27 are often retracted into the vehicle 19 for easy use.

The movable connection magnetic cores 25 and 27 are often movable essentially in a vertically direction.

The secondary coil 43 can be provided in a bottom part of the vehicle 19.

The embodiment also shows an inductive charging station for vehicles.

The inductive charging station includes a transmitter 12 and a pair of movable connection magnetic cores 25 and 27.

The transmitter 12 includes a primary coil 22 for generating an alternating magnetic field when an alternating electrical power is applied to the primary coil 22.

The movable connection magnetic cores 25 and 27 are movable between a charging position and a standby position. In the charging position, parts of the movable connection magnetic cores 25 and 27 are provided in the vicinity of the primary coil 22 for receiving the magnetic field and further parts of the movable connection magnetic cores 25 and 27 are intended for providing in the vicinity of a magnetic field receiver. This allows a magnetic field to extend between the primary coil 22 and the said parts, to extend between the said parts and the said further parts, and to extend between the said further parts and the magnetic field receiver.

In the standby position, the movable connection magnetic cores are often retracted into the ground of the inductive charging station.

The inductive charging station often includes a primary magnetic core 23, wherein the movable connection magnetic cores 25 and 27 are provided in the vicinity of ends of the primary magnetic core 23.

The primary coil 22 can be provided around the primary magnetic core 23 or be provided around the connection magnetic core 25 or 27.

The movable connection magnetic cores 25 and 27 are often movable essentially in a vertically direction.

The primary coil 22 can be provided in the ground of a charging station or be provided on or above the ground of a charging station.

Although the above description contains much specificity, this should not be construed as limiting the scope of the embodiments but merely providing illustration of the foreseeable embodiments. The above stated advantages of the embodiments should not be construed especially as limiting the scope of the embodiments but merely to explain possible achievements if the described embodiments are put into practice. Thus, the scope of the embodiments should be determined by the claims and their equivalents, rather than by the examples given.

REFERENCE LIST

10	Inductive Power Transfer (IPT) assembly
12	inductive transmitter
14	inductive power charging station
17	inductive receiver
19	electric vehicle
22	fixed primary induction coil
23	fixed primary magnetic core
25	movable connection magnetic core
27	movable connection magnetic core
28	top surface
29	top surface
30	electrical AC power source
32	gap
35	gap
40	fixed secondary magnetic plate
43	secondary induction coil
45	rechargeable battery
47	charging surface
49	charging surface
52	gap
54	gap
10a	IPT assembly
12a	inductive transmitter
17a	inductive receiver
22a	fixed primary induction coil
23a	fixed primary magnetic core
25a	movable connection magnetic core
27a	movable connection magnetic core
40a	fixed secondary magnetic plate
43a	fixed secondary induction coil
10b	IPT assembly

12b inductive transmitter

14b inductive power charging station

17b inductive receiver

19b electric vehicle

25b movable connection magnetic core

27b movable connection magnetic core

CLAIMS

1. An inductive charging assembly for a vehicle, the inductive charging assembly comprising

a transmitter comprising a primary coil for generating an alternating magnetic field,

a receiver comprising a secondary coil with a secondary magnetic core for charging a battery of the vehicle when the alternating magnetic field induces an alternating electrical current in the secondary coil, the secondary coil being provided around the secondary magnetic core, wherein

the inductive charging assembly further comprises a pair of movable connection magnetic cores, wherein the secondary magnetic core comprises a secondary magnetic plate, the secondary magnetic plate comprises a plurality of areas for coupling electromagnetically with the movable connection magnetic cores, wherein the movable connection magnetic cores are movable essentially in a vertical direction,

wherein the movable connection magnetic cores are movable between a charging position and a standby position, in the charging position, the movable connection magnetic cores are provided in the vicinity of the primary coil and are provided in the vicinity of the secondary magnetic core such that the alternating magnetic field extends between the movable connection magnetic cores and the secondary magnetic core.

2. The inductive charging assembly according to claim 1, wherein,

in the standby position, the movable connection magnetic cores are retracted into the vehicle.

3. The inductive charging assembly according to claim 1, wherein,
in the standby position, the movable connection magnetic cores are retracted into the ground of the charging station.

4. A vehicle comprising
a receiver comprising a secondary coil with a secondary magnetic core for charging a battery of the vehicle, the secondary coil being provided around the secondary magnetic core, and
a pair of movable connection magnetic cores,
wherein the secondary magnetic core comprises a secondary magnetic plate, the secondary magnetic plate comprises a plurality of areas for coupling electromagnetically with the movable connection magnetic cores, wherein the movable connection magnetic cores are movable essentially in a vertical direction,
wherein the movable connection magnetic cores are movable between a charging position and a standby position,
in the standby position, the movable connection magnetic cores are retracted into the vehicle, and
in the charging position, the movable connection magnetic cores are for providing in the vicinity of a magnetic field transmitter for receiving an alternating magnetic field from the magnetic field transmitter and are provided in the vicinity of the secondary magnetic core, such that the alternating magnetic field extends between the movable connection magnetic cores and the secondary magnetic core.

5. The vehicle according to claim 4, wherein,

in the charging position, the movable connection magnetic cores are provided in the vicinity of ends of the secondary magnetic core.

6. The vehicle according to claim 4, wherein
the secondary coil is provided in a bottom part of the vehicle.