Title: POWER SUPPLY DEVICE FOR ON-LINE ELECTRIC VEHICLE HAVING EMF CANCELLATION CAPABILITY

Abstract: A power supply device is embedded in the longitudinal direction of a road and used for supplying a power to an on-line electric vehicle using magnetic induction. The power supply device includes a pair of split return cables, each split return cable being arranged in parallel at a distance from a power supply line in the horizontal direction of the power supply line, one end of the split return cables being electrically connected to the other end of the power supply line, and the other ends of the split return cables being electrically connected to the power supply unit. Accordingly, the current from a power supply unit passes through the power supply line, branches off to the split return cables, and then flows to the power supply unit again, to thereby reduce EMF by canceling the EMF occurring at both sides of the power supply device.

Published: without international search report and to be republished upon receipt of that report (Rule 48.2(g))
Description

Title of Invention: POWER SUPPLY DEVICE FOR ON-LINE ELECTRIC VEHICLE HAVING EMF CANCELLATION CAPABILITY

Technical Field

[1] The present invention relates to a power supply device for an on-line electric vehicle, and more particularly, to a power supply device capable of canceling the intensity of electromagnetic field (EMF) occurring therefrom.

Background Art

[2] Existing battery-powered electric vehicles have problems such as an excessive capacity, a long charging time, low charging efficiency and a short lifetime of rechargeable batteries. Such rechargeable batteries lead to an increase in weight or volume and cost of the vehicles, and require charging stations therefor.

[3] In order to solve the above problems, there has been proposed a non-contact power supply device using magnetic induction, which is capable of supplying an electric power required for the on-line electric vehicle from a road, and charges a battery, while being driven. One of examples of the non-contact power delivery apparatus is disclosed in a PCT application PCT/KR2010/000856, filed on February 11, 2010, entitled POWER SUPPLY DEVICE, POWER ACQUISITION DEVICE AND SAFETY SYSTEM FOR ELECTROMAGNETIC INDUCTION-POWERED ELECTRIC VEHICLE, which is assigned to the assignee of the present application.

[4] The power supply device is embedded along a road and includes a power supply rail having a power supply core and one or more power supply lines connected to a power supply unit. In this power supply device, one power supply line defines a monorail and two power supply lines define a dual-rail.

[5] The power supply device needs to have durability against a load and pressure of the vehicle driving on the road, which amounts to more than 10 tons. Further, in the power supply device, the electromagnetic field emitting from the power supply device is required to reach up to 12cm or more from the ground, which is the minimum height between the power supply device and an on-line electric vehicle. However, the electromagnetic field is harmful to a human body, and specifically, the intensity of the electromagnetic field occurred in a monorail power supply device is higher than that of a dual-rail power supply device.

Disclosure of Invention

Technical Problem
In view of the above, the present invention provides a power supply device for an on-line electric vehicle to reduce the intensity of electromagnetic field (EMF) occurring in the power supply device by cancelling the EMF at both sides and/or lower side of the power supply device.

**Solution to Problem**

In accordance with a first aspect of the present invention, there is provided a power supply device of canceling the intensity of electromagnetic field, which embedded in the longitudinal direction of a road and used for supplying a power to an on-line electric vehicle using magnetic induction, the power supply device including: a power supply unit; a power supply rail, the power supply rail having a power supply core, an insulator and a power supply line which are sequentially stacked, wherein one end of the power supply line is connected to the output end of the power supply unit; and a pair of split return cables, each split return cable being arranged in parallel at a distance from the power supply line in the horizontal direction of the power supply line, one ends of the split return cables being electrically connected to the other end of the power supply line that is not connected to the power supply unit, and the other ends of the split return cables being electrically connected to the power supply unit.

Preferably, the power supply device further includes another pair of split return cables, each split return cable being located below of the power supply rail at a distance from the base of the power supply rail, one ends of the split return cables being electrically connected to the other end of the power supply line that is not connected to the power supply unit, and the other ends of the split return cables being electrically connected to the power supply unit.

In accordance with a second aspect of the present invention, there is provided a power supply device of canceling the intensity of electromagnetic field, which is embedded in the longitudinal direction of a road and used for supplying a power to an on-line electric vehicle using magnetic induction, the power supply device including: a power supply unit; a power supply rail, the power supply rail having a power supply core, an insulator and a power supply line which are sequentially stacked, wherein one end of the power supply line is connected to the output end of the power supply unit; and a pair of split return cables, each split return cable being arranged in parallel at a distance from the power supply line in the horizontal direction of the power supply line and located below of the power supply rail at a distance from the base of the power supply rail, one ends of the split return cables being electrically connected to the other end of the power supply line that is not connected to the power supply unit, and the other ends of the split return cables being electrically connected to the power supply unit.
Brief Description of Drawings

[10] The above and other objects and features of the present invention will become apparent from the following description of embodiments given in conjunction with the accompanying drawings, in which:

[11] Fig. 1 schematically illustrates a plan view of a power supply device for an on-line electric vehicle in accordance with a first embodiment of the present invention;

[12] Fig. 2 illustrates a sectional view taken along lines II-II of the power supply device illustrated in Fig. 1;

[13] Fig. 3 illustrates a sectional view of a power supply device for an on-line electric vehicle in accordance with a second embodiment of the present invention; and

[14] Fig. 4 illustrates a sectional view of a power supply device for an on-line electric vehicle in accordance with a third embodiment of the present invention.

Best Mode for Carrying out the Invention

[15] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. In the several Figures of the drawings, like reference numerals are used to designate like or equivalent elements, functions or components.

[16] Fig. 1 schematically illustrates a plan view of a power supply device for an on-line electric vehicle in accordance with a first embodiment of the present invention; and Fig. 2 illustrates a sectional view taken along lines II-II of the power supply device illustrated in Fig. 1.

[17] Referring to the drawings, the power supply device includes a power supply unit 600, and a power supply rail (or track) 100 in which a power supply core 130, an insulator 120 and a power supply line 110 are sequentially stacked. The power supply device is embedded in a road along the longitudinal direction of the road and used for supplying a power to an on-line electric vehicle using magnetic induction.

[18] The power supply line 110 is constructed of a flat conductive material, for example, copper or aluminum material, and the power supply core 130 is formed of a magnetic body. The insulator 120 electrically insulates the power supply line 110 and the power supply core 130 from each other. One end of the power supply line 110 is connected to the output end of the power supply unit 600.

[19] When current flows in the power supply line 110, an electromagnetic field (EMF) is created around the power supply line 110. The intensity of EMF proportions to the magnitude of the current and is reduced in inverse proportion to the distance from the power supply line 110.

[20] In order to reduce EMF, the power supply device further includes a pair of split return cables 200L and 200R. One ends of the split return cables 200L and 200R are
electrically connected to the input end of the power supply unit 600, and the other ends of the split return cables 200L and 200R are electrically connected to the other end of the power supply line 110 that is not connected to the power supply unit 600. The split return cables 200L and 200R are extended in the longitudinal direction of the road in parallel to each other and on both sides of the power supply rail 100. Each of the split return cables 200L and 200R is arranged at a distance 'g' from the power supply line 110 in the horizontal direction of the power supply line 110. Further, the split return cables 200L and 200R are arranged at a distance S to each other.

[21] Reference numerals 210L and 210R are segments of the power supply core 130, respectively, which are separated from the power supply core 130 and may be removed.

[22] Accordingly, the current from the power supply unit 600 passes through the power supply line 110, branches off to the split return cables 200L and 200R, and then flows to the power supply unit 600 again, to thereby reduce the EMF by canceling the EMF occurring at both sides of the power supply rail 100.

[23] When the distance 'g' between the split return cables 200L and 200R and the power supply line 110 is about 50cm, the intensity of EMF becomes equal to or less than 62.5 mG that is the permissible reference value of human exposure to the EMF. Such EMF ranges at a position where the height H and radius R from the center portion of the magnetic body are about 50cm and about 1.5m, respectively, that is, where the distance from the center portion of the magnetic body is about 1.58m, but not effect on a human body within the range.

[24] Fig. 3 illustrates a sectional view of a power supply device for an on-line electric vehicle in accordance with a second embodiment of the present invention.

[25] The power supply device of the second embodiment of the present invention is the same as that of the first embodiment of the present invention except that another pair of split return cables 300L and 300R is further included below the power supply rail 100. Therefore, detailed description for the same elements will be omitted.

[26] Although not specifically illustrated, like the split return cables 200L and 200R illustrated in Fig. 1, one ends of the return cables 300L and 300R are electrically connected to the input end of the power supply unit 600 and the other ends of the return cables 300L and 300R are electrically connected to the other end of the power supply line 110 which is not connected to the power supply unit 600.

[27] The split return cables 300L and 300R are located below the power supply rail 100 at a distance D from the base of the power supply rail 100 in the vertical direction of the road and adjacent to each other. The split return cables 300L and 300R extended in the longitudinal direction of the road in parallel to each other and on both sides of the power supply rail 100.

[28] Accordingly, the current from the power supply unit 600 passes through the power
supply line 110, branches off to the split return cables 200L and 200R; and 300L and 300R, and then flows to the power supply unit 600 again, to thereby reduce the intensity of EMF by canceling the EMF occurring at both sides and lower side of the power supply rail 100.

When the distance 'g' between the split return cables 200L and 200R and the power supply line 110 is 50cm and the distance D between the base of the power supply track 100 and the split return cables 300L and 300R is 5cm more or less, the intensity of EMF becomes equal to or less than 62.5 mG that is the permissible reference value of human exposure to the EMF. Such EMF ranges at a position where the height H and radius R from the center portion of the magnetic body are about 50cm and about 1.25m, respectively, that is, where the distance from the center portion of the magnetic body is about 1.58m, but not effect on a human body within the range.

Fig. 4 illustrates a sectional view of a power supply device for an on-line electric vehicle in accordance with a third embodiment of the present invention.

The power supply device of the third embodiment of the present invention is the same as that of the first embodiment except that split return cables 400L and 400R are located below the power supply rail 100 at a distance D from the base of the power supply rail 100 in the vertical direction of the road while being arranged at a distance 'g' from the power supply line 110 in the horizontal direction of the power supply line 110 on both sides of the power supply rail 100.

Therefore, detailed description for the same elements will be omitted. Further, the split return cables 400L and 400R are arranged at a distance S to each other.

Although not specifically illustrated, like the split return cables 200L and 200R illustrated in Fig. 1, one ends of the return cables 400L and 400R are electrically connected to the input end of the power supply unit 600 and the other ends of the return cables 400L and 400R are electrically connected to the other end of the power supply line 110 which is not connected to the power supply unit 600.

Accordingly, the current from the power supply unit 600 passes through the power supply line 110, branches off to the split return cables 400L and 400R, and then flows to the power supply unit 600 again, to thereby reduce the EMF by canceling the EMF occurring at both sides and lower side of the power supply rail 100.

When the distance 'g' between the split return cables 400L and 400R and the power supply line 110 is 50cm and the distance D between the base of the power supply track 100 and the split return cables 400L and 400R is 5cm more or less, the intensity of EMF becomes equal to or less than 62.5 mG that is the permissible reference value of human exposure to the EMF. Such EMF reaches ranges at a position where the height H and radius R from the center portion of the magnetic body are about 50cm and about 1.25m, respectively, that is, where the distance from the center portion of the magnetic
body is about 1.58m, but not effect on a human body within the range.

[36] While the present invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.
Claims

[Claim 1] A power supply device of canceling the intensity of electromagnetic field, which is embedded in the longitudinal direction of a road and used for supplying a power to an on-line electric vehicle using magnetic induction, the power supply device comprising:
a power supply unit;
a power supply rail, the power supply rail having a power supply core, an insulator and a power supply line which are sequentially stacked, wherein one end of the power supply line is connected to the output end of the power supply unit; and
a pair of split return cables, each split return cable being arranged in parallel at a distance from the power supply line in the horizontal direction of the power supply line, one ends of the split return cables being electrically connected to the other end of the power supply line that is not connected to the power supply unit, and the other ends of the split return cables being electrically connected to the power supply unit.

[Claim 2] The power supply device of claim 1, further comprising:
another pair of split return cables, each split return cable being located below of the power supply rail at a distance from the base of the power supply rail, one ends of the split return cables being electrically connected to the other end of the power supply line that is not connected to the power supply unit, and the other ends of the split return cables being electrically connected to the power supply unit.

[Claim 3] A power supply device of canceling the intensity of electromagnetic field, which is embedded in the longitudinal direction of a road and used for supplying a power to an on-line electric vehicle using magnetic induction, the power supply device comprising:
a power supply unit;
a power supply rail, the power supply rail having a power supply core, an insulator and a power supply line which are sequentially stacked, wherein one end of the power supply line is connected to the output end of the power supply unit; and
a pair of split return cables, each split return cable being arranged in parallel at a distance from the power supply line in the horizontal direction of the power supply line and located below of the power supply rail at a distance from the base of the power supply rail, one ends of the split return cables being electrically connected to the other
end of the power supply line that is not connected to the power supply unit, and the other ends of the split return cables being electrically connected to the power supply unit.