(54) Title: WALL MOUNTABLE DC ELECTRIC VEHICLE CHARGER


The present application presents a solution that intends to solve the problem of embodying a wall mountable electric vehicle DC fast charger. Disclosed is a wall mountable electric vehicle DC charger (201), comprising at least one high frequency AC to DC power converter module placed in the interior back of the charger, a cooling system with input and output channels placed on the back of the charger, between said charger and a wall (202), a wireless network interface and a central processing unit. In one embodiment, the unit does not incorporate a display for messages and commands and, instead, has the possibility of turning a mobile computational device (301) into a command console of the charger, that sends commands using wireless communication (302). It is useful for quick charging with DC electric power in different situations: private users, fleets, companies, condominiums, garages, car dealers and also in public places.

Published: — with international search report (Art. 21(3))
DESCRIPTION
"WALL MOUNTABLE DC ELECTRIC VEHICLE CHARGER"

Technical Field
The present application relates to a wall mountable Direct Current (DC) electric vehicle charger.

Background
Nowadays, electric vehicles comprise an onboard Alternate Current (AC) to DC converter that allows battery charging with AC electric power, a type of power easily available in many places requiring relatively simple chargers. Due to its size, weight and cost, the onboard converter is limited in amount of power, which entails, in the case of many vehicle models, the charging process usually taking several hours before completion.

In order to charge faster, higher power converters are used off board, supplying DC power to the electric vehicle's battery. For example, document US2013020993A1 disclose such a charger. Since fast charging DC chargers require considerable power, these are normally embodied in floor standing units, not suitable to installation in every place.

The document IEC 61851-23:2014, an international standard prepared and published by the International Electrotechnical Commission, gives the requirements for DC electric vehicle charging stations, for conductive connection to the vehicle, with an AC or DC input voltage up to 1000 V AC and up to 1500 V DC according to IEC 60038. It provides the general requirements for the control communication between a DC electric vehicle charging
station and an electric vehicle. The requirements for digital communication between DC electric vehicle charging station and electric vehicle for control of DC charging are defined in IEC 61851-24.

Wall mountable chargers overcome the cited problems since they have a reduced weight and size, allowing an easy installation procedure in most places. The problem is that these are usually only achieved for the AC type.

Summary

The present application discloses a wall mountable electric vehicle charger, comprising:
- at least one high frequency AC to DC power converter module placed in the interior back of the charger;
- a cooling system with input and output channels placed on the back of the charger;
- a wireless network interface; and
- a central processing unit,
wherein the central processing unit controls the cooling system, and operates the wireless network interface to communicate with a mobile computational device, and wherein the cooling system input and output channels interface with an interval from 1 cm to 20 cm in the back of the charger.

In one embodiment, the electric vehicle charger further comprises a movable front panel wherein the power converter modules are inserted and removed through the entry created by moving said panel.

In another embodiment, the wireless network interface uses any of the following communication protocols:
- Wi-Fi;
- Bluetooth;
- Infrared;
- Near Field Communication; or
- any other wireless communication protocol.

In a further embodiment, the electric vehicle charger further comprises a remote connection to a central server through a communication network.

In one embodiment, the communication network is the internet.

The present application also discloses a method of installing the wall mountable electric vehicle charger, comprising the following steps:
- mount the mountable electric vehicle charger without the power converter modules; and
- insert the power converter modules inside the charger through the entry created by moving the front panel.

The present application further discloses the use of the wall mountable electric vehicle charger, wherein the charger is mounted in a garage.

The present application discloses the use of the wall mountable electric vehicle charger, wherein the charger is mounted in a car dealership.

The present application discloses the use of the wall mountable electric vehicle charger, wherein the charger is mounted in a condominium.
**General description**

The present application presents a solution that intends to solve the problem of embodying a wall mountable electric vehicle DC fast charger.

Disclosed is a wall mountable electric vehicle DC charger, comprising:
- at least one high frequency AC to DC power converter module placed in the interior back of the charger;
- a cooling system with input and output channels placed on the back of the charger;
- a wireless network interface; and
- a central processing unit.

The high frequency converters use the AC supply frequency as input, but have an intermediate stage with a frequency in the kHz range or higher, which allows the size of transformers and other passive power components to be considerably smaller. Using converter modules of up to 10 kW limits the weight and size of each one.

The number of high frequency converter modules, which have a reduced size, is selected in order to achieve the desired output power. For example, 3 converters of 8 kW are used to achieve a 24 kW output power. Furthermore, the high frequency allows the magnetic and passive components to be smaller.

The compact size of the wall mountable electric vehicle DC charger requires an adequate cooling system. It is undesirable for the airflow to be directed to the front of the charger. Hence, the charger comprises an interval from 1 cm to 20 cm in the back, where the air is taken from and
where the air goes out. Airflow channels are also comprised, to make the air circulate inside.

To further reduce the weight and size, the unit does not incorporate a display for messages and commands, instead has the possibility of wirelessly communicating with a mobile computational device, turning this one into the command console of the charger. Wireless communications can be established using Wi-Fi, Bluetooth, Infrared, Near Field Communication or any other wireless communication protocol.

Said converter modules are placed on the back of the charger and are easily inserted and removed by moving the front panel. By having a structure that allows the modules to be inserted after the charger is mounted in place, the weight is lower while the mounting process is conducted, so producing an additional effect of allowing an easy installation, being very functional for construction, installation and maintenance.

In one embodiment, the charger has a remote connection to a central server, allowing it to be remotely managed. Several embodiments of the present charger, can be combined in a set and connected through a communication network, for example the internet, to the same server in order to form a networked electric vehicle system.

In one embodiment, the converters are controlled and managed by control electronics and software, to be adequate for the requirements of DC electric vehicle charging as defined in IEC61851-23. In one embodiment, the mountable electric vehicle charger implements system A, also known as CHAdeMO, in another embodiment implements system B, and in
other embodiment implements system C, also known as Combo or Combined Charging System (CCS), of said standard.

The present electric vehicle charger achieves the desired miniaturization that allows it to have enough low weight and volume to be mounted in several possible locations.

It is useful for quick charging with DC electric power in different situations: private users, fleets, companies, condominiums, garages, car dealers and also in public places.

Since it has output power high enough, for example a minimum value of 8 kW, to enable a quicker charge than what is possible with the AC input of many cars, which is limited in power, usually a maximum of 7kW and only in some cases can be more.

**Brief description of drawings**

Without intent to limit the disclosure herein, this application presents attached drawings of illustrated embodiments for an easier understanding.

Figure 1 illustrates a circuit diagram of various AC to DC power conversion modules, where the reference numbers show:

- 101 - AC input;
- 102 - DC output;
- 103 - AC to DC power conversion module 1; and
- 104 - AC to DC power conversion module N.

Figure 2 illustrates an embodiment of the wall mountable electric vehicle charger in position, where the reference numbers show:
201 - wall mountable electric vehicle charger;
202 - wall;
203 - air flow; and
204 - space between charger and wall.

Figure 3 illustrates an embodiment of controlling the wall mountable electric vehicle charger using a mobile computational device, where the reference numbers show:

201 - wall mountable electric vehicle charger;
202 - wall;
301 - mobile computational device; and
302 - wireless communication.

Mode(s) for carrying out embodiments

Referring to the drawings, herein are described optional embodiments in more detail, which however are not intended to limit the scope of the present application.

Figure 1 illustrates a circuit diagram of various AC to DC power conversion modules placed inside the wall mountable electric vehicle charger. The modules (103, 104) are placed in parallel between the AC input (101) and the DC output (102).

Figure 2 illustrates an embodiment of the wall mountable electric vehicle charger (201) in position, mounted in a wall (202), allowing the creation of an air flow (203) with a space between the charger and the wall (204). This airflow is created by the cooling system with input and output channels placed on the back of the charger.

Figure 3 illustrates an embodiment of controlling the wall mountable electric vehicle charger (201) in position,
mounted in a wall (202), using a mobile computational device (301). Commands are sent to the wall mountable electric vehicle charger (201) through wireless communication (302). The unit does not incorporate a display for messages and commands and, instead, has the possibility of turning the mobile computational device (301) into a command console of the charger.

Naturally, the present embodiments are not in any way limited to the embodiments described in this document and a person with average knowledge in the field will be able to predict many possible changes to it without deviating from the main idea, as described in the claims.
CLAIMS

1. A wall mountable electric vehicle charger, comprising:
   - at least one high frequency AC to DC power converter module placed in the interior back of the charger;
   - a cooling system with input and output channels placed on the back of the charger;
   - a wireless network interface; and
   - a central processing unit,
   wherein the central processing unit controls the cooling system, and operates the wireless network interface to communicate with a mobile computational device, and
   wherein the cooling system input and output channels interface with an interval from 1 cm to 20 cm in the back of the charger.

2. Mountable electric vehicle charger according to the previous claim, further comprising a movable front panel wherein the power converter modules are inserted and removed through the entry created by moving said panel.

3. Mountable electric vehicle charger according to any of the previous claims, wherein the wireless network interface uses any of the following communication protocols:
   - Wi-Fi;
   - Bluetooth;
   - Infrared;
   - Near Field Communication; or
   - any other wireless communication protocol.
4. Wall mountable electric vehicle charger according to any of the previous claims, further comprising a remote connection to a central server through a communication network.

5. Wall mountable electric vehicle charger according to the previous claim, wherein the communication network is the internet.

6. A method of installing the wall mountable electric vehicle charger described in any of the claims 2 to 5, comprising the following steps:
   - mount the mountable electric vehicle charger without the power converter modules; and
   - insert the power converter modules inside the charger through the entry created by moving the front panel.

7. Use of a wall mountable electric vehicle charge as described in any of the claims 1 to 5, wherein the charger is mounted in a garage.

8. Use of a wall mountable electric vehicle charge as described in any of the claims 1 to 5, wherein the charger is mounted in a car dealership.

9. Use of a wall mountable electric vehicle charge as described in any of the claims 1 to 5, wherein the charger is mounted in a condominium.
**A. CLASSIFICATION OF SUBJECT MATTER**

INV. B60L11/18

According to International Patent Classification (IPC) or to both national classification and IPC.

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

<table>
<thead>
<tr>
<th>B60L</th>
<th>H02J</th>
</tr>
</thead>
</table>

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2006/028178 Al (HOBBS RAYMOND [US]) 9 February 2006 (2006-02-09) the whole document</td>
<td>1,3-5, 7-9</td>
</tr>
<tr>
<td>Y</td>
<td>US 2011/291616 Al (KIM YOUNG-CH00N [KR] ET AL) 1 December 2011 (2011-12-01) the whole document</td>
<td>2,6</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance.
  - "E" earlier application or patent but published on or after the international filing date.
  - "L" document which may throw doubts on priority claim(s) one of which is cited to establish the publication date of another citation or other special reasons (as specified).
  - "O" document referring to an oral disclosure, use, exhibition or other means.
  - "P" document published prior to the international filing date but later than the priority date claimed.

**Date of the actual completion of the international search**

23 October 2015

**Date of mailing of the international search report**

03/11/2015

**Name and mailing address of the ISA**

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

**Authorized officer**

Anni bal, Stewart
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 2006028178 Al</td>
<td>09-02-2006</td>
<td>CA 2556791 Al</td>
<td>28-02-2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1770845 A2</td>
<td>04-04-2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2006028178 Al</td>
<td>09-02-2006</td>
</tr>
<tr>
<td>US 2011291616 Al</td>
<td>01-12-2011</td>
<td>CN 102470776 A</td>
<td>23-05-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2492133 A2</td>
<td>29-08-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 55499988 B2</td>
<td>16-07-2014</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2012518987 A</td>
<td>16-08-2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 101009485 B1</td>
<td>19-01-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2011291616 Al</td>
<td>01-12-2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2011132887 A2</td>
<td>27-10-2011</td>
</tr>
<tr>
<td>JP 2013070589 A</td>
<td>18-04-2013</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>