

**(12) STANDARD PATENT**  
**(19) AUSTRALIAN PATENT OFFICE**

(11) Application No. **AU 2018241040 B2**

(54) Title  
**USE OF TWO DC/DC CONTROLLERS IN THE POWER ELECTRONICS SYSTEM OF A CHARGING STATION OR ELECTRICITY CHARGING STATION**

(51) International Patent Classification(s)  
**H02J 7/00 (2006.01)**

(21) Application No: **2018241040** (22) Date of Filing: **2018.10.02**

(30) Priority Data

(31) Number	(32) Date	(33) Country
<b>10 2017 217 757.8</b>	<b>2017.10.06</b>	<b>DE</b>

(43) Publication Date: **2019.05.02**

(43) Publication Journal Date: **2019.05.02**

(44) Accepted Journal Date: **2023.03.09**

(71) Applicant(s)  
**ads-tec Energy GmbH;Dr. Ing. h.c.F. Porsche AG**

(72) Inventor(s)  
**Heyne, Raoul;Joslowski, Florian;Kiefer, Michael;Speidel, Thomas;Natour, Ali**

(74) Agent / Attorney  
**Phillips Ormonde Fitzpatrick, PO Box 323, COLLINS STREET WEST, VIC, 8007, AU**

(56) Related Art  
**US 2012/0181990 A1**  
**US 2007/0159860 A1**

**Abstract**

**Use of two DC/DC controllers in the power electronics system  
of a charging station or electricity charging station**

The invention provides a power electronics system of an electricity charging station having the following features: a first DC voltage converter (11), a first DC chopper (12) connected to the first DC voltage converter (11) for connection of a battery (21, 22) to the charging station (10) and a second DC chopper (13) connected to the first DC voltage converter (11) for connection of an electric automobile to the charging station (10).

The invention also provides a corresponding electricity charging station.

(Fig.)

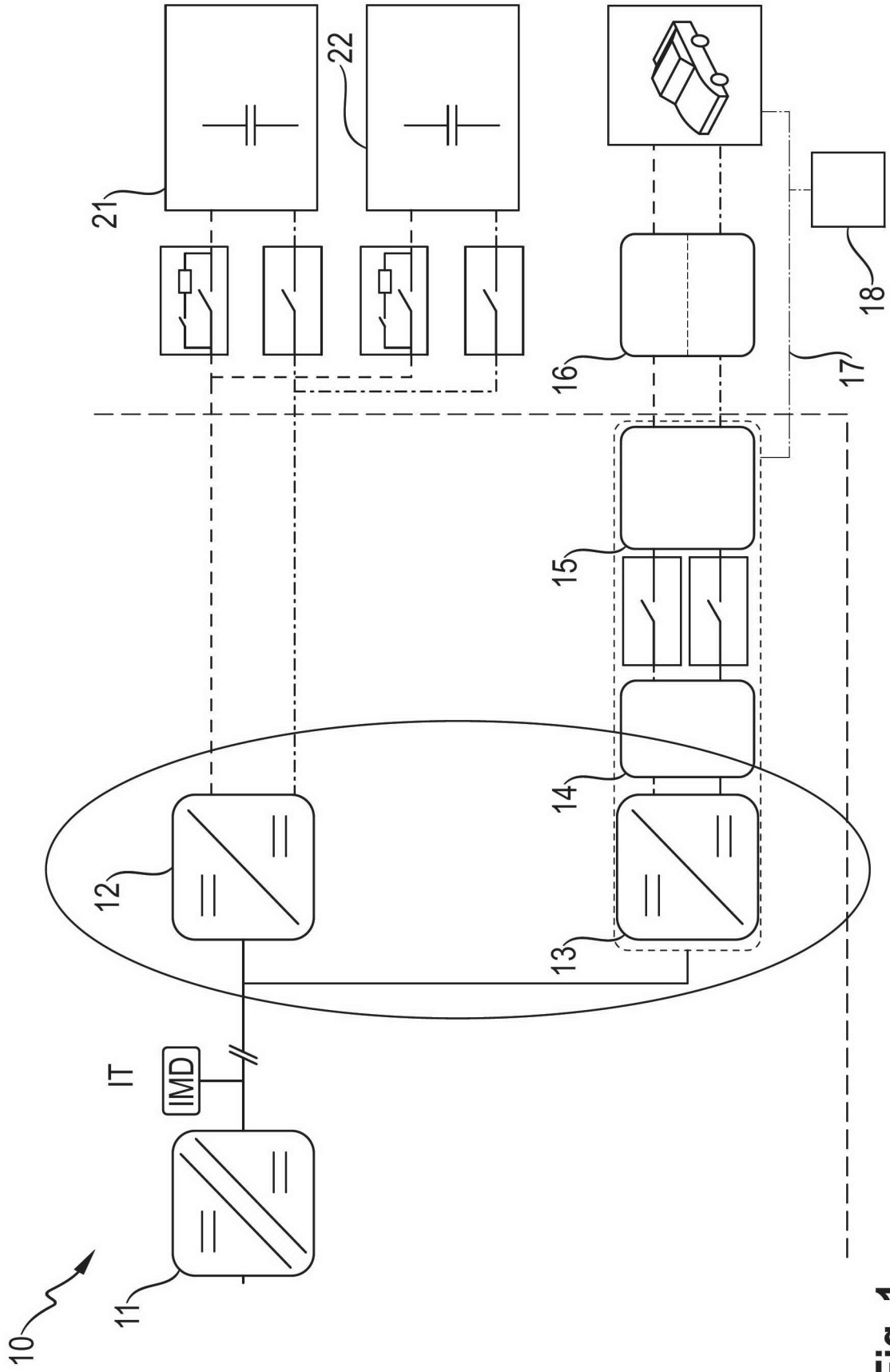


Fig. 1

**Use of two DC/DC controllers in the power electronics system  
of a charging station or electricity charging station**

[0001] This application claims priority from German Patent Application No. 10 2017 217 757.8 filed on 6 October 2017, the contents of which are to be taken as incorporated herein by this reference

[0002] The present invention relates to the use of two DC/DC controllers in the power electronics system of an electricity charging station. The present invention also relates to a corresponding charging station or electricity charging station.

Background

[0003] A reference herein to a matter which is given as prior art is not to be taken as an admission the matter was known or that the information it contains was part of the common general knowledge as at the priority date of any of the claims.

[0004] In electrical engineering, any stationary device or electrical system that serves for supplying energy to mobile, battery-operated units, machines or motor vehicles by way of simple setting or insertion without it being necessary for the energy store - for example the traction battery of an electric automobile - to be removed compulsorily is referred to as a charging station. Charging stations for electric automobiles are also sometimes referred to as "electricity charging stations" and can comprise a plurality of charging points.

[0005] Known here in particular are direct-current fast charging/high-performance charging (HPC) systems such as the so-called combined charging system (CCS), which is widespread in Europe. In the case of direct-current charging of the generic type, direct current is fed from the charging column directly into the vehicle and, for this purpose, is provided by way of a powerful rectifier from the electricity network or by way of large buffer accumulators at solar charging stations, for example. Situated in the vehicle is a battery management system, which communicates with the charging column directly or indirectly in order to adapt the current intensity, or to terminate the process when a capacity limit is reached.

[0006] The power electronics system is usually located in this case in the charging column. Since the direct-current connections of the charging column are connected directly to corresponding connections of the traction battery, it is possible for high charging currents to be transmitted with little loss, which allows short charging times.

[0007] In the various charging stations used worldwide, a wide variety of topologies are used for the power electronics system. Known in particular are charging stations that additionally use an energy store in the form of a battery. However, a plurality of topologies in the power electronics system are also possible for the connection of a battery.

[0008] For instance, US 2015202973 and WO 15103164 disclose converter constructions for a charging station for electric vehicles, which converter constructions enable additional energy storage batteries to be installed in the respective charging station. The arrangement consists in each case of a

rectifier connected to the network followed by a DC voltage converter or DC chopper. The respective battery is connected on one side to the electricity network and on the other side to the charging station.

[0009] JP 2012019602, US 2015328999 and US 2012074901 describe further fast-charging columns for charging electric vehicles with additional energy storage batteries.

[0010] US 2015061569 and US 2008067974 finally discuss in each case a vehicle charging station with an additional energy store and a network connection connected by means of a converter.

#### Summary of the invention

[0011] The invention provides two DC/DC controllers in a charging station for an electricity charging station and a corresponding electricity charging station.

[0012] In one form of the invention there is provided a charging station for an electricity charging station, comprising a first DC-to-DC voltage converter for the voltage supply of the charging station, a first DC chopper connected to the first DC-to-DC voltage converter, of a first power path for connecting a battery to the charging station and for returning energy stored in the battery for faster charging of an electric car, and a second DC chopper connected to the first DC-to-DC voltage converter of a second power path, an EMC filter connected downstream of the second DC chopper and a second DC-to-DC voltage converter, connected downstream of the EMC filter and operated in a discontinuous conduction mode, for connecting the electric car to the charging station in order to charge the electric car.

[0013] The presently used solution having two DC/DC controllers downstream of the galvanic isolation has the advantage that one DC controller is responsible only for the battery and the other is responsible for charging the vehicle. As a result, the voltage range of the battery can be

used in optimum fashion. This in turn makes it possible to use the maximum battery capacity for charging.

[0014] Such a topology is, at first glance, unusual because the impression may be as if it were possible to dispense with a DC/DC controller; however, said topology constitutes a very efficient solution.

[0015] The proposed approach is based on the insight that the storage battery can be incorporated into the charging column at many different connections in the topology of the power electronics system. In this case, care must be taken to ensure that the storage battery is installed efficiently. Furthermore, said storage battery should be integrated so that the storage battery is arranged in the same housing as the rest of the power electronics system in order to create a compact apparatus.

[0016] The invention also takes into account the fact that most known charging solutions provide charging columns, which draw the required charging energy directly from the network and therefore do not have an additional store. An additional store can be added very easily in these charging columns by virtue of said store being connected on the AC side to the network and to the charging column. This is not necessarily the most efficient solution. Also, additional stores are often not accommodated in the same housing as the charging column, which requires more outlay in terms of installation. The charging columns furthermore often have a specific minimum size because topologies with outdated IGBT technologies are used. These are cheap but require more installation space. Additionally integrated stores are also not always integrated so that the voltage range and hence the optimum storage capacity can be used completely.

[0017] In contrast, one preference of the invention disclosed here lies in the introduced possibility of installing the energy store - in this case a battery - in the same housing as the charging column in order to minimize the installation outlay. The overall solution is also very compact in order not to obstruct the visibility in road traffic significantly. This requires the use of very fast converter topologies at high switching frequencies, which in turn requires the use of SiC MOS modules. In this case, the battery is accommodated in the DC part, which improves the efficiency of the charging station and reduces the production costs thereof.

[0018] Where the terms "comprise", "comprises", "comprised" or "comprising" are used in this specification (including the claims) they are to be interpreted as specifying the presence of the stated features, integers, steps or components, but not precluding the presence of one or more other features, integers, steps or components, or group thereto.

#### Brief description of the drawing

[0019] One exemplary embodiment of the invention is illustrated in the drawing and is described in more detail below.

[0020] The single figure shows a converter configuration according to the invention.

#### Embodiments of the invention

[0021] The image illustrates by way of example an electricity charging station equipped with a charging station (10) according to the invention. A rectifier (AC/DC

converter), which is not illustrated in the drawing, serves here in general for connection to the public TN or TT low-voltage network. A first DC voltage converter (*DC/DC converter* 11) connected to said rectifier transmits the voltage for protection against ground faults to the internal IT network of the charging station (10).

[0022] At this location, essentially two power paths, which are essential to the invention, split up inside the charging station (10): a first DC chopper (12) feeds the connected battery (21, 22) comprising strings (21, 22), of which there are two in accordance with the image, and allows the energy stored in such a way to be fed back for the accelerated charging of connected vehicles. For the supply of power to said connected vehicles, in the exemplary embodiment, a second DC chopper (13) having a DC EMC filter (14) connected downstream and a second DC voltage converter (15), preferably operated in discontinuous conduction mode (DCM), are provided, which second DC chopper and second DC voltage converter have suitably protected connection lines for the purpose of power transmission. The associated pilot line (17) can be provided with an overvoltage protection system (18) depending on the charging standard and the charging voltage.

#### 'Plurality of Strings'

[0019] A battery has multiple battery sections, which are referred to as battery strings. Where two battery strings are used, they are referred to as battery halves.

[0020] Each battery string/battery half comprises multiple battery modules. Each battery module has multiple battery cells. The battery cells of each battery module are connected in series. The battery modules of each battery string/battery

half are connected in series. Battery strings/battery halves may also be connected in parallel, for example, when they act together with a single power electronic. The battery strings/battery halves may also not be connected with each other. In this case they act together with individual power electronics.

**The claims defining the invention are as follows:**

1. A charging station of an electricity charging station,  
comprising:
- a first DC-to-DC voltage converter for voltage supply  
of the charging station,
  - a first DC chopper connected to the first DC-to-DC  
voltage converter, of a first power path for  
connecting a battery to the charging station and for  
returning energy stored in the battery for faster  
charging of an electric car, and
  - a second DC chopper connected to the first DC-to-DC  
voltage converter of a second power path, an EMC  
filter connected downstream of the second DC chopper  
and a second DC-to-DC voltage converter, connected  
downstream of the EMC filter and operated in a  
discontinuous conduction mode, for connecting the  
electric car to the charging station in order to  
charge the electric car.
2. An electricity charging station comprising:
- the charging station according to claim 1.
3. The electricity charging station according to claim 2,  
comprising a battery connected to the first DC chopper.
4. The electricity charging station according to claim 3,  
wherein:
- the battery comprises a plurality of strings.

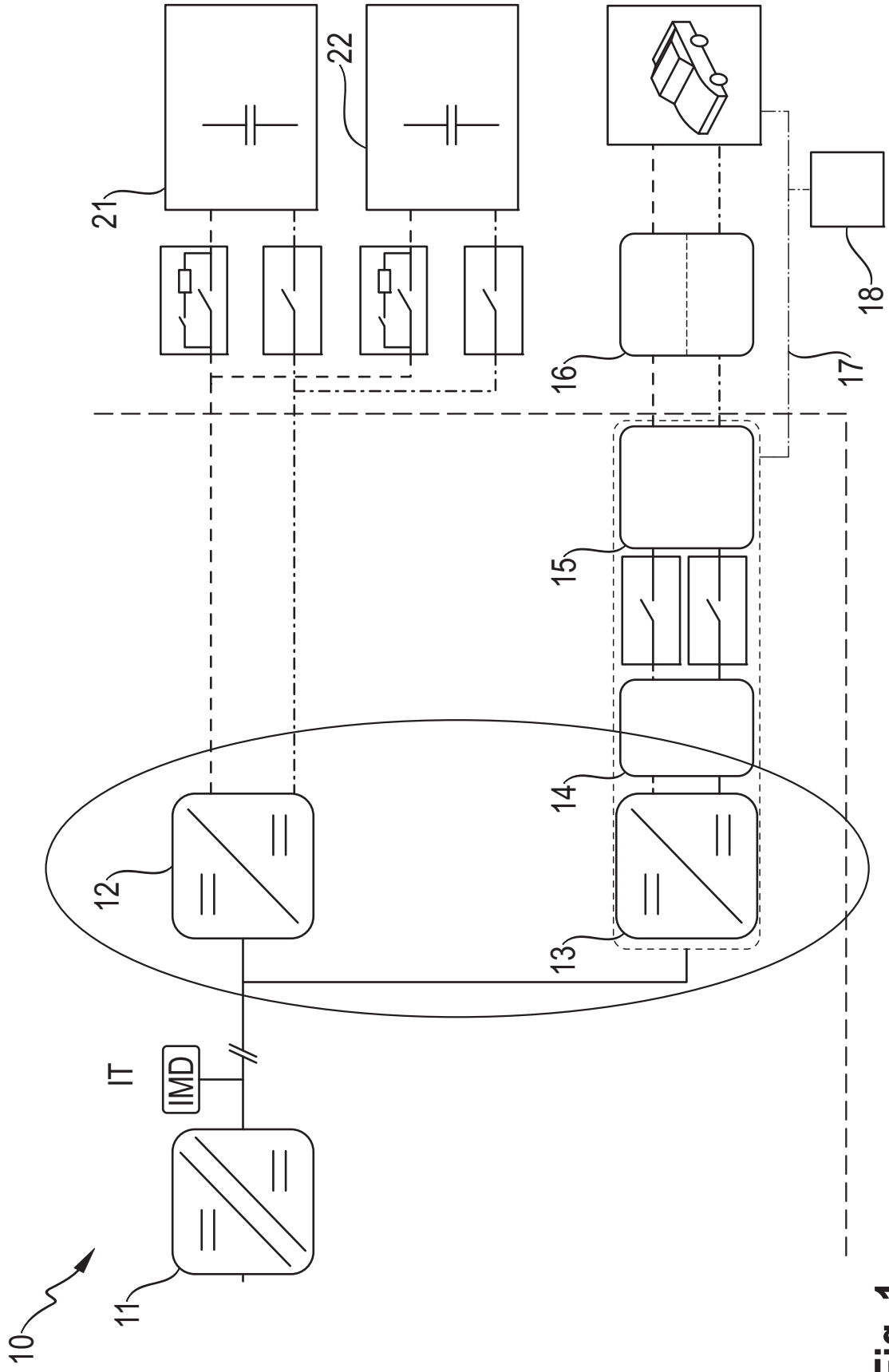


Fig. 1