

UNDERGROUND CAR PARK FOR ELECTRIC VEHICLES

The present invention relates to a carpark for electric vehicles.

5 A carpark of the invention is particularly suitable for parking electric hire vehicles, in particular for short-duration rentals.

Certain towns already have self-service stations for renting electric vehicles. Those stations enable users to select a vehicle, and to use it over a short or medium
10 duration, and then return it.

In order to ensure that each newly-used vehicle has some minimum available range, each parking place in a rental station is generally provided with electrical recharging means to which the vehicles are always
15 reconnected between two uses.

Such rental stations nowadays occupy large amounts of road space.

Since this type of rental service is increasing, there exists a need to increase the number of vehicles
20 that are available for users without further increasing the amount of road space occupied, and while also guaranteeing effective service for users.

The present invention has been developed for this purpose.

25 In the invention, an underground carpark for electric vehicles comprises: a plurality of parking places, each having an electrical power supply device; a plurality of parking interfaces, each parking interface being adapted to be electrically connected to a vehicle
30 in such a manner as to co-operate therewith to form a parking module; and automatic means for moving each parking module between each at least one parking place and a user zone; the carpark being configured in such a manner that when a parking module is on a parking place,
35 the parking interface of said module is automatically electrically connected to the electrical power supply device of the parking place. The carpark is provided

with a system for detecting the state of charge of the vehicle in each parking module (where state of charge should be understood herein as being the state of electrical charge of the vehicle, which is generally expressed in amp-hours).

The carpark of the invention constitutes simple means for parking a large number of electric vehicles while minimizing the road space occupied and while making it easy for users to take possession of a vehicle with a suitable state of charge.

The carpark also makes it possible to recharge the vehicles continuously while they are parked.

In an embodiment, each parking interface is provided with at least one primary electrical connector adapted to be connected to a complementary electrical connector of a vehicle, in particular to be connected manually by the user.

In order to provide the electrical connection between the vehicle and the power supply device at the parking place, each parking interface further includes, by way of example, at least one secondary electrical connector that is electrically connected to the primary electrical connector and that is adapted to connect itself electrically to the power supply device of a parking place. It can be understood that the secondary electrical connector is arranged on the parking module so as to face the electricity power supply device of the parking place when said module is parked on the parking place.

In an embodiment, the parking interface includes remotely controllable means for controlling the vehicle to which it is connected, these means being controllable in particular from a central control unit of the carpark. Under such circumstances, the vehicle can be driven automatically between the parking places and the user zone by said control means.

In another embodiment, the parking interface comprises a movable support platform configured to receive at least one vehicle. The platform may be self-propelled or not (in the latter case, it is moved with the help of external means, e.g. jacks). The primary electrical connector and/or the secondary electrical connector are then mounted by way of example on a terminal secured to said platform. In an embodiment, the power supply device comprises a stationary connector connected to a central electricity power supply unit of the carpark.

In an embodiment, the user zone is arranged on a first level of the carpark and the parking places are distributed over at least one second level situated below the first level. Generally, the first level is situated at roadway level, so as to make it easier for users to return and withdraw vehicles, while the parking places are distributed over a plurality of underground levels.

In an embodiment, the carpark further includes a system for identifying the positions and the states of each of the parking interfaces, in particular of the platforms (e.g. charged or not charged state).

Preferably, the carpark further includes means for identifying the vehicle that presents the greatest state of charge. These provisions make it possible to provide each new user with a vehicle presenting the greatest state of charge.

In addition, the present invention also provides a method of withdrawing an electric vehicle parked in an underground carpark having a plurality of parking modules, each comprising a vehicle and a parking interface electrically connected to said vehicle and to an electricity power supply device, wherein the vehicle presenting the greatest state of charge is identified; the parking module having the vehicle identified as presenting the greatest state of charge is automatically moved from a parking place to a user zone, the parking

interface being automatically disconnected from said electrical power supply device when the parking module leaves the parking place; and the vehicle is disconnected from the parking interface in the user zone.

5 In a particular implementation, a parking module comprising a support platform with a primary electrical connector electrically connected to a vehicle carried by the platform and a secondary electrical connector electrically connected to said primary electrical
10 connector is moved automatically from a parking place of the carpark to a user zone; the secondary electrical connector is automatically disconnected from an electrical power supply device of the parking place when the platform leaves the parking place, thereby stopping
15 the electrical power supply to the vehicle; and in the user zone, the vehicle is disconnected from the primary electrical connector and disengaged from the support platform.

Other characteristics and advantages of the
20 invention appear on reading the following description of an embodiment of the invention given by way of non-limiting illustration. The description refers to the accompanying sheets of drawings, in which:

· Figure 1 is an axial section view of an
25 underground carpark constituting an embodiment of the present invention;

· Figure 2 is a partially cutaway plan view of the carpark, showing in particular how an underground level of the carpark is arranged;

30 · Figure 3 is a perspective view of a parking module of the invention, together with a parking place on which said module is parked; and

· Figure 4 is a partially cutaway perspective view from above of the Figure 1 carpark.

35 With reference to Figures 1 to 4, there follows a description of a carpark constituting an embodiment of the invention, for parking electric vehicles that are

available for hire. In the embodiment, the vehicles parked in the carpark 10 are all identical.

As can be seen better in Figure 1, in this embodiment, the carpark 10 is an underground construction having an outside wall 12 with an outside face that is naturally in contact with the ground S. This retaining wall 12 may be made by the diaphragm wall technique followed by excavation of the ground inside the wall made in this way, or indeed by sheet pile systems, or by any other appropriate technique. It provides sealing relative to the outside and the bottom 14 of the construction. The bottom 14 is preferably constituted by a foundation slab or raft that is connected to the outer side wall 12.

By way of example, in horizontal projection, the outer side wall 12 may present a shape that is circular, elliptical, or a quadrilateral (in particular a rectangle or a square).

The carpark 10 comprises a peripheral volume 16 having horizontal floors 17 made therein that are spaced apart vertically from one another, defining a plurality of levels.

The carpark also has a central transfer zone 18 leading to the surface of the ground in its top portion.

In the transfer zone 18, there is provided an elevator 22 serving the above-ground portion of the carpark (carpark level 0) and also each underground level (levels -1, -2, -3).

The above-ground portion of the carpark (level 0) constitutes a user zone 20. In addition to the top portion of the transfer zone 18 in which the elevator 22 operates, it also comprises a commercial zone 24 accessible to users, provided with a computer 26 connected to a central control unit 80 of the carpark, for enabling users to perform the operations that are required for returning and/or withdrawing a vehicle. The top portion of the transfer zone is accessible to users

via a main door 28 that is controlled by the central control unit 80. For manifest safety reasons, the door 28 can only be commanded to open if the elevator 22 is stationary at level 0.

5 In order to handle busy periods, in another embodiment, the carpark 10 may have a plurality of transfer zones 18 and a corresponding number of commercial zones 24. For example, the carpark 10 may have at least one first user zone dedicated to returning
10 vehicles and at least one second user zone dedicated to withdrawing vehicles.

 As shown in Figure 2, at least one central aisle 30 is arranged on each underground level of the carpark 10, the central aisle 30 extending from the central transfer
15 zone 18 between a plurality of parking places 32 for receiving vehicles V.

 In the embodiment shown, the carpark 10 is entirely automatic. For this purpose, it has a plurality of movable support platforms 40 (referred to below as
20 platforms 40), forming parking interfaces that are designed so that each of them is capable of supporting at least one vehicle V and so that they can move between the parking places 32 and the user zone 20, in this embodiment automatically, under the effect of an
25 electronic command.

 By virtue of the above-specified provisions, the operations of returning and withdrawing vehicles can be performed in the user zone 20, with vehicles V being moved and parked in a parking place 32 under automatic
30 control by the central control unit 80.

 By way of example, each platform 40 has a plurality of drive wheels 46 driven by motors 50 that are powered by batteries 52 mounted directly on the platform 40 and remotely controlled by the central control unit 80.

35 In a variant, a platform 40 may also be movable by using external devices, e.g. jacks.

In order to determine the position of each platform 40 within the carpark and/or in order to be permanently informed whether or not a platform is loaded, each platform 40 may be provided with at least one positioning sensor 54 and/or at least one state sensor 56 that continuously transmits positioning information and state information concerning said platform 40 to a parking management unit 82.

As mentioned above, the carpark 10 is for parking electric vehicles. The platforms 40, like the parking places 32, are thus fitted to enable parked vehicles to be recharged.

A platform 40 as shown in Figure 3 has the particular feature of including an electrical recharging terminal 42 constituted in this embodiment by a primary electrical connector in the form of an outlet 44 configured to co-operate with a recharging plug F in a vehicle V.

As shown in Figure 3, a platform 40 also includes two secondary electrical connectors 60 and 62 that are connected via electrical conductors to the outlet 44. It should be observed that the batteries 52 of the motors 50 are advantageously connected to the same electrical circuit.

As can be seen in Figure 2, each parking place 32 has a stationary electrical connector 34 that is connected to a central electricity power supply unit 70.

When the platform is parked on a parking place 32, one of its secondary electrical connectors 60, 62 is automatically connected to the stationary connector 34 of the parking place 32, such that the recharging terminal 42 is electrically powered. The battery of the vehicle V connected to said terminal 42 is then being charged. In the embodiment, the same applies to the batteries 52 of the platform. It can readily be understood that providing two connectors 60, 62 enables the platform to

be parked equally well on either side of the central aisle 30 shown in Figure 2.

5 The recharging terminal 42 and/or the stationary connector 34 are adapted to transmit information to the parking management unit 82 about the state of charge of the vehicle V parked on the platform 40.

The parking management unit 82 is preferably also adapted to act continuously to determine which vehicle parked in the carpark has the greatest state of charge.

10 The operation of the carpark 10 is described in greater detail below.

When a user returns a vehicle V, the user makes a request by means of the computer 26, which forwards the request to the central control unit 80. The main door 28 is still closed.

15 The central control unit then interrogates the parking management unit 82 to discover which platform is free and to control the motors 50 associated with the selected platform 40 and also the elevator 22 so as to move the platform 40 to the transfer zone 18.

When the elevator 22 carrying the support platform 40 reaches level 0, the main door 28 opens. The user can then park the vehicle V on the platform and connect its recharging plug F to the electrical terminal 42.

25 In order to cope with any negligence on the part of the user, proper connection of the vehicle V may be a precondition for stopping the metering of the user's rental time.

30 The central control unit 80 controls the motors 50 associated with the platform and the elevator 22 in order to transfer the parking module M as constituted by the support platform 40 carrying the vehicle connected to the primary electrical connector 42, to its initial parking place 32.

35 When the platform 40 reaches the parking place 34, and as explained above, one of its secondary electrical connectors 60, 62 is connected automatically to the

stationary connector 34. The vehicle V is then being charged, and its charging data is continuously transmitted to the unit 84 for managing the charging states of vehicles.

5 When a user seeks to withdraw a vehicle, the user makes a request via the computer 26, which forwards the request to the central control unit 80.

10 The central control unit 80 then interrogates the platform management unit 82 and the unit 84 for managing the states of charge of the vehicles in order to discover which of the loaded platforms has the vehicle V with the greatest charge.

15 The unit 80 then controls the motors 50 associated with the selected platform 40, and also the elevator 22, so as to bring that vehicle to the transfer zone 18.

20 When the elevator 22 carrying the platform 40 reaches level 0, the main door 28 opens. The user can then recover the vehicle V on the platform 40. The user disconnects its recharging plug F from the electrical terminal 42 and disengages the vehicle V from the platform 40.

CLAIMS

1. An underground carpark (10) for electric vehicles (V), the carpark comprising:

· a plurality of parking places (32), each having an electrical power supply device (34);

· a plurality of parking interfaces (40), each parking interface being adapted to be electrically connected to a vehicle (V) in such a manner as to co-operate therewith to form a parking module (M); and

· automatic means for moving each parking module (M) between each at least one parking place and a user zone;

the carpark being configured in such a manner that when a parking module (M) is on a parking place (32), the parking interface (40) of said module (M) is

automatically electrically connected to the electrical power supply device of the parking place; and

the carpark being characterized in that it further comprises a system (82) for detecting the state of charge of the vehicle (V) of each parking module (M).

2. A carpark according to claim 1, wherein each parking interface (40) is provided with at least one primary electrical connector (44) adapted to be connected to a complementary electrical connector of a vehicle (V), and at least one secondary electrical connector (60, 62) that is electrically connected to the primary electrical conductor (42) and that is adapted to connect itself electrically to the power supply device (34, 70) of a parking place (32).

3. A carpark according to claim 1 or claim 2, wherein each parking interface (40) comprises a movable support platform configured to receive at least one vehicle (V).

4. A carpark (10) according to any one of claims 1 to 3, wherein the electrical power supply device comprises a

stationary connector (34) connected to a central electricity power supply unit (70) of the carpark.

- 5 5. A carpark (10) according to any one of claims 1 to 4, wherein the user zone (20) is arranged on a first level (N0) and the parking places (32) are distributed over at least one second level (N-1) situated below the first level (N0).
- 10 6. A carpark (10) according to any one of claims 1 to 5, further including a system for identifying the positions and the states of each of the parking interfaces (40).
- 15 7. A carpark (10) according to any one of claims 1 to 6, further including means for identifying the vehicle (V) that presents the greatest state of charge.
- 20 8. A method of withdrawing an electric vehicle (V) parked in an underground carpark (10) having a plurality of parking modules (M), each comprising a vehicle (V) and a parking interface (40) electrically connected to said vehicle (V) and to an electricity power supply device (34, 70), wherein:
- 25 · the vehicle (V) presenting the greatest state of charge is identified;
 - the parking module (M) having the vehicle (V) identified as presenting the greatest state of charge from a parking place (32) is automatically moved to a user zone (20), the parking interface (40) being
 - 30 automatically disconnected from said electrical power supply device (34, 70) when the parking module (M) leaves the parking place (32); and
 - the vehicle (V) is disconnected from the parking interface (40) in the user zone (20).