

{DESCRIPTION}

{Title of Invention}

CHARGING DEVICE FOR MULTILEVEL MECHANICAL PARKING FACILITY AND
MULTILEVEL MECHANICAL PARKING FACILITY EQUIPPED WITH THE SAME

{Technical Field}

{0001}

The present invention relates to a multilevel mechanical parking facility capable of charging on-vehicle batteries of electric vehicles while the electric vehicles are parked in the facility.

{Background Art}

{0002}

In recent years, there is growing awareness concerning environmental preservation all over the world, and hybrid vehicles and electric-powered cars (hereinafter, called electric vehicles) have been remarkably entering into widespread use. Such an electric vehicle is loaded with a large capacity on-vehicle battery, and travels by driving an electric motor by the electric power stored in the on-vehicle battery. The on-vehicle battery is charged by connecting a charging connection section provided on the outer surface of the vehicle body of the electric vehicle and a power supply receptacle of a household power supply (commercial power supply) or the like with a charging cable.

{0003}

It is thus desired that multilevel mechanical parking facilities be equipped with charging equipment to charge the on-vehicle batteries of electric vehicles. Conventionally, the multilevel mechanical parking facility equipped with the charging equipment as disclosed in, for example, Patent Literature 1 has been proposed. The charging device is configured such that the power reception unit (pallet side terminal box) for charging the electric vehicle parked on a pallet is provided at an undersurface of the pallet, whereas a power transmission device is provided at a parking rack of a parking facility structure. When the pallet moves inside the parking facility structure and is then housed in a predetermined parking rack, the power reception unit contacts the power transmission device so that the pallet is supplied with electric power. Also, a receptacle unit for connecting a feeder cable of the electric vehicle parked on the pallet is provided on an upper surface of the pallet.

{0004}

The power reception unit provided on the under surface side of the pallet like this and the receptacle unit provided on the upper surface side of the pallet are electrically connected by a wiring member.

{Citation List}

{Patent Literature}

{0005}

{PTL 1}

Japanese Unexamined Patent Application, Publication No.
2011-47243

{Summary of Invention}

{Technical Problem}

{0006}

When modification work for mounting a charging device to an existing multilevel mechanical parking facility which is not equipped with a charging device, it is necessary to provide power reception units and receptacle units in a number of pallets. However, in the configuration of the charging equipment of Patent Literature 1, it is necessary to install power reception units on the under surface side of the pallets, and install receptacle units on the upper surface of the pallets, and assembly thereof is difficult. Further, it is necessary to place wiring members that connect the power reception units and the receptacle units in such a manner as to penetrate through the pallets. Therefore, it becomes difficult to perform modification work of the pallets in a multilevel mechanical parking facility, and the problem arises that modification cost and the modification period increase.

{0007}

If the power reception unit is provided on the upper surface of the pallet, the power reception unit can be connected to the receptacle unit without having the pallet

therebetween; the modification work described above can be significantly simplified on one hand, but on the other hand, water, dust and the like easily adhere to the power reception unit provided on the upper surface of the pallet. Therefore, there is a drawback that an exclusive cover member or the like needs to be provided, the structure and assembly of the charging device become complicated, and the cost then increases. In addition, the upper surface of the pallet has less space because a vehicle to be parked is placed thereon; therefore, concern arises that if the power reception unit and the receptacle unit are installed on the upper surface of the pallet, the parked vehicle collides with the power reception unit and the receptacle unit, causing damages to the vehicle, the power reception unit and the receptacle unit.

{0008}

The present invention is made in light of the above described problem, and has an object to provide a charging device for a multilevel mechanical parking facility and a multilevel mechanical parking facility equipped with such a charging device. The charging device, with a simple and economical configuration, enables a power reception unit and a receptacle unit to be installed in a pallet of an existing multilevel mechanical parking facility not equipped with a charging device. The installation is done in such a manner as not to be an obstacle to facilitate modification work of

equipping the charging device. The charging device enhances usability of the receptacle unit and prevents water, dust and the like from adhering to the power reception unit and the power transmission device, and can supply electric power to the pallets reliably and safely.

{Solution to Problem}

{0009}

In order to solve the above described problem, the present invention adopts the following means.

A first aspect of a charging device for a multilevel mechanical parking facility according to the present invention is a charging device that is annexed to a multilevel mechanical parking facility including a pallet that conveys an electric vehicle inside a parking facility structure with the electric vehicle placed on the pallet, the charging device comprising: a power reception device for charging the electric vehicle, provided on the pallet; and a power transmission device for supplying electric power of an external power supply to the power reception device by contacting the power reception device, provided in the parking facility structure, wherein the power reception device has a power reception unit that receives power supply from the power transmission device and a receptacle unit to which a charging cable of the electric vehicle is connected, with the power reception unit and the receptacle unit integrated, and wherein

the power reception device is installed on an upper surface of a curb portion at a side edge portion of the pallet.

{0010}

In the case of the above described configuration, the power reception device, in which the power reception unit for receiving power supply from the power transmission device and the receptacle unit connected to the charging cable of the electric vehicle are integrally formed, is installed on the pallet. Therefore, since wiring between the power reception unit and the receptacle unit is completed in the power reception device, the power reception device constitutes one unit, and the structure of the power reception device can be made simple and economical. Accordingly, the power reception unit and the receptacle unit are made easily installable on the pallet, and the modification work of equipping the charging device at the pallet of the existing multilevel mechanical parking facility that is not equipped with a charging device can be easily performed. In addition, since the parked vehicle does not ride on the curb portion of the pallet, the power reception device can be installed on the upper surface of the curb portion without becoming an obstacle on the pallet.

{0011}

A second aspect of the charging device for a multilevel mechanical parking facility according to the present invention

is such that a width dimension of the power reception device in the aforementioned first aspect is set to fit in the curb portion.

{0012}

According to the above described configuration, a parked vehicle is prevented from colliding with the power reception device installed on the upper surface of the curb portion. The structural member and the like located at the outer peripheral side of the pallet are prevented from colliding with the power reception device so that safety of the power reception device is maintained, and electric power can be supplied to the pallet reliably and safely.

{0013}

A third aspect of the charging device for a multilevel mechanical parking facility according to the present invention is such that in addition to the aspects described in the first or the second aspect, the power reception unit is placed on the upper surface of the curb portion, and the receptacle unit is placed to lie on the power reception unit, the power reception unit includes a contact housing and a power reception contact, wherein the contact housing has the receptacle unit on its upper surface and an opening that opens toward an outer side in a width direction of the pallet, and the power reception contact is installed in a position set back from the opening of the contact housing, whereby the

power reception contact receives power supply by contacting a power supply contact provided at the power transmission device.

{0014}

According to the above described configuration, the contact housing that constitutes the power reception unit opens toward the outer side in the width direction of the pallet, and the power reception contact is installed in the position set back from the opening of the contact housing. Therefore, the top surface of the contact housing and the receptacle unit placed on the top surface of the contact housing become eaves, and prevent water and dust from falling on the power reception contact installed in the position set back from the opening of the contact housing. Accordingly, electric power can be supplied to the pallet reliably and safely.

{0015}

In addition, the receptacle unit is placed on the top surface of the power reception unit installed on the upper surface of the curb portion of the pallet; therefore, the height of the receptacle unit becomes remarkably higher than the floor surface of the pallet. Accordingly, usability is enhanced at the time a user connects the charging cable to the receptacle unit.

{0016}

A fourth aspect of the charging device for a multilevel mechanical parking facility according to the present invention is such that in addition to the third aspect, electrical conduction is achieved by shortening of a relative distance between the power reception device and the power transmission device and then by bringing one of the power supply contact and the power reception contact to come into contact with the other one with one of the contacts resiliently pressed against the other one.

{0017}

According to the above described configuration, even if the relative distance between the power reception device and the power transmission device varies to some extent, the contact state of the power supply contact and the power reception contact is well maintained. Therefore, electric power can be supplied to the pallet reliably and safely.

{0018}

A fifth aspect of the charging device for a multilevel mechanical parking facility according to the present invention is such that in addition to the aforementioned fourth aspect, the power reception contact has a contact surface in a surface direction orthogonal to a relative moving direction of the power transmission device, and the power supply contact has a form of elastic rod urged by a spring to extend from the power transmission device toward the contact surface of the power

reception contact.

{0019}

According to the above described configuration, the thickness of the power reception contact in a flat plate becomes slim; the power reception contact can be then disposed in the position more set back with respect to the opening of the contact housing which constitutes the power reception unit. Therefore, water and dust are more effectively prevented from falling on the power reception contact, and electric power can be supplied to the pallet reliably and safely.

{0020}

A sixth aspect of the charging device for a multilevel mechanical parking facility according to the present invention is such that in addition to any one of the aforementioned third to fifth aspects, the power transmission device is provided with a cover member that covers an upper side of the power supply contact, and that is urged in a direction to protrude toward the power reception device, and the cover member is configured to retreat toward the power transmission device after contacting with the power reception device as a relative distance between the power reception device and the power transmission device becomes shortened.

{0021}

According to the above described configuration, when the

power reception device and the power transmission device are separated from each other and when the power reception device and the power transmission device contact each other, the upper side of the power supply contact of the power transmission device is always covered with the cover member. Therefore, water and dust are effectively prevented from falling on the power supply contact, and electric power can be supplied to the pallet reliably and safely.

{0022}

A seventh aspect of the charging device for a multilevel mechanical parking facility according to the present invention is such that in addition to any one of the aforementioned fourth to sixth aspects, the power transmission device comprises a plurality of power supply contacts disposed in a horizontal direction, which are integrally rotatable by a predetermined angle around a vertical shaft provided at the power transmission device.

{0023}

According to the above described configuration, a plurality of the power supply contacts and the power reception contacts elastically contact one another, and the power supply contacts can be rotated by the predetermined angle around the vertical shaft. Therefore, even if the relative distance and the relative angle between the power reception device and the power transmission device vary to some extent, all the

plurality of power supply contacts can be brought into contact with the power reception contacts. Accordingly, electric power can be supplied to the pallet reliably and safely.

{0024}

An eighth aspect of the charging device for a multilevel mechanical parking facility according to the present invention is such that in addition to any one of the aforementioned first to seventh aspects, a pole member is interposed between the power reception unit and the receptacle unit both of which constitute the power reception device.

{0025}

According to the above described configuration, the receptacle unit can be disposed, with respect to the power reception unit, at a position higher by the height of the pole member. Therefore, the user does not have to bend down to connect the charging cable to the receptacle unit; usability at the time of connecting the charging cable to the receptacle unit is remarkably enhanced.

{0026}

Further, a multilevel mechanical parking facility according to the present invention includes the charging device in addition to any one of the aforementioned first to eighth aspects.

{0027}

According to the above described configuration, the power

reception unit, which receives power supply from the power transmission device, and the receptacle unit, to which the charging cable of the electric vehicle is connected, are integrated in one unit of the power reception device; therefore, the structure of the charging device can be made simple and economical.

{Advantageous Effects of Invention}

{0028}

As described above, according to the present invention, the charging device for a multilevel mechanical parking facility and the multilevel mechanical parking facility including the same facilitate the modification work of equipping the charging device by making the power reception unit and the receptacle unit installable in the pallet of the existing multilevel mechanical parking facility not equipped with the charging device.

In addition, water, dust and the like are prevented from adhering to the power reception unit and the power transmission device; electric power can be supplied to the pallet reliably and safely.

Furthermore, the receptacle unit can be disposed at the position higher than the floor surface of the pallet usability at the time of connection of the charging cable can be thus enhanced.

{Brief Description of Drawings}

{0029}

{Fig. 1}

Fig. 1 is a vertical sectional view showing one example of a multilevel mechanical parking facility to which a charging device according to the present invention is applicable.

{Fig. 2}

Fig. 2 is a perspective view of a pallet, and a power reception device that constitutes the charging device according to a first embodiment of the present invention.

{Fig. 3}

Fig. 3 is a side view of the pallet and the power reception device by view from the arrow III of Fig. 2.

{Fig. 4}

Fig. 4 is a front view of the charging device showing a state in which the power reception device and a power transmission device do not contact each other by enlarging the IV part of Fig. 1.

{Fig. 5}

Fig. 5 is a plan view of the charging device showing a state in which the power reception device and the power transmission device do not contact each other by view from the arrow V of Fig. 4.

{Fig. 6}

Fig. 6 is a lateral view of the power transmission device

by view from the arrow VI of Fig. 4.

{Fig. 7}

Fig. 7 is a front view of the charging device showing a state in which the power reception device and the power transmission device contact each other.

{Fig. 8}

Fig. 8 is a plain view of the charging device showing the state in which the power reception device and the power transmission device contact each other by view from the arrow VIII of Fig. 7.

{Fig. 9}

Fig. 9 is a perspective view of a pallet and a power reception device that constitutes a charging device according to a second embodiment of the present invention.

{Fig. 10}

(a) is a lateral view of the power reception device by view from the arrow Xa of Fig. 9, and (b) is a front view of the power reception device by view from the arrow Xb of Fig. 9.

{Fig. 11}

Fig. 11 is a cross-sectional view taken along the line XI-XI of Fig. 10(a).

{Description of Embodiments}

{0030}

[First embodiment]

Hereinafter, a first embodiment of the present invention will be described with reference to Figs. 1 to 8. Note that the present invention can be widely applied to any multilevel mechanical parking facility in which a parked vehicle is placed on a pallet and is conveyed inside a parking facility structure, and is not limited to only an elevator type multilevel parking facility in the following description.

{0031}

Fig. 1 is a vertical sectional view showing one example of a multilevel mechanical parking facility to which a pallet according to the present invention can be applied. A multilevel mechanical parking facility 1 is an elevator type multilevel parking facility establishment that is capable of housing a plurality of vehicles, and includes a parking tower 4 (parking facility structure) with an loading/unloading port 3 for a vehicle 2 being opened on a ground part. On a floor surface of a ground floor of the parking tower 4, a turn table 5, which turns an orientation of the vehicle, is installed. The turn table 5 has a configuration in which a turning board 7 and a turning drive portion 8 are provided in a pit 6 formed in a concave shape on the surface of ground floor.

{0032}

A vertical hoistway 11 is formed in a center portion of the parking tower 4; an elevator-shaped conveying table 12 is provided to move vertically up and down in the hoistway 11.

The conveying table 12, for example, has four corners suspended by a plurality of wire ropes 13 that extend downward from a winch (not illustrated) provided at an upper portion of the parking tower 4 and can vertically move up and down in the hoistway 11 by the above described winch upon its actuation.

{0033}

Meanwhile, at both sides of the hoistway 11, vehicle storage racks 14 (a part of parking facility structure) are provided. The vehicle storage racks 14 are provided in a form of multiple stories vertically to sandwich the hoistway 11, and one pallet 15 for loading a vehicle is housed in each of the vehicle storage racks 14. Note that illustration of supporting columns or the like of the vehicle storage racks 14 is omitted. A delivery mechanism (not illustrated) is provided on floor surfaces of the conveying table 12 and the vehicle storage rack 14 to smoothly deliver the empty pallet 15 or the pallet 15 loaded with the vehicle 2 from the conveying table 12 to the vehicle storage rack 14 or from the vehicle storage rack 14 to the conveying table 12, when heights of the floor surfaces of both the conveying table 12 and the vehicle storage rack 14 are leveled.

{0034}

When the vehicle 2 enters the multilevel mechanical parking facility 1, the pallet 15 of the vehicle storage rack

14 in which the vehicle 2 is not stored is brought onto the turning board 7 of the turn table 5 by the conveying table 12. The vehicle 2 stops on the pallet 15 installed on the turn table 5 from the loading/unloading port 3; the turn table 5 turns to change direction so that an orientation of the vehicle 2 corresponds to an orientation of the vehicle storage rack 14. The pallet 15 which orientation is changed is conveyed upward by the conveying table 12 to the height of the vehicle storage rack 14 in which the vehicle 2 is not stored. The pallet 15 is then slid to the floor surface of the vehicle storage rack 14 from the floor surface of the conveying table 12. In this way, the vehicle 2 including the pallet 15 is stored in the vehicle storage rack 14.

{0035}

At a time of unloading vehicle, the conveying table 12 stops to level to the height of the vehicle storage rack 14 in which the vehicle 2 to be unloaded is stored. Together with the pallet 15 the vehicle 2 stored in the vehicle storage rack 14 is transferred to the conveying table 12. The conveying table 12 lowers to the turn table 5 to receive the pallet 15 and the vehicle 2 thereon. The turn table 5 changes orientation of the vehicle 2 to the direction of the loading/unloading port 3, and thereafter, the vehicle 2 departs.

{0036}

The multilevel mechanical parking facility 1 equipped with a charging device A allows an electric vehicle 2E that travels by power of an electric motor to be parked therein, in addition to an ordinary vehicle 2 that travels by power of an internal combustion engine. The multilevel mechanical parking facility 1 can charge an on-vehicle battery by the charging device A after conveying the electric vehicle 2E to the vehicle storage rack 14. Note that in Fig. 1, although power transmission devices 24, which constitutes the charging device A and will be described later, are provided at all the vehicle storage racks 14, the power transmission devices 24 may be provided at only some of the vehicle storage racks 14.

{0037}

Fig. 2 is a perspective view of the pallet 15 and a power reception device 23 that constitutes the charging device A and will be described later. Note that for convenience, in the following description, a width direction of the pallet 15 will be called an X direction, a length direction will be called a Y direction, and a height direction will be called a Z direction.

{0038}

The pallet 15 has an ordinary W-shaped sectional structure formed by press-molding a steel plate similar to the pallets that are applied to ordinary multilevel mechanical parking facilities. The pallet 15 has two wheel guide grooves

19 that guide wheels of the ordinary vehicle 2 and the electric vehicle 2E along the Y direction of the pallet 15 between a center guide convex portion 17 in a central portion thereof in the X direction and a pair of left and right curb portions (derail preventing walls) 18 raised at side edge portions at both sides. A slide rail 20 and the like are fixed at a back surface side of the pallet 15 to slide on the vehicle storage rack 14 (see Fig. 3).

{0039}

The charging device A includes the power reception device 23 installed on the pallet 15 and the power transmission device 24, which is installed at a side of the parking tower 4 and supplies electric power of an external power supply (commercial power supply) to the power reception device 23 by contacting the power reception device 23. The power reception device 23 is installed on an upper surface of the curb portion 18 of the pallet 15. Namely, as shown in Fig. 1, the power reception devices 23 are disposed at diagonal positions of the rectangular pallet 15 such as a front end portion of one of the left and the right curb portions 18, and a rear end portion of the other one of the left and the right curb portions 18. The power reception devices 23 may be installed in a larger number of positions of the curb portion 18.

{0040}

A power reception unit 26, which receives power supply

from the power transmission device 24, and a receptacle unit 27, to which a charging cable of the electric vehicle 2E is connected, are integrally formed in the power reception device 23. As shown in Figs. 3 and 4, the power reception unit 26 is placed on the upper surface of the curb portion 18, and the receptacle unit 27 is placed thereon to lie on the power reception unit 26. A width dimension W of the power reception device 23 is set so as to fit in the curb portion 18 (see Fig. 4).

{0041}

The power reception unit 26 includes a contact housing 31 that constitutes an outer block and a contact holding member 32 installed in the contact housing 31. The contact housing 31 is formed into a box shape having an opening 33 which opens toward an outer side in the X direction of the pallet 15, a bottom surface 34 thereof is fastened and fixed to the top surface of the curb portion 18 by a bolt or the like (not illustrated), and onto a top surface of a ceiling surface 35 thereof, the receptacle unit 27 is fastened and fixed by a plurality of screws 36 and the like. Further, the block-shaped contact holding member 32 is fastened to an inner side of a lateral surface 37 (the surface oriented to an inner side in the X direction of the pallet 15) of the contact housing 31 with a plurality of screws 38. Note that a short suspended portion 39 that extends downward and forms an upper edge

portion of the opening 33 is formed at an outer end portion in the X direction of the ceiling surface 35 of the contact housing 31.

{0042}

The contact holding member 32 is made of an insulating material such as resin and ceramics, and has three plate-shaped power reception side contacts 41 made of a conductive material fixed to a lateral surface, which is oriented to the power transmission device 24 in the X direction. These three power reception contacts 41 are respectively allocated for positive, negative and grounding; they have contact surfaces 41a in a direction orthogonal to a relative moving direction of the power reception device 23 and the power transmission device 24, namely, in the Y direction. As described above, the contact holding member 32 is fixed to the inner side of the lateral surface 37 of the contact housing 31, and therefore, the power reception contact 41 is disposed at a position set back from the opening 33 of the contact housing 31. Note that three terminals 42 that are connected to the respective power reception contacts 41 are provided on the top surface of the contact holding member 32. These terminals 42 are shielded from outside by a protection plate 44 (see Fig. 4), which is fixed to an end surface of the contact housing 31 with screws 43 and located directly below the ceiling surface 35 of the contact housing 31.

[0043]

The receptacle unit 27 has a receptacle box 47, for example, in a shape of a book cover and is fixed to the ceiling surface 35 of the power reception unit 26 (contact housing 31) with a plurality of screws (not illustrated), and a substrate 50 is fixed to a back side of the receptacle box 47 with a plurality of screws 51 (see Fig. 4). Further, a receptacle main body 48 is fixed to an inner side of the receptacle box 47 with a plurality of screws 49, and a receptacle cover 48a provided at an inner side surface (surface oriented to the inner side in the X direction of the pallet 15) of the receptacle main body 48 opens and closes toward the inner side in the X direction of the pallet 15. When the receptacle cover 48a is opened, a receptacle hole (not illustrated) provided in the inner surface of the receptacle main body 48 is exposed, and the charging cable of the electric vehicle 2E is connected thereto. Note that the terminals 42 of the power reception contacts 41 are connected to the receptacle main body 48 by lead wires (not illustrated).

{0044}

Furthermore, the receptacle unit 27 is covered with a waterproof cover 53 which can be opened and closed. The waterproof cover 53 is pivotally fitted to a cover bracket 54 fixed to the ceiling surface 35 of the power reception unit 26

(contact housing 31) via a rotary shaft 55. The waterproof cover 53 can rotate between a closed position 53a, at which the receptacle unit 27 is covered with the waterproof cover 53, and an open position 53b, at which the receptacle unit 27 is exposed, as shown in Fig. 3. A knob 56 for opening and closing operation is provided at an outer side of the waterproof cover 53. In any position of the waterproof cover 53 from the closed position 53a to the open position 53b in view in the Y direction is to fit in the curb portion 18 of the pallet 15.

{0045}

Meanwhile, the power transmission device 24 is configured as follows.

As shown in Figs. 4 and 6, a fixing bracket 61 is fixed to a floor slab and the like of the vehicle storage rack 14 in the parking tower 4; a vertical shaft 64 is rotatably inserted into a holding pipe 63 fixed to the fixing bracket 61 with bolts 62 and extends in the Z direction (vertical direction); and a rotational bracket 65 that extends along the Y direction of the pallet 15 is rotatably and integrally fixed to an upper end portion of the vertical shaft 64. A pair of L-shaped contact stays 66 are fixed to both end portions of the rotational bracket 65 with bolts 67. A contact holding plate 68 that extends horizontally in the X direction toward the power reception device 23 is fixed to between the contact

stays 66 with bolts 69. A block-shaped contact holding member 71 is fastened to an undersurface side of the contact holding plate 68 with bolts 72 (members 66 and 68 are omitted in Fig. 5).

{0046}

The contact holding member 71 is made of an insulating material such as resin and ceramics; from a surface of the contact holding member 71, which is oriented to the power reception device 23 side, three power supply contacts 73 in shapes of round rods made of a conductive material are protruded. These three power supply contacts 73 are linearly disposed along the horizontal direction (Y direction) at heights conforming to the positions of the three power reception side contacts 41 of the power reception device 23, and are respectively pressed by a spring to extend toward the contact surfaces 41a of the power reception side contacts 41 to be stretchable in the X direction. Therefore, a relative distance (distance in the X direction shown in Fig. 4) between the power reception device 23 and the power transmission device 24 is shortened, whereby the power supply contacts 73 contact in such a manner as to be pressed against the contact surfaces 41a of the power reception contacts 41 with elastic force; current is conducted, and the power reception contacts 41 receive power supply from the power transmission device 24, as shown in Figs. 7 and 8. Note that a distal end portion of

each of the power supply contacts 73 is in a gentle spherical shape.

{0047}

The three power supply contacts 73 can rotate by a predetermined angle in an R direction (see Fig. 5) around the vertical shaft 64 integrally with the contact holding member 71. The rotation amount is adjusted to, for example, about 5° to 10° by a screwed amount of a pair of rotation amount regulating bolts 74 provided at the holding pipe 63. Terminals 75 for connecting power supply wires to the respective power supply contacts 73 are provided on a back surface of the contact holding member 71.

{0048}

Furthermore, as shown in Figs. 4 to 6, the power transmission device 24 is provided with a cover member 78 that covers upper sides of the power supply contacts 73, and is urged to protrude in the X direction toward the power reception device 23. The cover member 78 is supported by a cover stay 80 fastened together with the contact holding plate 68 to the contact stay 66, for example, with the bolt 69. The cover member 78 is slidable in the X direction. Namely, two slide pipes 81 that extend in the X direction are fixed to an upper surface of the cover stay 80, a slide shaft 82 in a long bolt shape can be slid into each of the slide pipes 81. A movable bracket 83 having an L-shaped section along the Y

direction is fixed to a distal end thereof. A double nut 84 is fastened to a rear end of the slide shaft 82 (members 80 to 84 are omitted in Fig. 5).

{0049}

A cover plate 85 is fixed to an upper surface of the movable bracket 83 with a screw 86, a cushion block 87 made of a cushioning material such as a resin and rubber is fastened to a front surface of the movable bracket 83 with a screw 88. The cover plate 85 is in a shape that covers the upper side of the contact holding member 71 and the power supply contacts 73 and has an extension portion 85a that covers both sides of the power supply contacts 73 that protrude from the contact holding member 71 in view in the Y direction, as shown in Fig. 4. The cover member 78 includes the slide shaft 82, the movable bracket 83, the double nut 84, the cover plate 85, the cushion block 87 and the like. Further, a cover spring 89 is fitted to the slide shaft 82 in such a manner as to be elastically fitted to between the slide pipe 81 and the movable bracket 83. The cover member 78 is always urged to protrude in the X direction toward the power reception device 23 side by an urging force thereof. The cover member 78 stops at the position of Fig. 4 by the double nut 84's abutting on the slide pipe 81.

{0050}

In the cover member 78, the cushion block 87 thereof

abuts on the contact housing 31 (suspended portion 39) of the power reception device 23 as a relative distance (distance in the X direction shown in Fig. 4) between the power reception device 23 and the power transmission device 24 is shortened. After abutment, the cover spring 89 is compressed, and thereby the cover member 78 retreats toward the power transmission device 24 as shown in Figs. 7 and 8. In this state, the contact holding member 71 and the power supply contacts 73 of the power transmission device 24 protrude to the power reception device 23 in the X direction from the distal end portion (cushion block 87) of the cover member 78.

{0051}

The mechanical parking facility 1 and the charging device A are configured as above.

When the electric vehicle 2E which needs to be charged while parked in the mechanical parking facility 1 stops on the pallet 15 in the loading/unloading port 3, a user of the electric vehicle 2E or a person in charge of the parking facility opens the receptacle cover 48a of the receptacle unit 27 and the waterproof cover 53, with which the receptacle unit 27 of the power reception device 23 provided at the pallet 15 is covered. The charging cable of the electric vehicle 2E is then connected to the receptacle unit 27 (receptacle main body 48). Thereafter, the pallet 15 is, by the conveying table 12, transferred to and stored in an empty vehicle storage rack 14

provided with the power transmission device 24.

{0052}

When the pallet 15 laterally slides onto the vehicle storage rack 14 from the conveying table 12 and is stored in a fixed position on the vehicle storage rack 14, the power reception device 23 provided at the pallet 15 and the power transmission device 24 provided at the vehicle storage rack 14 are brought from a state in which the power reception device 23 and the power transmission device 24 are apart from each other in the X direction and do not contact each other (as shown in Figs. 4 and 5) into a state in which the power reception device 23 and the power transmission device 24 contact each other as shown in Figs. 7 and 8. At this time, the power reception contacts 41 (contact surfaces 41a) of the power reception device 23 (power reception unit 26) are pressed against the power supply contacts 73 of the power transmission device 24. The power supply contacts 73 are then pushed back to the inside of the contact holding member 71 against the urging force of the spring provided inside the contact holding member 71; the power supply contacts 73 are brought into contact with the contact surfaces 41a of the power reception contacts 41 in a state in which the power supply contacts 73 are pressed against the contact surfaces 41a by a reaction force of the above described spring so that an electrical conduction state is kept. Subsequently,

electric power is supplied to the power reception contacts 41 from the power supply contacts 73. In the charging time, the distal end portion of the contact holding member 71 enters an internal side from the opening 33 of the contact housing 31 of the power reception unit 26, as shown in Figs. 7 and 8.

{0053}

In this way, the on-vehicle battery is charged while the electric vehicle 2E is parked. When the electric vehicle 2E which completes charging leaves, the pallet 15 on which the electric vehicle 2E is placed is conveyed to the loading/unloading port 3 by the conveying table 12; the user of the electric vehicle 2E or the person in charge of the parking facility detaches and retrieves the charging cable connected to the receptacle unit 27 and closes the receptacle cover 48a and the waterproof cover 53; thereafter, the electric vehicle 2E leaves the parking facility.

{0054}

In the charging device A configured as above, the power reception device 23 thereof comprises the power reception unit 26, which receives power supply from the power transmission device 24, and the receptacle unit 27, to which the charging cable of the electric vehicle 2E is connected, in an integral manner. The power reception device 23 is installed on the upper surface of the curb portion 18 of the pallet 15. Therefore, wiring between the power reception unit 26 and the

receptacle unit 27 is completed inside the power reception device 23; the power reception device 23 is created as one unit, so that the structure of the power reception device 23 can be made simple and economical.

{0055}

Accordingly, the power reception device 23, which comprises the power reception unit 26 and the receptacle unit 27, can be made easily installable on the pallet 15; the modification work to be equipped with the exiting multilevel mechanical parking facility without a charging device becomes extremely easy and is made possible in a short period with the charging device A. In addition, the parked vehicle does not ride on the curb portion 18 of the pallet 15; therefore, the power reception device 23 installed on the upper surface of the curb portion 18 does not become an obstacle, so that interference with the parked vehicle can be prevented.

{0056}

Further, the width dimension W of the power reception device 23 is set so as to fit in the curb portion 18. Therefore, collision of the parked vehicle to the power reception device 23 and interference of the structure member and the like located at the outer peripheral side of the pallet 15 with the power reception device 23 are prevented whereby safety of the power reception device 23 is kept, and electric power can be supplied to the pallet 15 reliably and

safely.

{0057}

Furthermore, the power reception unit 26 is placed on the upper surface of the curb portion 18, and the receptacle unit 27 is placed to lie on the power reception unit 26. The power reception unit 26 includes the contact housing 31 which has the receptacle unit 27 placed on the top surface, and has the opening 33 which opens toward the outer side (power transmission device 24 side) in the X direction (width direction) of the pallet 15. The contact holding member 32 and the power reception side contacts 41 are attached to the position which is set back from the opening 33 of the contact housing 31.

According to the above configuration, the power reception contacts 41 are installed in the position set back from the opening 33 of the contact housing 31 which opens toward the outer side in the X direction of the pallet 15. Therefore, the ceiling surface 35 of the contact housing 31 and the receptacle unit 27 which is placed on the ceiling surface 35 become eaves (cover) to prevent external water, dust and the like from falling on the power reception contacts 41 so that safety of the power reception contacts 41 is kept, and electric power can be supplied to the pallet 15 reliably and safely.

{0058}

In addition, since the receptacle unit 27 is placed on the top surface of the power reception unit 26 installed on the upper surface of the curb portion 18 of the pallet 15, the height of the receptacle unit 27 is remarkably higher than the floor of the pallet 15; usability at the time the user of the electric vehicle 2E connects the charging cable to the receptacle unit 27 can be thus enhanced.

{0059}

Further, as the relative distance between the power reception device 23 and the power transmission device 24 is shortened, the power supply contacts 73 contact the power reception side contacts 41 in such a manner as to be pressed against the power reception side contacts 41 with elastic force to pass an electric current. Therefore, even if the relative distance between the power reception device 23 and the power transmission device 24 varies to some extent, the contact state of the power supply contacts 73 and the power reception side contacts 41 is well maintained. Accordingly, electric power can be supplied to the pallet 15 reliably and safely.

{0060}

In particular, the power reception contacts 41 have the contact surfaces 41a in the direction orthogonal to the relative moving direction (X direction) to the power transmission device 24; the power supply contacts 73 which

contacts the contact surfaces 41a are in the rod shapes, stretchable and urged by the spring to extend toward the contact surfaces 41a of the power reception side contacts 41 from the power transmission device 24; therefore, the thickness of the power reception contacts 41 and the contact holding member 32 formed in the shapes of flat plates can be made small. Therefore, the power reception contacts 41 can be disposed in the position set further backward with respect to the opening 33 of the contact housing 31. Accordingly, water, dust and the like are more effectively prevented from falling on the power reception contacts 41; thus, electric power can be supplied to the pallet 15 reliably and safely.

{0061}

The power transmission device 24 is provided with the cover member 78 which covers the upper side of the power supply contacts 73 and is urged in the direction to protrude toward the power reception device 23. The cover member 78 is configured to retrieve toward the power transmission device 24 after abutting on the power reception device 23 as the relative distance between the power reception device 23 and the power transmission device 24 is shortened. Therefore, when the power reception device 23 and the power transmission device 24 are separated from each other and contact with each other, the upper side of the power supply contacts 73 is always covered with the cover member 78. Accordingly, water,

dust and the like is effectively prevented from falling on the power supply contacts 73; thus, electric power can be supplied to the pallet 15 reliably and safely.

{0062}

Furthermore, the three power supply contacts 73 are disposed on the contact holding member 71 in the horizontal direction (Y direction); these three power supply contacts 73 elastically contact the power supply contacts 41. Because of this mechanism, the three power supply contacts 73 are rotatable by a predetermined angle around the vertical shaft 64 provided at the power transmission device 24 integrally with the contact holding member 71. Therefore, even if the relative distance and the relative angle and the relative position in the Y direction between the power reception device 23 and the power transmission device 24 vary or are displaced to some extent, all the three power supply contacts 73 can be favorably brought into contact with the power reception contacts 41. Accordingly, electric power can be supplied to the pallet reliably and safely.

{0063}

[Second embodiment]

Hereinafter, a charging device B according to a second embodiment of the present invention will be described with reference to Figs. 9 to 11. Fig. 9 is a perspective view of the pallet 15 and a power reception device 91 that constitutes

the charging device B according to the second embodiment of the present invention. Fig. 10(a) is a side view of the power reception device 91 by view from the arrow Xa of Fig. 9, and Fig. 10(b) is a front view of the power reception device 91 by view from the arrow Xb of Fig. 9. Fig. 11 is a cross-sectional view taken along the XI-XI line of Fig. 10(a).

{0064}

The power reception device 91 includes the power reception unit 26 and the receptacle unit 27 of the configurations similar to the power reception device 23 of the first embodiment. Meanwhile, a difference lies in only the point that a pole member 92 is interposed between the power reception unit 26 and the receptacle unit 27, and the receptacle unit 27 is not provided with a waterproof cover. The structure of the pallet 15 is similar to the first embodiment. Accordingly, the components of the same configurations as in the first embodiment are assigned with the same reference signs and the description thereof will be omitted.

{0065}

The pole member 92 is formed by, for example, a metallic round pipe or square pipe. A mounting plate 93 that is fixedly attached to a lower end portion of the pole member 92 is fixed to the upper surface of the contact housing 31 which constitutes the power reception unit 26 with bolts 94, and a

mounting plate 95 fixedly attached to an upper end portion of the pole member 92 is fixed to the bottom surface of the receptacle box 47, which constitutes the receptacle unit 27 with bolts 96. A lead wire not illustrated that connects the contact holding member 32 (power reception side contacts 41) of the power reception unit 26, and the receptacle main body 48 of the receptacle unit 27 is installed to pass through an inside of the pole member 92. Further, a holder member 97 is attached to an intermediate portion of the pole member 92 with bolts 98. The holder member 97 holds a controller and the like provided at a charging cable annexed to an electric vehicle.

{0066}

According to the above described configuration, the receptacle unit 27 can be disposed at a position higher by the height of the pole member 92 with respect to the power reception unit 26. Therefore, a user does not have to bend down when the user connects the charging cable to the receptacle unit 27. Usability is thus significantly enhanced. The pole member 92 may be formed by a flexible pipe such as a spring pipe formed a resin pipe or a coil spring. Thus, even if a parked vehicle collides with the receptacle unit 27 and the pole member 92, the pole member 92 deflects, whereby damage of both of them is avoided or reduced. Also, the pole member 92 may be configured to be collapsible at a root

portion.

{0067}

The present invention is not limited to the above described embodiments, and modifications can be properly added within the range without departing from the gist of the present invention. For example, in the above described embodiments, the case of the multilevel mechanical parking facility of a lower entry type in which the vehicles 2 and 2E enter and leave from the loading/unloading port 3 provided at the lower portion of the parking tower 4 constructed on the ground is described; a multilevel mechanical parking facility of an upper entry type in which a parked vehicle enters and leaves may adopt, for example, a garage constructed underground from the loading/unloading port provided on the ground.

{0068}

In addition, in the above described embodiments, the power reception devices 23 and 91 are installed on the top surfaces of the end portions of the curb portions 18 of the pallets 15; however, they may be also installed in intermediate portions of the curb portions 18. Further, in the above described embodiments, the power reception devices 23 and 91 and the power transmission device 24 are configured to move relatively in the width direction (X direction) of the pallet 15 to contact and separate from each other; however,

they may move relatively in the length direction (Y direction) and the height direction (Z direction) of the pallet 15.

Also, the cover member 78 of the power reception device 23 and the rotational mechanism thereof and the like are not limited to the present embodiment.

{Reference Signs List}

{0069}

A, B CHARGING DEVICE

1 MULTILEVEL MECHANICAL PARKING FACILITY

2E ELECTRIC VEHICLE

3 LOADING/UNLOADING PORT

4 PARKING TOWER (PARKING FACILITY STRUCTURE)

11 HOISTWAY

12 CONVEYING TABLE

14 VEHICLE STORAGE RACK (PARKING FACILITY STRUCTURE)

15 PALLET

18 CURB PORTION

23, 91 POWER RECEPTION DEVICE

24 POWER TRANSMISSION DEVICE

26 POWER RECEPTION UNIT

27 RECEPTACLE UNIT

31 CONTACT HOUSING

32, 71 CONTACT HOLDING MEMBER

33 OPENING

41 POWER RECEPTION CONTACT

41a CONTACT SURFACE

48 RECEPTACLE MAIN BODY

64 VERTICAL SHAFT

73 POWER SUPPLY CONTACT

78 COVER MEMBER

92 POLE MEMBER

Y RELATIVE MOVING DIRECTION OF POWER RECEPTION CONTACT AND
POWER TRANSMISSION DEVICE

W WIDTH DIMENSION OF POWER RECEPTION DEVICE

{CLAIMS}

{Claim 1}

A charging device that is annexed to a multilevel mechanical parking facility including a pallet that conveys an electric vehicle inside a parking facility structure with the electric vehicle placed on the pallet, the charging device comprising:

a power reception device for charging the electric vehicle, provided on the pallet; and

a power transmission device for supplying electric power of an external power supply to the power reception device by contacting the power reception device, provided to the parking facility structure, wherein

the power reception device has a power reception unit that receives power supply from the power transmission device and a receptacle unit to which a charging cable of the electric vehicle is connected, with the power reception unit and the receptacle unit integrated, and wherein the power reception device is installed on an upper surface of a curb portion provided at a side edge portion of the pallet.

{Claim 2}

The charging device for a multilevel mechanical parking facility according to claim 1,

wherein a width dimension of the power reception device

is set to fit in the curb portion.

{Claim 3}

The charging device for a multilevel mechanical parking facility according to claim 1 or 2,

wherein the power reception unit is disposed on the upper surface of the curb portion, and the receptacle unit is disposed to lie on the power reception unit,

the power reception unit includes a contact housing and a power reception contact, the receptacle unit disposed on a top surface of the contact housing, the contact housing having an opening that opens toward an outer side in a width direction of the pallet, the power reception contact disposed on a position set back from the opening of the contact housing, and

the power reception contact receives power supply by contacting a power supply contact at the power transmission device.

{Claim 4}

The charging device for a multilevel mechanical parking facility according to claim 3,

wherein electrical conduction is achieved by shortening a relative distance between the power reception device and the power transmission device, whereby bringing one of the power supply contact and the power reception contact into contact

with the other one with one of the contacts resiliently pressed against the other one.

{Claim 5}

The charging device for a multilevel mechanical parking facility according to claim 4,

wherein the power reception contact has a contact surface in a direction orthogonal to a relative moving direction of the power transmission device, and

the power supply contact is in a form of elastic rod urged by a spring from the power transmission device to extend toward the contact surface of the power reception contact.

{Claim 6}

The charging device for a multilevel mechanical parking facility according to any one of claims 3 to 5,

wherein the power transmission device is provided with a cover member that covers an upper side of the power supply contact, and the cover member is urged in a direction to protrude toward the power reception device and configured to retrieve toward the power transmission device after abutment with the power reception device by shortening relative distance between the power reception device and the power transmission device.

{Claim 7}

The charging device for a multilevel mechanical parking facility according to any one of claims 4 to 6,

wherein the power transmission device comprises a plurality of power supply contacts which are disposed in a horizontal direction and integrally rotatable by a predetermined angle around a vertical shaft provided at the power transmission device.

{Claim 8}

The charging device for a multilevel mechanical parking facility according to any one of claims 1 to 7,

wherein a pole member is interposed between the power reception unit and the receptacle unit, both of which constitute the power reception device.

{Claim 9}

A multilevel mechanical parking facility including the charging device according to any one of claims 1 to 8.