SPECIFICATION

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MULTI-STORY PARKING FACILITY AND METHOD OF PUTTING CARS INTO AND OUT OF THE SAME

Field of the Invention

The present invention relates to a multi-story parking facility capable of holding multiple cars in a single parking chamber and to a method of putting cars into and out of this facility.

Background of the Invention

In multi-story parking facilities comprising in a plurality of parking floors a transfer truck apparatus for transferring cars, a plurality of parking chambers placed along a horizontal transfer space in which the transfer truck apparatus travels, and an elevating apparatus having a lift capable of elevating through each of the parking floors, there have been proposed, from the view point of effectively utilizing a building space or an underground space, such facilities that are configured to hold two or three cars in a single parking chamber.

If, however, a single parking chamber is used to park cars in each of an inner-side and an outer-side parking spaces or an inner-side, an intermediate, and an outer-side parking spaces and if the cars are to be put out from the inner-side parking space, the transfer truck apparatus must be used to

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move the cars from the outer-side parking space or from the intermediate and inner-side parking spaces, thereby increasing the excess operation of the transfer truck apparatus and thus the cycle time required to put cars out. In particular, in the case of a multi-story parking facility such as one that a large number of cars enter and leave in a short time, it is important to reduce the time required to put cars into and out of the facility but this may not be sufficiently dealt with. In addition, the number of available parking chambers on each parking floor decreases.

Disclosure of the Invention

It is an object of this invention to provide a multi-story parking facility that allows cars to be efficiently put into and out of it to reduce the required time even if the facility is adapted to park multiple cars in a single chamber and to provide a method of putting cars into and out of the facility.

To achieve this object, a multi-story parking facility according to Claim 1 comprises a plurality of parking chambers placed along a horizontal transfer space, a transfer truck apparatus that can move along the horizontal transfer space, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including the parking chambers and transfer truck apparatus, characterizing that the facility includes a double parking chamber having an outer-side and an inner-side

parking spaces relative to the horizontal transfer space and an intermediate shelf formed between the vertical transfer space of the lift and the horizontal transfer space of the transfer truck apparatus and including an intermediate conveyor apparatus capable of holding at least one car and delivering cars between the lift and the transfer truck apparatus and in that when the car is put out of the inner-side parking space in the double parking chamber, the elevating apparatus is used to transfer the car from the outer-side parking space to the intermediate shelf on another parking floor so that the shelf can be used as a standby space.

Since this configuration couples the vertical transfer space of the elevating apparatus to the horizontal transfer space of the transfer truck via the intermediate shelf and the intermediate conveyor apparatus is provided on the intermediate shelf, cars can be easily delivered between the lift and the transfer truck and the multi-story parking facility can be installed without being limited by the structure of the inside of the building. When the car is to be put out of the inner-side parking space in the double parking chamber, the intermediate shelf enables the intermediate shelf on another floor to be used as a standby space to facilitate the temporary placement of the car from the outer-side parking space and to eliminate the need to maintain an empty parking chamber on each parking floor, thereby increasing the number of accommodated cars.

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A multi-story parking facility according to Claim 2 comprises a plurality of parking chambers placed along a horizontal transfer space, a transfer truck apparatus that can move along the horizontal transfer space, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including the parking chambers and transfer truck apparatus, characterizing that the facility includes a parking chamber conveyor apparatus disposed in the parking chamber and capable of transferring cars while supporting them from below, a triple parking chamber in which an outer-side, an intermediate, and an inner-side parking spaces relative to the horizontal transfer space are formed on the parking chamber conveyor apparatus in at least part of the parking chamber, a lift conveyor apparatus disposed on the lift and capable of transferring two cars while supporting them from below, and two truck conveyor apparatuses disposed on the transfer truck apparatus in the travelling direction in the horizontal transfer space and capable of transferring cars while supporting them from below, so that cars can be delivered between the truck conveyor apparatus and the lift conveyor apparatus and between the transfer truck conveyor apparatus and the parking chamber conveyor apparatus.

Since this configuration can use the lift to simultaneously transfer two cars to a parking floor, on which they are transferred to the transfer truck apparatus, which then transfers them to the parking chamber and two cars can be

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simultaneously put out, the cycle time required to put cars into and out of the facility can be significantly reduced. In addition, in a triple parking chamber capable of parking three cars, if the cars are to be put out of the inner-side parking space, the cars can be simultaneously transferred from the intermediate and outer-side parking spaces to an empty space using the transfer truck, thereby reducing the time required to put cars out of the facility.

A multi-story parking facility according to Claim 3 is a configuration according to Claim 2 characterized in that the transfer truck apparatus includes a shifting conveyor apparatus capable of transferring cars between two truck conveyor apparatuses.

If two cars are to be transferred between the parking chamber at the end of the transfer space and the transfer truck apparatus, the above configuration can use the shifting conveyor apparatus to transfer cars between the two truck conveyor apparatuses in order to continuously put the two cars into or out of the facility, thereby reducing the required cycle time. Furthermore, in a triple parking chamber, the cars in the intermediate and outer-side parking spaces can be continuously transferred to the transfer truck apparatus and temporarily placed in an empty space, thereby reducing the time required to put the cars out of the inner-side parking space.

A multi-story parking facility according to Claim 4 comprising a plurality of parking chambers placed along the

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horizontal transfer space, a transfer truck apparatus that can move along a horizontal space, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including the parking chambers and transfer truck apparatus, characterized in that the facility includes a parking chamber conveyor apparatus disposed in the parking chamber and capable of transferring cars while supporting them from below, a triple parking chamber in which an inner-side, an intermediate, and an outer-side parking spaces relative to the horizontal transfer space are formed on the parking chamber conveyor apparatus in at least part of the parking chamber, a lift conveyor apparatus disposed on the lift and capable of transferring cars while supporting them from below, two truck conveyor apparatuses disposed on the transfer truck apparatus in the travelling direction in the horizontal transfer space and capable of transferring cars while supporting them from below, and a shifting conveyor apparatus provided on the transfer truck apparatus and capable of transferring cars between two truck conveyor apparatuses, so that cars can be delivered between the truck conveyor apparatus and the lift conveyor apparatus and between the transfer truck conveyor apparatus and the parking chamber conveyor apparatus.

This configuration enables even the cars at the intermediate and front positions in the parking chamber located at the end of the travelling space to be continuously transferred to that transfer truck and to be temporarily

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placed in an empty space, thereby reducing the time required to put out the car at the rear position.

A method of putting cars into and out of a multi-story parking facility according to Claim 5 that puts cars into and out of a multi-story parking facility comprising a plurality of parking chambers placed along a horizontal transfer space, a transfer truck apparatus that can move along the horizontal transfer space and capable of delivering the cars between the parking chambers, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including the parking chambers and transfer truck apparatus and deliver the cars to and from the transfer truck apparatuses, is characterized in that the method comprises the steps of maintaining a single parking space in a single parking chamber as an empty space on each parking floor having a double parking chamber capable of holding cars in an inner-side and an outer-side parking spaces relative to the horizontal transfer space; when putting the car out of the inner-side parking space in the double parking chamber in which two cars are held, using the transfer truck apparatus to temporarily place the car from the outer-side parking space into the empty space in the parking chamber; and then using the transfer truck apparatus to transfer the car from the inner-side parking space to the lift.

Even when the facility is full, this configuration enables the car in the outer-side parking space to be temporarily placed in the maintained empty space, thereby

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enabling the car in the inner-side parking space to be promptly put out.

A method of putting cars into and out of a multi-story parking facility according to Claim 6 is a configuration according to Claim 5 characterized in that the empty space is provided near the center of the transfer stroke of the transfer truck apparatus.

This configuration can reduce the distance over which the transfer truck moves for temporary placement and thus the required time, thereby further reducing the time required to put cars out of the facility.

Brief Description of the Drawings

FIG. 1 is a general top sectional view showing a first embodiment of a multi-story parking facility according to this invention;

FIG. 2 is a general side sectional view of the multi-story parking facility according to this invention;

FIG. 3 is a top view showing an entry and exit floor in the multi-story parking facility according to this invention;

FIG. 4 is a perspective view showing a transfer truck apparatus in the multi-story parking apparatus according to this invention;

FIG. 5 is a top view showing a lift in the multi-story parking apparatus according to this invention;

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FIG. 6 is a general top sectional view showing a second embodiment of the multi-story parking facility according to this invention;

FIG. 7 is a general horizontal sectional view of the multi-story parking facility according to this invention;

FIG. 8 is a general vertical sectional view of the multi-story parking facility according to this invention;

FIG. 9 is a schematic top view showing a transfer truck apparatus in the multi-story parking facility according to this invention;

FIG. 10 is a partly enlarged top view showing the transfer truck apparatus in the multi-story parking apparatus according to this invention;

FIG. 11 is a partly enlarged horizontal sectional view showing the transfer truck apparatus in the multi-story parking apparatus according to this invention;

FIG. 12 is a partly enlarged vertical sectional view showing the transfer truck apparatus in the multi-story parking apparatus according to this invention;

FIG. 13 is a general horizontal sectional view showing a third embodiment of the multi-story parking facility according to this invention;

FIG. 14 is a general top sectional view showing a fourth embodiment of the multi-story parking facility according to this invention;

FIG. 15 is a general top sectional view showing a fifth embodiment of the multi-story parking facility according to this invention;

FIG. 16 is a partly top sectional view showing a sixth embodiment of the multi-story parking facility according to this invention; and

FIG. 17 is a partly perspective view of the multi-story parking facility according to this invention.

Description of the Embodiments

A first embodiment of a multi-story parking facility according to this invention is described with reference to FIGS. 1 to 5.

This multi-story parking facility is installed by effectively using a predetermined space on a plurality of parking floors in a building 1 as shown in FIGS. 1 and 2 wherein parking floors 2A to 2D are formed on the plurality of floors and wherein an entry and exit floor 3 is formed on the highest parking floor 2D. A transfer truck apparatus 5 movably placed along a linear horizontal transfer space 4 and a plurality of parking chambers 6A and 6B located on both sides of the horizontal transfer space 4 so as not to interfere with columns or facilities in the building are disposed on each of the parking floors 2A to 2D. A vertical transfer space 7 in communication with each of the parking floors 2A to 2D and the entry and exit floor 3 is formed away from the horizontal transfer space 4, and an elevating

apparatus 9 having a lift 8 that can elevate and lower is disposed in the vertical transfer space 7. This configuration is provided because when placed so as to avoid interference with columns or auxiliary facilities, the components cannot be disposed adjacent to the horizontal transfer space 4 or vertical transfer space 7 due to the structure of the building 1. Such a layout, however, can be arbitrarily provided. The entry and exit floor 3 comprises an entry portion 11 and an exit portion 12 formed on either side of the elevating apparatus 9 and includes an entry path 13 that leads to the entry portion 11 and an exit path 14 that allows cars to go out from the exit portion 12 as shown in FIG. 3.

The parking chambers 6A to 6C provided on each of the parking floors 2A to 2D are each composed of a first parking chamber 6A that can hold a single car; a second parking chamber 6B that is a dual parking chamber having an inner-side parking space A and an outer-side parking space B of the horizontal transfer space 4 and capable of holding two cars, and a third parking chamber 6C capable of holding a single car that is installed in the rear of the vertical transfer space 7 and to which a car can be directly transferred from the lift 8. The first and third parking chambers 6A to 6C are placed using a space that is allowed depending on the structure of the building 1. In addition, an intermediate shelf 21 that can hold a single car is installed between the vertical transfer space 7 and the horizontal transfer space 4.

Furthermore, a driven (idly running) parking chamber conveyor apparatus 22A composed of a front-wheel slat conveyor 22a and a rear-wheel slat conveyor 22b supporting the wheels is disposed in each of the first and second parking chambers 6A and 6B. A driven parking chamber conveyor apparatus 22B and an intermediate conveyor apparatus 22C composed of the front-wheel slat conveyor 22a and rear-wheel slat conveyor 22b are located in each of the third parking chamber 6C and intermediate shelf 21.

A driven truck conveyor apparatus 24 consisting of a front-wheel slat conveyor 24a and a rear-wheel slat conveyor 24b provided on a truck frame 23 and driven by a truck conveyor drive motor 25 is disposed in the transfer truck apparatus 5, as shown in FIG. 4. A transmission 26 that transmits power to the parking chamber conveyor apparatus 22A to rotationally drive it is provided on both sides of the truck frame 23 transmits the power of the truck conveyor apparatus 24 to the parking chamber conveyor apparatus 22A in order to deliver cars between the transfer truck apparatus 5 and the first and second parking chambers 6A and 6B.

A turning table apparatus 27 with a conveyor that inverts a car by 180° in a predetermined turning space in the horizontal transfer space 7 is provided in the lift 8 of the elevating apparatus 9, as shown in FIG. 5. A lift conveyor apparatus 28 consisting of a front-wheel slat conveyor 28a and a rear-wheel slat conveyor 28b is disposed in a turning frame 27a that is driven and turned by the turning table apparatus

27. The turning table apparatus 28 is stopped and driven at a car-turning spatial position in the middle of the vertical transfer space 7 that does not interfere with the other members and can invert a car on the lift 8 by 180° between an entry position and an exit position.

The driven parking chamber conveyor apparatus 22B including a drive motor (not shown) is disposed in the third parking chamber 6C provided opposite to the intermediate shelf 21 and facing the vertical transfer space 7, and can deliver and receive cars to and from the lift 8.

If the above configuration is used to put the car out of the inner-side parking space A in the second parking chamber 6B, the transfer truck apparatus 5 is stopped opposite to the second parking chamber 6B in which the target car is held. The truck conveyor apparatus 24 is driven and the transmission 26 drives the parking chamber conveyor 22A to transfer the car in the outer-side parking space B from the parking chamber conveyor apparatus 22A to the truck conveyor apparatus 24 while simultaneously moving the car from the inner-side parking space A to the outer-side parking space B. The transfer truck apparatus 5 is then moved until it is opposed to the intermediate shelf 21. Once the transfer truck apparatus 5 has been stopped, the truck conveyor apparatus 24, intermediate conveyor apparatus 22C, and lift conveyor apparatus 28 are each driven to transfer the car from the transfer truck apparatus 5 to the lift 8 via the intermediate shelf 21. Furthermore, the elevating apparatus 9 is driven to

move the lift 8 to a different one of the parking floors 2A to 2D, where it is temporarily placed on the intermediate shelf 21.

Then, the transfer truck apparatus 5 is returned to the parking chamber 6B, and then car in the outer-side parking space 6b is loaded on the transfer truck apparatus 5 and then moved until it is opposed to the intermediate shelf 21. The car is transferred from the truck conveyor apparatus 24 to the lift conveyor apparatus 28 via the intermediate conveyor apparatus 22C to completely go out of the facility.

The car temporarily placed on the intermediate shelf 21 on the different one of the parking floors 2A to 2D may be returned to the parking chamber 6B on the original floor or one of the chambers 6A to 6C of the parking floors 2A to 2D that is empty.

According to the first embodiment, even if the structure and auxiliary facilities of the building 1 prevent the horizontal transfer space 4 and vertical transfer space 7 from being located in such a way as to be adjacent to each other, the intermediate shelf 21 can be provided to easily deliver cars between the lift 8 and the transfer truck apparatus 5, thereby enhancing the degree of freedom of design for the inside of the building 1. In addition, a parking facility including the parking chamber 6B capable of normally holding two cars must always maintain an empty parking space sufficient for a single car to allow the car in the outer-side position to be temporarily placed therein, but by using the

intermediate shelf 21 on another parking floor as a standby space, the need to maintain the space in the parking chambers 6A to 6C can be eliminated to increase the parking capacity.

A second embodiment of the multi-story parking facility according to this invention is described with reference to FIGS. 6 to 12.

This multi-story parking facility is installed in an underground structure 51 and an entry portion 52 and an exit portion 53 are provided on the highest floor, as shown in FIGS. 6 to 8. A plurality of (in the figure, four) parking floors B1 to B4 are formed in the underground structure 51, and a horizontal transfer space 55 in which the transfer truck apparatus 54 is moved is formed at the center of each of the parking floors B1 to B4. A parking chamber 56 that is a triple parking chamber capable of holding three cars M is formed on both sides of the horizontal transfer space 55, and the inner-side parking space A, intermediate parking space C, and outer-side parking space B are formed in the parking chamber 56. Only some of the parking chambers 56 may be triple parking chambers.

An entry vertical transfer space in communication with the entry portion 52 is formed in part of the parking chamber 56 and an entry elevating apparatus 57 is placed therein, while an exit vertical transfer space in communication with the exit portion 53 is formed and an exit elevating apparatus 58 is placed therein.

The entry elevating apparatus 57 and exit elevating apparatus 58 have the same configuration and well-known elevating drive apparatuses 61A and 61B drive lifts 62A and 62B to elevate and lower them along the vertical transfer space. Driven lift conveyor apparatuses 63A and 63B that can deliver the car M are disposed on the lifts 62A and 62B, respectively. The lift conveyor apparatuses 63A and 63B are composed of a front-wheel slat conveyor 63a supporting the front wheels and a rear-wheel slat conveyor 63b supporting the rear wheels, respectively, with their transfer stroke set to a sufficient length to simultaneously mount two cars M thereon. A driven entry conveyor apparatus 64 and a driven exit conveyor apparatus (not shown) that can deliver the car M between the lift conveyor apparatuses 63A and 63B are disposed on the entry portion 52 and exit portion 53, respectively. These conveyor apparatuses 54 and 55 are composed of a front- and a rear-wheel slat conveyors, respectively. The transfer stroke of the entry conveyor apparatus 64 and exit conveyor apparatus are set to a sufficient length to simultaneously mount two cars M thereon.

The transfer truck apparatus 54 located on each of the parking floors B1 to B4 includes on a truck body 71 a plurality of travelling wheels 73 that are guided by travelling rails 72 disposed on the respective sides of the horizontal transfer space 55 as shown in FIG. 9. Predetermined travelling wheels 73 are rotationally driven by a travelling drive apparatus 74 to travel along the horizontal

transfer space 55. A front truck conveyor apparatus 75 and a rear truck conveyor apparatus 76 are mounted on the truck body 71 of the transfer truck apparatus 54 in the longitudinal direction of the transfer direction. The front truck conveyor apparatus 75 and rear truck conveyor apparatus 76 are composed of front-wheel conveyors 75a and 76a and rear-wheel conveyors 75b and 76b, respectively. In addition, a shifting conveyor apparatus 77 that can deliver the car M between the front truck conveyor apparatuses 75 and the rear truck conveyor apparatus 76 is disposed on the truck body 71. The shifting conveyor apparatus 77 is composed of a lateral pair of a left-wheel conveyor 77a and a right-wheel conveyor 77b disposed so as to cross the front-wheel conveyors 75a and 76a and rear-wheel conveyors 75b and 76b.

The front truck conveyor apparatus 75 and the rear truck conveyor apparatus 76 are composed of a plurality of slat conveyors 81A and 81B and an auxiliary roller 82 as shown in FIGS. 10 to 12. The slat conveyors 81A and 81B disposed in a predetermined space are each composed of a chain 81c wound around a sprocket 81a or 81b, a slat block 81d attached to a link to the chain 81c, a supporting rail member 81e that guides and supports the chain 81b from below at the upper transfer position, and a conveyor drive motor 81h that drives the chain 81c via the sprocket 81a, an interlock shaft 81f, and a wrapping connection mechanism 81g.

In addition, the right- and left-wheel conveyors 77a and 77b are each composed of roller conveyors 83A and 83B placed

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between the slat conveyors 81A and 81B and a slat conveyor 83C connecting the conveyors 83A and 83B, and are rotationally driven by shifting drive motors 84A and 84B via the wrapping connection mechanisms. In addition, the roller conveyors 83A and 83B are each placed on an elevating frame 86 supported by a switching elevating cylinder 85 in such a way as to be elevated and lowered, and their transfer surface can be elevated and lowered to and from the vertical position of the transfer surface of the slat conveyors 81A and 81B.

Thus, the switching elevating cylinder 85 is moved to elevate the roller conveyors 83A and 83B in order to pass the car M supported on the slat conveyors 81A and 81B via the wheels, from the slat conveyors 81A and 81B onto the roller conveyors 83A and 84B, and the shifting drive motors 84A and 84B can drive the roller conveyors 83A and 83B and the slat conveyor 83C to transfer the car M between the front truck conveyor apparatus 75 and the rear truck conveyor apparatus 76.

An idly running parking chamber conveyor apparatus 91 disposed in each of the parking chambers 56 consists of a front-wheel slat conveyor 91a and a rear-wheel slat conveyor 91b to transmit a transfer drive force to the parking chamber conveyor apparatus 91 from the transmission (not shown) provided in the transfer truck apparatus 54.

In this configuration, if two cars M are to be put into the facility, the cars M are stopped on the entry conveyor apparatus 64 and the operators get out of the cars. The entry

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conveyor apparatus 64 and lift conveyor apparatus 63A are driven to continuously load the two cars M onto the lift 62A. Furthermore, the elevating drive apparatus 61A is driven to lower the lift 62A and to stop it on the target one of the parking floors B1 to B5.

The transfer truck apparatus 4 has been stopped in the travelling space 55 opposite to the entry elevating apparatus 57 in such a way as to be opposed to the front truck conveyor apparatus 75. The lift conveyor apparatus 63A and front truck conveyor apparatus 75 are driven to load the first car M on the transfer truck apparatus 54. The transfer truck apparatus 54 is moved forward and stopped at a position at which the rear truck conveyor apparatus 76 is opposed to the elevating conveyor apparatus 63A. Furthermore, the elevating conveyor apparatus 63A and rear truck conveyor apparatus 76 are driven to load the next car M on the transfer truck apparatus 54.

Then, the transfer truck apparatus 54 is moved and stopped opposite to an empty parking chamber 56. The front truck conveyor apparatus 75 and rear truck conveyor apparatus 76 are driven to put the cars M from the transfer truck apparatus 54 to the parking chamber conveyor apparatus 91 in the adjacent parking chambers 56, 56, respectively. After the first car has been put into the target parking chamber 56, the transfer truck apparatus 54 is moved to put the second car into the same parking chamber 56 or a different parking chamber 56.

In addition, if two cars M are continuously put into the parking chamber 56 at the front end of the travelling space 66, the first car M is passed from the front truck conveyor apparatus 75 into the parking chamber conveyor apparatus 91 in the parking chamber 56. Subsequently, the switching elevating cylinder 85 of the transfer truck apparatus 54 is moved to elevate the shifting conveyor apparatus 77, so that the car M on the rear truck conveyor apparatus 76 can be received by the shifting conveyor apparatus 77. The shifting conveyor apparatus 77 is driven to transfer the car M frontward. The switching elevating cylinder 85 is compressed to lower the shifting conveyor apparatus 77, so that the car M can be loaded on the front truck conveyor apparatus 75. The car is then passed from the front truck conveyor apparatus 75 into the parking chamber conveyor apparatus 91. The car M that has already been put into the conveyor apparatus is fed to the intermediate parking space C, while the car M that has newly been put into the conveyor apparatus is moved into the outer-side parking space B.

Cars may be continuously put into the parking chamber 56 at the rear end of the travelling space 55 from the rear truck conveyor 76.

Furthermore, if the car M accommodated in the inner-side parking space A in the parking chamber 56 at the front end of the travelling space 55, the car M in the outer-side parking space B is transferred from the parking chamber conveyor apparatus 91 to the front truck conveyor apparatus 75 (at the

same time, the car M in the intermediate parking space C is fed to the outer-side parking space B and the car M in the inner-side parking space A is fed to the intermediate parking space B). Subsequently, the car M is passed to the rear truck conveyor apparatus 76 via the shifting conveyor apparatus 77 with the car M in the outer-side parking space B that was located in the intermediate parking space C is loaded on the front truck conveyor apparatus 75 (at the same time, the car M in the intermediate parking space C is moved to the outer-side parking space B). The transfer truck apparatus 54 is moved and stopped opposite to an empty parking chamber 56, the two cars M or one of them is loaded and temporarily placed in that parking chamber 56, and the transfer truck apparatus 54 is returned, so that the car M in the outer-side parking space B that was located in the inner-side parking space A is loaded on the empty front or rear truck conveyor apparatus 75 or 76 on the transfer truck apparatus 54 and then put out of the facility.

In addition, if the car M in the intermediate parking space C is put out of the facility, the car M in the outer-side parking space B can be temporarily placed on one of the truck conveyor apparatuses 75 and 76, while the car M in the intermediate parking space C that is to be put out of the facility can be loaded on the other truck conveyor apparatus 76 or 75 for exit. Furthermore, the two cars M may be simultaneously put out of the facility.

FIG. 13 shows a third embodiment. Although according to the second embodiment, the single elevating conveyor apparatus 63A or 63B having a sufficient transfer stroke to allow the two cars M to be simultaneously mounted thereon is located on each of the lifts 62A and 62B, two lift conveyor apparatuses 101a and 101b that can deliver cars to each other are continuously located on each of the lifts 62A and 62B, according to the third invention.

According to the third embodiment, the two cars M can be simultaneously moved in the opposite directions, so the entry conveyor apparatuses 102a and 102b and an exit conveyor apparatus can be installed in the entry portion 52 or exit portion 53 on either side of the stopped position of the lift 62A or 62B to simultaneously put the two cars M into or out of the facility, thereby substantially reducing the time required for entry and exit.

FIG. 14 shows a fourth embodiment. Although according to the second embodiment, the two cars M are mounted on each of the lifts 62A and 62B in the entry direction of the parking chamber 4, two transfer truck conveyor apparatuses 113A and 113B are installed side by side on a single lift 112A or 112B so that the two cars M can be mounted on the transfer truck 54 in its transfer direction, according to a fourth invention. A vertical transfer space is formed over the two parking chambers 56, 56 so as to face the horizontal transfer space, and the truck conveyor apparatuses 113A and 113B are located on each lift 112A or 112B so as to correspond to the two

parking chambers 56, 56. According to the fourth embodiment, the two cars M can be simultaneously transferred to the entry or exit portion 52 or 53 or the transfer truck 54. This embodiment can also reduce the time required to put cars into and out of the facility. It also enables a parking chamber 56a to be provided to and from which the car M can be directly transferred from the lifts 62A, 62B.

FIG. 15 shows a fifth embodiment. This embodiment deletes the shifting conveyor apparatus 77 on the transfer truck 54 according to the second embodiment.

FIGS. 16 and 17 show a sixth embodiment.

FIGS. 16 and 17 show one 201 of the plurality of parking floors provided in the building or underground. A horizontal transfer space 203 in which the transfer truck apparatus 202 travels is formed at the center of the parking floor 201. A plurality of partitioned parking chambers 205 are provided on parking shelf 204 on both sides of the horizontal transfer space 203. A vertical transfer space 207 for the elevating apparatus 206 is formed in one of the parking chambers 205 over each parking floor 201, and a lift 208 of the elevating apparatus 206 is provided in the vertical transfer space 207 in such a way that it can elevate and lower through each parking floor 201.

Front-wheel slat conveyors 202a, 205a, and 208a that are an example of a transfer means and that holds the right and left wheels in such a way that they can transfer the wheels and rear-wheel slat conveyors 202b, 205b, and 208b that hold

the right and left wheels in such a way that they can transfer the wheels are disposed in the transfer truck apparatus 202, parking chamber 205, and lift 208, respectively, so that cars can be delivered at positions at which these components are opposed to each other.

The transfer means may be a roller conveyor apparatus, a combination of an idly running roller conveyor and a pallet drive apparatus that transfers cars via a pallet, or a transfer apparatus consisting of a drive roller conveyor apparatus.

The parking chamber 205 is configured as a double parking chamber in which long slat conveyors 205a and 205b that can each accommodate cars thereon are disposed in an inner-side parking space A and an outer-side parking space B closer to the transfer space 3 to hold two cars.

The parking chamber 205 on each parking floor 201 is controlled by a central controller (not shown) using the numbers added to the inner- and outer-side parking spaces A and B. The number of cars accommodated in all parking chambers 205 on each parking floor is set equal to the total number N-1 of the parking spaces A and B in such a way that a single empty space D is maintained for each parking chamber 205. In this case, the inner-side parking space A is used as the empty space D because the inner- and outer-side parking spaces A and B are interlocked by the slat conveyors 205a and 205b, and the outer-side parking space B is used as the empty space D if the slat conveyors 205a and 205b for the inner- and

outer-side parking spaces A and B are independently driven transfer apparatuses.

In this configuration, when the facility is filled with cars and an exit instruction is issued to the inner-side parking space A, the transfer truck apparatus 202 is moved to a position opposed to a target parking chamber 205. The slat conveyors 202a, 202b, 205a, and 205b are driven to transfer the car from the outer-side parking chamber B to the transfer truck apparatus 202 and to transfer the car from the inner-side parking space A to the outer-side parking chamber B. The transfer truck apparatus 202 is then moved to a position opposed to the parking chamber 205 including the empty space D, the car in the outer-side parking space B is transferred to the inner-side parking space A, and the car on the transfer truck 202 is loaded in the outer-side parking space B and temporarily placed there. The transfer truck 202 then returns to the position of the target parking chamber 205 to receive the target car and moves to a position opposed to the vertical space 207. The slat conveyors 202a, 202b, 208a, and 208b are driven to deliver the car from the transfer truck 202 to the lift 208. The lift 208 is transferred to an entry and exit floor including an entry and exit apparatus, where the car is put out of the facility. The car temporarily placed in the outer-side parking space B is returned to the outer-side parking space B in the original parking chamber 205 by the transfer truck 202.

The empty space D is set near the center of the transfer stroke of the transfer truck 202 and also set so as to minimize the distance over which the transfer truck 202 must travel to temporarily place the car in order to reduce the required time.

According to this embodiment, since the number of parked cars when the each floor 201 is filled with cars is set as the total number N-1 of the parking spaces A and B in all parking chambers 205 and the inner-side parking space A is used as the empty space D, the empty space D can be used to facilitate the prompt exit of the car in the inner-side parking space A when a car is held in each of the outer- and inner-side parking spaces B and A.

Although in this embodiment, the temporarily placed car is returned to the original parking chamber 205, the outer-side parking chamber B of the parking chamber 205 that becomes empty after the exit can be used as the empty space D without returning the car.

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CLAIMS

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1. A multi-story parking facility comprising a plurality of parking chambers placed along a horizontal transfer space, a transfer truck apparatus that can move along said horizontal transfer space, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including said parking chambers and transfer truck apparatus,

wherein said facility includes:

a double parking chamber having an outer- and an inner-side parking spaces relative to the horizontal transfer space; and

an intermediate shelf formed between the vertical transfer space of said lift and the horizontal transfer space of said transfer truck apparatus and including an intermediate conveyor apparatus capable of holding at least one car and delivering cars between the lift and the transfer truck apparatus, and wherein:

when the car is put out of the inner-side parking space in said double parking chamber, the elevating apparatus is used to transfer the car from the outer-side parking space to the intermediate shelf on another parking floor so that the shelf can be used as a standby space.

2. A multi-story parking facility comprising a plurality of parking chambers placed along a horizontal transfer space, a

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transfer truck apparatus that can move along said horizontal transfer space, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including said parking chambers and transfer truck apparatus,

wherein the facility includes:

a parking chamber conveyor apparatus disposed in said parking chamber and capable of transferring cars while supporting them from below;

a triple parking chamber in which an inner-side, intermediate, and outer-side parking spaces relative to the horizontal transfer space are formed on said parking chamber conveyor apparatus in at least part of said parking chamber;

a lift conveyor apparatus disposed on the lift and capable of transferring two cars while supporting them from below; and

two truck conveyor apparatuses disposed on said transfer truck apparatus in the travelling direction in the horizontal transfer space and capable of transferring cars while supporting them from below, and wherein:

cars can be delivered between said truck conveyor apparatus and said lift conveyor apparatus and between said transfer truck conveyor apparatus and said parking chamber conveyor apparatus.

3. A multi-story parking facility according to Claim 2, wherein the transfer truck apparatus includes a shifting

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conveyor apparatus capable of transferring cars between two truck conveyor apparatuses.

4. A multi-story parking facility comprising a plurality of parking chambers placed along a horizontal transfer space, a transfer truck apparatus that can move along said horizontal transfer space, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including said parking chambers and transfer truck apparatus,

wherein the facility includes:

a parking chamber conveyor apparatus disposed in said parking chamber and capable of transferring cars while supporting them from below;

a triple parking chamber in which an inner-side, intermediate, and outer-side parking spaces relative to the horizontal transfer space are formed on said parking chamber conveyor apparatus in at least part of said parking chamber;

a lift conveyor apparatus disposed on said lift and capable of transferring cars while supporting them from below;

two truck conveyor apparatuses disposed on said transfer truck apparatus in the travelling direction in the horizontal transfer space and capable of transferring cars while supporting them from below; and

a shifting conveyor apparatus provided on said transfer truck apparatus and capable of transferring cars between two truck conveyor apparatuses, and wherein:

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cars can be delivered between said truck conveyor apparatus and said lift conveyor apparatus and between said transfer truck conveyor apparatus and said parking chamber conveyor apparatus.

5. A method of putting cars into and out of a multi-story parking facility that puts cars into and out of a multi-story parking facility comprising a plurality of parking chambers placed along a horizontal transfer space, a transfer truck apparatus that can move along said horizontal transfer space and capable of delivering the cars between the parking chambers, and an elevating apparatus having a lift that can elevate through a vertical transfer space formed over a plurality of parking floors including said parking chambers and transfer truck apparatus and deliver the cars to and from the transfer truck apparatuses,

wherein the method comprises the steps of:

maintaining a single parking space in a single parking chamber as an empty space on each parking floor having a double parking chamber capable of holding cars in inner- and outer-side parking spaces relative to the horizontal transfer space;

when putting the car out of the inner-side parking space in the double parking chamber in which two cars are held, using the transfer truck apparatus to temporarily place the car from the outer-side parking space into the empty space in said parking chamber; and

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then using the transfer truck apparatus to transfer the car from the inner-side parking space to the lift.

6. A method of putting cars into and out of a multi-story parking facility according to Claim 5, wherein the empty space is provided near the center of the transfer stroke of the transfer truck apparatus.

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