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SPECIFICATION

Multistory Parking System

FIELD OF THE INVENTION

The present invention relates generally to a multistory parking system for receiving cars in a multistory manner, particularly to a device associated with the entrance/exit section thereof.

BACKGROUND OF THE INVENTION

In a conventional multistory parking system, as shown in Fig. 10, a plurality of parking stories 81A - 81C each have a horizontal transport passage 83 for a transport carriage 82 to move therealong, and a plurality of parking chambers 84 are defined on each side of the horizontal transport passage 83. And it is arranged that cars can be carried in and out between the transport carriage 82 and the parking chambers 84. Some of the parking chambers 84 are converted into a lifting space 85 extending across the individual parking stories 81A - 81C, and a lifting device 86 having a lifting stand 86a is installed in said lifting space 85. On the other hand, an entrance/exit story 81D having an entrance section 87 and an exit section 88 is formed with an entrance passage 87a and an exit passage 88a corresponding to the construction of the building.

In this connection, in a building having a multistory parking system, the position of pillars and the disposition of

other structures are greatly limited by the peculiar construction of the building. Therefore, it is desirable that the construction of a multistory parking system be such that it allows smooth entrance and exit of cars, applicable to all types of space. For example, if the building has an incidental facility which lies forward in the direction of exit, it is necessary to start a car obliquely from the exit section at the time of exit. Further, if the entrance passage 87a and the exit passage 88a are formed in a direction which differs from the direction in which a car assumes its entering attitude, it is necessary for the car to change its direction of movement.

In these cases, according to the prior art, it has been common practice to provide a turntable in the entrance section 87 or the exit section 88.

This turntable device, however, is on a large scale, requiring a large installation space. If such installation space is not available on account of the limitations imposed by the building, it is impossible to install the turntable device.

DISCLOSURE OF THE INVENTION

The present invention has for its object the provision of a multistory parking system which, even in the case where a turntable device cannot be installed in the entrance section or the exit section, ensures safe entrance and exit as it allows the car in its exiting state to change its direction of

movement.

To achieve this object, the invention described in Claim 1 is an entrance/exit device for a multistory parking system comprising: a plurality of parking stories each having a plurality of parking chambers defined therein; a lifting device having a lifting stand capable of moving up and down over an exit section from which cars are carried out; front and rear wheel conveyors disposed in the entrance/exit section and capable of receiving a car from the lifting stand; and an exit attitude adjusting device for turning a car by sliding the wheels, after stopping one conveyor, by a driving force produced by the other conveyor; said exit attitude adjusting device comprising a first car body detecting device for detecting a car body disposed on a transport passage of one of the front and rear wheel conveyors, a second car body detecting device for detecting a car body on a transport passage of the other conveyor at a position nearer to the delivery side than the first car body detecting device, and a car starting direction control device which, after one of the conveyors has been stopped on the basis of a detection signal from the first car body detecting device, stops the other conveyor on the basis of a detection signal from the second car body detecting device.

According to the above arrangement, the exit attitude adjusting device makes it possible to slide the wheels of a car on the conveyors and turn and stop the car by shifting the time to stop the conveyor devices on the basis of detection

signals from the two car body detecting devices during transport of the car with the front and rear wheels placed on the conveyor devices.

Therefore, even if there is an obstacle in the direction of exit, the car can be stopped in a tilted attitude to clear the obstacle in the direction of linear movement of the car; thus, the car can be safely carried out of the exit section without using a large-scale apparatus such as a turntable.

Further, the invention described in Claim 2 is an exit device for a multistory parking system as set forth in Claim 2, wherein the first and second car body detecting devices are each composed of a photoelectric detecting device which detects a car body when the latter crosses its optical axis, the first car body detecting device has its first optical axis disposed across and over one of the conveyors and in a direction orthogonal to the transport direction, and the second car body detecting device has its second optical axis disposed across and over the other conveyor and inclined in a direction in which cars are started to move.

According to the above arrangement, the use of a photoelectric detector in the car body detecting device with its optical axis extending longitudinally of the car when the conveyor is stopped makes it possible to correctly detect the car to be turned; thus, the car can be correctly turned and stopped, the safety being high.

Further, the invention as described in Claim 3 is an

entrance/exit device for a multistory parking system comprising: a plurality of parking stories each having a plurality of parking chambers defined therein; a lifting device having a lifting stand capable of moving up and down over an exit section from which cars are carried out; front and rear wheel conveyors disposed in the entrance/exit section and capable of receiving a car from the lifting stand; and an exit attitude adjusting device for turning a car by sliding the wheels, after the stoppage of one conveyor, by a driving force produced by the other conveyor; said exit attitude adjusting device having installed thereon, a first car body detecting device disposed on a transport passage for one of the front and rear wheel conveyors for detecting a car body, a timer for measuring the time from the time one conveyor stops to the time the other conveyor stops, and a car starting direction control device which, after one of the conveyors has been stopped on the basis of a detection signal from the first car body detecting device, stops the other conveyor by means of said timer.

According to the above arrangement, the same effects as those of the invention of Claim 1 can be attained.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a complete plan view of a parking story of a multistory parking system according to the present invention;

Fig. 2 is a complete side view, in section, of said multistory parking system;

Fig. 3 is a complete plan view of the entrance/exit story of said multistory parking system;

Fig. 4 is a side view, in section, of the lifting stand of said multistory parking system;

Fig. 5 is a front view, in section, of the lifting stand of said multistory parking system;

Fig. 6 is a plan view of the lifting stand of said multistory parking system;

Fig. 7 is a perspective view of the transport carriage device of said multistory parking system;

Fig. 8 is an enlarged plan view showing the entrance/exit section of said multistory parking system;

Fig. 9 is a plan view of the exit section of said multistory parking system; and

Fig. 10 is a perspective view showing a conventional multistory parking system.

DESCRIPTION OF EMBODIMENTS

A multistory parking system according to the present invention will now be described with reference to Figs. 1 - 9.

This multistory parking system, as shown in Figs. 1 and 2, is installed by utilizing the predetermined space of the stories of a building, parking stories 2A - 2D being defined in said stories, the uppermost parking story 2D being formed with an entrance/exit story 3. And each of the parking stories 2A - 2D is provided with a transport carriage device 5 disposed for movement along a linear horizontal transport

space 4, and a plurality of parking chambers 6A -6C disposed on both sides of the horizontal transport space 4 and within a range in which they do not interfere with the pillars or structures of the building. Further, at a position remote from the horizontal transport spaces 4, there is defined a lifting transport space 7 communicating with the parking stories 2A - 2D and the entrance/exit story 3, and a lifting device 9 having a lifting stand 8 is installed in said lifting transport space 7. The reason for selecting this arrangement is that if it is installed clear of the pillars or attached structures, it cannot be disposed in contact with the horizontal transport space 4 or lifting transport space 7 because of the construction of the building 1. However, it could be optionally installed. The entrance/exit story 3, as shown in Fig. 3, has an entrance section 11 and an exit section 12 formed on opposite sides of the lifting device 9, and an entrance passage 13 leading to the entrance section 11 and an exit passage 14 which allows a car to start from the exit section 12.

The details of this multistory parking system will be described below.

The parking chambers 6A - 6C defined in each of the parking stories 2A - 2D comprise first parking chambers 6A each adapted to receive a single car, second parking chambers 6B each adapted to receive two cars, and a third parking chamber 6C installed in the innermost region of the lifting transport space 7 to receive a car directly from the lifting

stand 8 and deliver it thereto, making effective use of the space provided by the construction of the building. An intermediate shelf 21 capable of receiving a single car is installed between the lifting transport space 7 and the horizontal transport space 4. Further, the first and second parking chambers 6A and 6B are each provided with a driven type (free rotation type) parking chamber conveyor device 22A composed of a front wheel slat conveyor 22a and a rear wheel slat conveyor 22b. Further, the intermediate shelf 21 and the third parking chamber 6C are each provided with an externally driven type parking chamber conveyor device 22B composed of a front wheel slat conveyor 22a and a rear wheel slat conveyor 22b and an intermediate conveyor device 22C.

In the transport carriage device 5, as shown in Fig. 7, the carriage frame 23 has mounted thereon a driven type carriage conveyor device 24 composed front and rear wheel slat conveyors 24a and 24b and driven by a carriage conveyor driving motor 25. Installed on opposite sides of the carriage frame 23 are power transmission devices 26 driven for rotation and adapted to transmit power to the free rotation type parking chamber conveyor device 22A so that the latter is driven for rotation, said power transmission devices 26 enabling the power from the carriage conveyor device 24 to be transmitted to the parking chamber conveyor device 22A to effect delivery of cars between the transport carriage device 5 and the first and second parking chambers 6A, 6B.

The lifting stand 8 of said lifting device 9 is

provided with a turning table device 51 equipped with a conveyor for reversing a car for 180° in a predetermined car space of the lifting transport space 7. That is, as shown in Figs. 4 through 6, a lifting frame 53 liftably supported by a lifting drive unit 52 through a wire rope has a shaft 54 supported in a bearing for rotation around its vertical axis. And a frame 55 is attached to the upper end of said shaft 54 and a ring gear 56a is fixed on the intermediate region of said shaft 54. Further, mounted on the lifting frame 53 is a drive unit 56 comprising a driving motor 56a, a driving gear 56c driven by said driving motor 56b through a speed reduction mechanism, and said ring gear 56a meshing with said driving gear 56c.

A lifting stand conveyor device 57 comprises a pair of slat conveyors 57A, 57B, disposed in the front and rear positions on the frame 55, for mounting the front or rear wheels of a car thereon. This lifting stand conveyor device 57 has a plurality (three in the figure) of sprockets 57b rotatably supported on a rotary shaft 57a on each side of the frame 55, with chains 57c extending between and entrained around the sprockets 57b disposed on opposite sides. And a number of slat bars 57d are disposed to extend between the front and rear chains 57c.

Further, a conveyor driving motor 57e is operatively connected to the rotatable shaft 57a belonging equally to the slat conveyors 57A, 57B through a speed reduction mechanism, said conveyor driving motor 57e driving both said slat

conveyors 57A and 57B. Said slat bars 57d are so arranged that they are moved along the upper and lower surfaces of the frame 55 as they are guided by the chains 57c, the greater part of the frame 55 being received between the upper and lower slat bars 57d of the lifting stand conveyor device 57, the whole of the frame 55 including the lifting stand conveyor device 57 being constructed in reduced bulk. Auxiliary rollers 57f are installed in the ends of the slat conveyors 57A, 57B.

Therefore, carrying cars into and out of the parking system can be effected by selecting one of the parking stories 2A - 2D which is a predetermined car space and in which the third parking chamber 6C (including the intermediate shelf 21) is vacant, and stopping the lifting stand conveyor device 57 in the car space position where it does not interfere with the parking chamber conveyor device 22, the frame 55 through 180° by the drive unit 56 so that the car on the lifting stand conveyor 57 can be easily reversed; in this manner, a 180° reversal is made between the parking system entering attitude and the parking system leaving attitude.

The third parking chamber 6C disposed on the opposite side of lifting transport space 7 with respect to the intermediate shelf 21 has the driven type parking chamber conveyor device 22B having a driving motor (not shown) and is capable of receiving a car from the lifting stand 8 and delivering it thereto.

As shown in Figs. 8 and 9, an entrance conveyor device

61 comprising a front wheel slat conveyor 61a and a rear wheel slat conveyor 61b is disposed at the entrance section 11 of said entrance/exit story 3, making it possible to transfer a car onto the lifting stand 8.

Further, an exit section 12 also has an exit conveyor device 62 comprising a front wheel slat conveyor 62a and a rear wheel slat conveyor device 62b, making it possible to receive the car from the lifting stand 8 and carry it out.

Since the exit passage 14 is constructed to extend below the entrance passage 13, it is easy to move the car along the exit passage 14 by starting it from the exit section 12 after backing it once from the exit section 12. However, there is a structure T attached to the building 1 in the direction of backward linear movement of the car from the exit conveyor device 62, so that the car has to be backed while turning the steering wheel; thus, there is a problem of safety.

Therefore, in this embodiment, a car body attitude adjusting device 63 is installed on the exit conveyor device 62 to allow exit while moving the car linearly backward.

This car body attitude adjusting device 63 allows the wheels to slide on the exit conveyor device 62 to turn the car body in that it displaces the stop position on the rear wheel slat conveyor 62b to one downstream of the front wheel slat conveyor 62a.

More particularly, the car body attitude adjusting device 63 comprises a first car body detecting device 64

composed of a photoelectric detecting device which, at a predetermined position above the front wheel slat conveyor 62a, forms a first optical axis S1 on a central lower photoreceiver 64b from an upper front phototransmitter 64a in a direction orthogonal to the direction of transport, a second car body detecting device 65 composed of a photoelectric detecting device which, at a predetermined position above the rear wheel slat conveyor 62b rearwardly of said first car body detecting device 64 in the direction of transport, forms a second optical axis S2 over an upper rear photoreceiver 65b disposed at a central lower position from an upper rear phototransmitter 65a as seen in the direction of exit (in the direction in which the rear portion of the car body turns to the right), and a starting direction control device 66 which, on the basis of the detection signals from the first and second car body detecting devices 64 and 65, operates the front wheel driving motor 62c of the front wheel slat conveyor 62a and also operates the rear wheel driving motor 62d of the rear wheel slat conveyor 62b.

Therefore, when a car transported from the exit conveyor device 62 crosses the first optical axis S1 to be detected by the first car body detecting device 64, the front wheel driving motor 62c is stopped by the starting direction control device 66 on the basis of the detection signal. Then, a transport force provided by the rear wheel slat conveyor 62b is applied to the car body through the rear wheels and the front and rear wheels slip on the slat bars of the exit

conveyor device 62, whereby the car body is turned around the front wheels. And when the rear portion of the car body crosses the second optical axis S2, the rear wheel slat conveyor 62b is stopped on the basis of the detection signal from the second car body detecting device 65. Thereby, the car is stopped in the turned attitude with no attached structures found in the direction of rear linear movement.

How to enter and leave the multistory parking system of the above construction will now be described.

(1) A car coming in from the entrance passage 13 is stopped on the entrance conveyor device 61 in the entrance section 11. After the driver has got off the car, the entrance conveyor device 61 and the lifting stand conveyor device 57 are driven to transport the car from the entrance section 11 onto the lifting stand 8 of the lifting device 9.

(2) The lifting stand 8 is lowered along the lifting transport space 7 until it is stopped at one of the car spaces corresponding to the parking stories 2A - 2D where there is no car received in the third parking chamber 6C. And the turning table device 51 is driven to reverse the car through 180°. And it is lifted or lowered to the intended one of the parking stories 2A - 2D.

(3) The lifting stand conveyor device 57 and the intermediate conveyor device 22C are driven to transfer the car from the lifting stand 8 to the intermediate shelf 21. Further, the transport carriage device 5 is stopped opposite the intermediate shelf 21, and the carriage conveyor device 24

of the transport carriage device 5 and the intermediate conveyor device 22C are driven so that the car is transferred from the intermediate conveyor device 22C to the transport carriage device 5.

(4) The transport carriage device 5 is moved along the horizontal transport space until it is stopped opposite the first or second parking chamber 6A or 6B which is intended. And the carriage conveyor device 24 is driven while the parking chamber conveyor device 22A is driven by the power transmission device 26, so that the car is carried to the parking chamber conveyor device 22A from the carriage conveyor device 24.

Of course, the first to third parking chambers 6A - 6C have respective addresses allotted thereto, and the addresses are controlled by the central control device of the multistory parking system on the basis of known entrance detection signals, whereby cars can be correctly distributed in spite of the fact that the first parking chambers 6A which differ in the number of cars parked therein from the second and third parking chambers 6B and 6C are intermingled with the latter.

(5) For leaving the parking system, the transport carriage device 5 is stopped opposite the parking chambers 6A, 6B where the intended car has been received. And the carriage conveyor device 24 is driven while the parking chamber conveyor device 22A is driven by the power transmission device 26, whereby the car is carried from the parking chamber conveyor device 22A to the carriage conveyor device 24.

The car received in the innermost region of the second parking chamber 6B will be carried out after the other car has been transferred to the vacant parking chamber 6A or 6B by the transport carriage device 5.

In addition, in the case of a parking system having a parking chamber 6B capable of receiving two cars, a vacant space sufficient to receive one car must be prepared in order to temporarily receive the innermost but one car. In this embodiment, however, the intermediate shelves 21 of the other parking stories 2A - 2D can be utilized as standby spaces; therefore, all of the parking chambers 6A - 6C in each parking story can be used to receive cars.

(6) And after the transport carriage device 5 has been moved to the intermediate shelf 21 and stopped there, the carriage conveyor device 24, the intermediate conveyor device 22C of the intermediate shelf 21 and the lifting stand conveyor device 57 are driven, so that the car is transferred from the carriage conveyor device 24 to the lifting stand 8 through the intermediate conveyor device 22C.

In addition, in the case where a car has been received in the third parking chamber 6C, it is carried directly to the lifting stand conveyor device 57 of the lifting stand 8 from the parking chamber conveyor device 22B of the third parking chamber 6C.

(7) When the lifting stand 8 is stopped in the entrance/exit story 3 by the lifting device 9, the lifting stand conveyor device 57 and the exit conveyor device 62 in

the exit section 12 are driven to transfer the car from the lifting stand 8 to the exit section 12. And the front wheel slat conveyor 62a is stopped by the first car body detecting device 64 of the exit attitude adjusting device 63. Thus, the transport force produced by the rear wheel slat conveyor 62b slides the front and rear wheels on the slat bars to turn the car body around the front wheels. And the rear wheel slat conveyor 62b is stopped by the second car body detecting device 65, and the car is stopped in a turned attitude with no attached structure T present in the direction of rearward linear movement.

(8) Getting on the car, the driver backs the car in the direction of linear movement and then advances the car so as to leave the parking system from the exit passage 14.

According to the above embodiment:

A. In the exit section 14, since the exit conveyor device 62 is provided with the exit attitude adjusting device 63, the direction of the car in leaving the parking system can be optionally adjusted, so that even if there is an obstacle in the vicinity of the exit section 14, it is possible for the car to stop the car clear of this obstacle and in a turned attitude; therefore, the car can safely leave the parking system by starting in the direction of linear movement. Furthermore, there is no need to provide a large-scale apparatus such as a turntable, the cost of equipment being correspondingly reduced.

Further, the use of the first and second car body

detecting devices 64 and 65 each comprising a photoelectric detector makes it possible to reliably detect a car body, ensuring high safety. In addition, although the car body is turned by sliding the wheels on the front and rear wheel slat conveyors 62a, 62b, the load due to friction on the slat bars imposed on the wheels and on the exit conveyor device 62 is so little that it causes little problem except that it requires the use of a slat bar belt having a relatively large width.

B. Since the turning table device 51 is installed on the lifting stand 8 of the lifting device 9 to enable the slat bar belt of the lifting stand conveyor device 57 mounted on said frame 55 to move along the upper and lower surface of the frame, the portion can be made less bulky, so that a car can be turned through 180° or a desired angle by utilizing the non-interfering car space in the lifting transport space 7. Therefore, as compared with the case in which a turn table or other device is provided, a car can be easily turned in a space saving manner, and the degree of freedom of designing multistory parking facilities can be increased.

C. Since the third parking chambers 6c which allow direct entrance to and exit from the lifting stand 8 are provided in the back of the lifting transport space 7, the vacant space in the building 1 can be effectively used, increasing the number of cars to be received. Further, the intermingling of the first parking chambers 6A each capable of receiving one car with the second parking chambers 6B each capable of receiving two cars makes it possible to increase

the number of cars to be received by making effective use of the space in the building 1.

D. Even in the case where the construction or attached structures of the building 1 make it impossible to position the horizontal transport space 4 and the vertical transport space 7 in contact with each other, the provision of the intermediate shelves 21 facilitates the delivery of cars between the lifting stand 8 and the transport carriage device 5, thus making it possible to increase the degree of freedom of design within the building 1. Further, in a parking system having parking chambers 6B each capable of receiving two cars, it is necessary to provide a parking space for receiving one car in order to temporarily receive the innermost but one car; however, utilization of the intermediate shelves in the other parking stories as standby spaces obviates the need for having vacant spaces in the parking chambers 6A - 6C, and hence the parking volume can be increased.

In addition, in the above form, it has been arranged that in the exit section 12, the car is backed for leaving the parking system; however, it may be arranged that the car is advanced for leaving the parking system.

WHAT IS CLAIMED IS:

1. An entrance/exit device for a multistory parking system, comprising
 - a plurality of parking stories each having a plurality of parking chambers defined therein;
 - a lifting device having a lifting stand capable of moving up and down over an exit section from which cars are carried out;
 - front and rear wheel conveyors disposed in the entrance/exit section and capable of receiving a car from the lifting stand; and
 - an exit attitude adjusting device for tilting a car by sliding wheels, after stopping one conveyor, by a driving force produced by the other conveyor;
 - said exit attitude adjusting device comprising:
 - a first car body detecting device for detecting a car body disposed on a transport passage of one of the front and rear wheel conveyors;
 - a second car body detecting device for detecting a car body on a transport passage of the other conveyor at a position nearer to the delivery side than the first car body detecting device; and
 - a car starting direction control device which, after one of the conveyors has been stopped on the basis of a detection signal from the first car body detecting device, stops the other conveyor on the basis of a detection signal from the second car body detecting device.

2. An exit device for a multistory parking system as set forth in Claim 1, wherein the first and second car body detecting devices each comprises a photoelectric detecting device which detects a car body when the latter crosses its optical axis, the first car body detecting device has its first optical axis disposed across and over one of the conveyors and in a direction orthogonal to the transport direction, and the second car body detecting device has its second optical axis disposed across and over the other conveyor and tilted in a direction in which a car is started to move.

3. An entrance/exit device for a multistory parking system, comprising

a plurality of parking stories each having a plurality of parking chambers defined therein;

a lifting device having a lifting stand capable of moving up and down over an exit section from which cars are carried out;

front and rear wheel conveyors disposed in the entrance/exit section and capable of receiving a car from the lifting stand; and

an exit attitude adjusting device for tilting a car by sliding wheels, after stopping one conveyor, by a driving force produced by the other conveyor;

said exit attitude adjusting device comprising:

a first car body detecting device for detecting a car

body disposed on a transport passage of one of the front and rear wheel conveyors;

a timer for measuring the time span from the time one conveyor stops to the time the other conveyor stops; and

a car starting direction control device which, after stopping one of the conveyors on the basis of a detection signal from the first car body detecting device, stops the other conveyor by means of said timer.