

DESCRIPTION

Title of Invention

MECHANICAL PARKING DEVICE AND METHOD FOR CONTROLLING
SAME

5

Technical Field

[0001]

The present invention relates to a mechanical
parking device and a method for controlling the same, which
10 includes a cage that is suspended by cord members and moves
up and down a vertical hoistway.

Background Art

[0002]

15 FIG. 1 is a schematic view illustrating an elevator
type parking device 1.

The elevator type parking device 1 includes: a cage
3 whose four corners are suspended by cord members 2 (e.g.,
wire ropes or chains) and that moves up and down a vertical
20 hoistway; and a lifting mechanism 4 that lifts and lowers
the cage 3.

[0003]

The lifting mechanism 4 includes a sheave drive
device 5, driven pulleys 6, a drive sheave 7, and a
25 counterweight 8. The sheave drive device 5 rotates the
drive sheave 7. The middle portions of the cord members 2
are hung on the drive sheave 7. One ends of the cord

members 2 are fixed to the cage 3, and the other ends of the cord members 2 are fixed to the counterweight 8.

[0004]

5 With this configuration, when the drive sheave 7 is rotated, the cord members 2 hung on the drive sheave 7 are unreeled toward the cage 3 or are lifted up from the cage side and are unreeled toward the counterweight 8 depending on the rotation direction, and thus the cage 3 moves up and down. In the example of FIG. 1, the cord members 2 include
10 four members. These four cord members 2 respectively extend from the four corners of the cage 3, are sequentially hung on the driven pulleys 6, the drive sheave 7, and the driven pulley 6, and extend up to the counterweight 8.

15 In this drawing, the reference number 9 indicates a hoistway and the reference number 10 indicates a pallet on which a vehicle is placed.

[0005]

20 The lifting mechanism 4 described above is referred to as a traction type (friction type) because the mechanism lifts and lowers the cage 3 by a frictional force between the drive sheave 7 and the cord members 2. The traction-type lifting mechanism 4 is suitable for many parking devices from low to high layers.

25 Herein, to reduce a diameter of the drive sheave 7 of the lifting mechanism 4, the four corners of the cage 3 may be suspended by a plurality (e.g., two) of the cord

members 2.

[0006]

On the other hand, a drum-type mechanism is also known as the lifting mechanism 4. The drum-type lifting mechanism is one in which the cord members 2 are wound around a cylindrical drum to wind up and unwind the cord members 2. The drum-type lifting mechanism is suitable for parking devices from low to middle layers.

[0007]

The elevator type parking device described above is disclosed in, for example, PTL 1.

Citation List

Patent Literature

[0008]

PTL 1: Japanese Patent Publication Laid-open No. 2018-40127

Summary of Invention

Technical Problem

[0009]

FIG. 2 is a schematic view illustrating a traversing state of the conventional pallet 10. This drawing illustrates a state where the pallet 10 on which the vehicle is placed is traversed from the cage 3 to a storage shelf 12 with the four corners of the cage 3 suspended by the cord members 2. The storage shelf 12 is fixed to a

fixed portion of the device.

In this drawing, FIG. 2(A) illustrates the start time of traversing and FIG. 2(B) illustrates a time when traversing rollers 11 of the pallet 10 pass a boundary portion B between the cage and the storage shelf. Moreover, in both FIG. 2(A) and FIG. 2(B), the upper part illustrates the lightweight side of the vehicle and the lower part illustrates the heavyweight side of the vehicle.

[0010]

The weight balance between the front wheel side and the rear wheel side of the vehicle (not illustrated) placed on the pallet 10 is commonly different (for example, 60:40). For that reason, amounts of extension of the front and rear cord members 2 suspending the cage 3 are different due to a weight difference between the front and rear of the vehicle. The difference in amounts of extension of the front and rear cord members 2 varies depending on the height (i.e., the lengths of the cord members 2) of the cage 3 and the weight of the vehicle. For example, the difference is 10 mm to 20 mm.

[0011]

FIG. 2(A) illustrates a state where the pallet support height of the lightweight-side cage 3 is matched with the storage shelf 12. In this case, a step Δh occurs between the pallet support height of the heavyweight-side cage 3 and the pallet support height of the storage shelf due to the weight difference between the front and rear of

the vehicle. The step Δh is 10 mm to 20 mm for example.

When traversing is started in this state, because the heavyweight-side traversing roller 11 cannot smoothly overcome the step Δh as illustrated in FIG. 2(B), shock or vibration may occur or traversing may not be performed.

When the pallet support height of the heavyweight-side cage 3 is matched with the storage shelf, the step Δh similarly occurs on the lightweight side.

[0012]

Unlike FIG. 2, a case where the cage 3 and the storage shelf 12 include a plurality of the traversing rollers 11 for traversing at intervals in a traverse direction and the pallet 10 includes a horizontal support that is supported to be traversable by the traversing rollers 11 of the cage 3 and the storage shelf 12 has also the same problem.

Hereinafter, the pallet 10 in this case is referred to as a "rollerless pallet".

[0013]

FIG. 3 is the same schematic view as FIG. 2 illustrating a case where the traverse direction positions (width direction positions) of the traversing rollers 11 of the pallet 10 are different between the front and rear of the vehicle.

In this drawing, FIG. 3(A) illustrates a state where the front and rear traversing rollers 11 on the right side (shelf side) are placed on a shelf rail 12a of the storage

shelf 12, and FIG. 3(B) illustrates a time when the
traversing roller 11 on the left side (anti-shelf side) of
the heavyweight side passes the boundary portion B and the
traversing roller 11 on the left side (anti-shelf side) of
5 the lightweight side remains on the cage.

In other words, FIG. 3(B) illustrates a state just
after all the traversing rollers 11 on one side of the
front and rear move onto the shelf and one of the
traversing rollers 11 on the other side remains on the cage.

[0014]

In FIG. 3(A), the traversing roller 11 on the left
side of the heavyweight side supports about half of the
heavyweight-side load, and an amount of extension of the
heavyweight-side and the shelf-side cord member 2
15 (hereinafter, cord member 2a) is large (e.g., 100 mm or
more).

On the other hand, in FIG. 3(B), because the
traversing roller 11 on the left side of the heavyweight
side is placed on the shelf rail 12a, a load acting on the
cord member 2a of the cage 3 becomes the minimum and the
20 extension of the cord member 2a considerably becomes small
(e.g., 20 mm or less).

[0015]

For that reason, in FIG. 3(B), due to the sudden
25 decrease in an amount of extension of the cord member 2a,
the heavyweight-side corner of the cage 3 suspended by the
cord member 2a suddenly jumps up (shift) upward along with

an on-cage rail 3a. This shift amount is 80 mm or more for example.

As a result, a part of the weight side (e.g., the on-cage rail 3a) of the jumped cage 3 may interfere with a part of the pallet 10.

[0016]

The present invention was created to solve the above-described problem. In other words, the first object of the present invention is to provide a mechanical parking device and a method for controlling the same in which a pallet can smoothly traverse with the four corners of a cage suspended by cord members without being affected by a weight difference between the front and rear of a vehicle.

Moreover, the second object is to provide a mechanical parking device and a method for controlling the same in which it is possible to prevent the jumping of the cage just after all the traversing rollers on one side of the front and rear move onto a shelf and one of the traversing rollers on the other side remains on the cage due to the difference between the traverse direction positions of the traversing rollers of the pallet at the front and rear of the vehicle.

Solution to Problem

[0017]

According to the present invention, a mechanical parking device includes storage shelves that are provided

along a hoistway, a cage that is suspended by cord members and moves up and down the hoistway, and a lifting control device that controls lifting of the cord members. The mechanical parking device causes a pallet to traverse
5 across a boundary portion between the cage and the storage shelf. The pallet includes or the cage and the storage shelf include a plurality of traversing rollers for traversing that are provided at both ends in a longitudinal direction thereof, traverse direction distances of the
10 traversing rollers up to the boundary portion are different between front and rear of a vehicle, and a horizontal distance difference thereof is equal to or greater than a first threshold value. The lifting control device implements re-leveling at the front and rear of the vehicle
15 to correct pallet support heights of the cage by lifting and lowering the cage during traversing.

[0018]

Moreover, according to the present invention, a control method of the mechanical parking device includes
20 implementing, by the lifting control device, the re-leveling during traversing so that a difference between pallet support heights of the cage and the storage shelf falls within a second threshold value when each of pallet support points at the front and rear of the vehicle crosses
25 the boundary portion.

Advantageous Effects of Invention

[0019]

According to the present invention, the plurality of traversing rollers for traversing are provided at both ends in the longitudinal direction of the pallet or the cage and the storage shelf, the traverse direction distances of the traversing rollers up to the boundary portion are different between the front and rear of the vehicle, and the horizontal distance difference is equal to or greater than the first threshold value.

With this configuration, a time difference corresponding to the horizontal distance difference of the traverse direction distances occurs when the front and rear of the vehicle cross the boundary portion during traversing of the pallet.

[0020]

Moreover, according to the present invention, the lifting control device implements re-leveling at the front and rear of the vehicle to correct the pallet support heights of the cage by lifting and lowering the cage during traversing.

As a result, because the pallet support heights of the cage are respectively corrected at the front and rear of the pallet, the front and rear of the vehicle can smoothly cross the boundary portion and the pallet can smoothly traverse with the four corners of the cage suspended by the cord members without being affected by the weight difference between the front and rear of the vehicle.

Brief Description of Drawings

[0021]

FIG. 1 is a schematic view illustrating an elevator
5 type parking device.

FIG. 2 is a schematic view illustrating a traversing
state of a conventional pallet.

FIG. 3 is the same schematic view as FIG. 2
illustrating a case where traversing rollers at both ends
10 of the pallet in a longitudinal direction are different
between the front and rear of a vehicle.

FIG. 4 is a front view illustrating a first
embodiment of a mechanical parking device according to the
present invention.

15 FIG. 5 is a view illustrating the first embodiment
of a pallet according to the present invention.

FIG. 6 is a view explaining the present invention
during traversing from a cage to a storage shelf.

FIG. 7 is a view explaining the present invention
20 during traversing from the storage shelf to the cage.

FIG. 8 is a view illustrating a second embodiment of
a pallet according to the present invention.

FIG. 9 is a view explaining the present invention
during traversing from a cage to a storage shelf when a
25 pallet is a "rollerless pallet".

FIG. 10 is a front view illustrating the second
embodiment of a mechanical parking device according to the

present invention.

FIG. 11 is a view illustrating a third embodiment of a pallet according to the present invention.

FIG. 12 is a view explaining the first half during
5 traversing from a cage to a storage shelf.

FIG. 13 is a view explaining the latter half during traversing from the cage to the storage shelf.

FIG. 14 is a view explaining the present invention during traversing from the storage shelf to the cage.

10 FIG. 15 is a view illustrating a fourth embodiment of a pallet according to the present invention.

Description of Embodiments

[0022]

15 Hereinafter, preferred embodiments of the present invention will be described with reference to the drawings. Herein, the same components in each drawing have the same reference numbers, and the overlapping descriptions will be omitted.

20 [0023]

FIG. 4 is a front view illustrating a first embodiment of a mechanical parking device 100 according to the present invention. The mechanical parking device 100 is an elevator type parking device in this example.

25 [0024]

In this drawing, the mechanical parking device 100 includes a plurality of storage shelves 12, a cage 3, a

lifting drive device 16, and a lifting control device 18.

[0025]

The plurality of storage shelves 12 are provided along a hoistway 9 at intervals up and down.

5 The cage 3 is suspended by a plurality (e.g., four in this example) of cord members 2 and moves up and down the hoistway 9.

10 The lifting drive device 16 drives the plurality of cord members 2 by synchronously lifting and lowering the members. The cord members 2 are wire ropes or chains, for example.

 The lifting control device 18 controls the lifting drive device 16.

15 The mechanical parking device 100 is adapted to traverse a pallet 10 on which a vehicle is placed across a boundary portion B between the cage 3 and the storage shelf 12, by using a traversing mechanism not illustrated.

[0026]

20 FIG. 5 is a view illustrating the first embodiment of the pallet 10 according to the present invention. In this drawing, FIG. 5(A) is a plan view, FIG. 5(B) is a view taken in a direction of an arrow B-B, and FIG. 5(C) is a view taken in a direction of an arrow C-C.

25 In this example, a pair of traversing rollers 11 for traversing is provided at each of the front and rear (longitudinal-direction both ends) of the pallet 10.

 In this an example, pallet support points S are at

the lower ends of the traversing rollers 11.

[0027]

In FIG. 5, traverse direction distances La and Lb of the traversing rollers 11 up to the boundary portion B are different between the front and rear of the vehicle, and a horizontal distance difference ΔL between the distances is set to be equal to or greater than a first threshold value.

In other words, in this example, the traverse direction positions of the traversing rollers 11 are different to be equal to or greater than the first threshold value at the front and rear (longitudinal-direction both ends) of the vehicle.

The first threshold value K1 is 100 mm to 200 mm for example, and is preferable to be set to be able to secure a re-leveling time Δt in which a re-leveling R to be described later is implemented.

[0028]

Hereinafter, in this example, at the front and rear of the pallet 10, a side where an interval L1 between the traversing rollers 11 is relatively large is called "wide side" and a side where an interval L2 thereof is relatively small is called "narrow side". In this case, it is necessary to satisfy the following Formula (1).

$$(L1-L2)/2 \geq K1 \quad (1)$$

Moreover, the interval L2 on the narrow side is preferable to be equal to or greater than the first threshold value K1 to secure the re-leveling time Δt .

[0029]

In FIG. 4, the cage 3 and the storage shelf 12 respectively include on-cage rails 3a and shelf rails 12a that support the traversing rollers 11 when traversing.

5 When the pallet 10 traverses, the upper surfaces of the on-cage rail 3a and the shelf rail 12a correspond to the pallet support heights. In other words, in this case, the pallet support heights are the heights of the lower ends of the traversing rollers 11.

10 [0030]

Herein, unlike FIGS. 4 and 5, the plurality of traversing rollers 11 for traversing may be provided at both ends in the longitudinal direction of the cage 3 and the storage shelf 12 at intervals in the traverse direction. In this case, the pallet 10 includes a horizontal support that is supported to be traversable by the traversing rollers 11 of the cage 3 and the storage shelf 12.

The pallet 10 in this case is a "rollerless pallet" described above.

20 [0031]

When the pallet 10 is a rollerless pallet, the pallet support points are at the upper ends of the traversing rollers 11. Moreover, also in this case, it is necessary that the traverse direction positions of the traversing rollers 11 are different at the longitudinal-direction both ends so that the difference therebetween is equal to or greater than the first threshold value K1.

The difference between the traverse direction positions of the traversing rollers 11 at the longitudinal-direction both ends (the front and rear of the pallet 10) may be constant or different if the difference is equal to or greater than the first threshold value K1.

[0032]

Hereinafter, it will be described with reference to FIGS. 4 and 5.

[0033]

In FIG. 4, the lifting drive device 16 includes an electric motor 16a, an inverter 16b, and an encoder 16c (or pulse generator).

The electric motor 16a rotationally drives a drive sheave 7 to wind up or unwind the cord members 2. The inverter 16b controls the speed of the electric motor 16a. The encoder 16c detects a rotational position of the electric motor 16a.

[0034]

It is preferable that the lifting control device 18 is a computer that includes a storage device 18a and an arithmetic device 18b.

[0035]

Note that the configuration of the lifting drive device 16 and the lifting control device 18 described above is not essential. It is sufficient to be able to control the lifting of the cage 3 suspended by the plurality of cord members 2.

[0036]

The lifting control device 18 implements the re-leveling R at the front and rear of the vehicle to correct the pallet support heights of the cage 3 by lifting and
5 lowering the cage 3 during traversing.

In other words, when each of the pallet support points S at the front and rear of the vehicle crosses the boundary portion B, the lifting control device 18 implements the re-leveling R so that a difference
10 (hereinafter, step Δh) between the pallet support heights of the cage 3 and the storage shelf 12 falls within a second threshold value K2.

The second threshold value K2 of the step Δh is 2 mm to 10 mm for example.

15 Hereinafter, a time zone in which the re-leveling R is implemented is called the "re-leveling time Δt ".

[0037]

"A time when each of the pallet support points S crosses the boundary portion B" means a time when a load
20 supporting each of the pallet support points S between the cage 3 and the storage shelf 12 is suddenly changed.

The detection of "the time when each of the pallet support points S crosses the boundary portion B" is set by a time from the start of traversing for example. Moreover,
25 the position of a driving unit (e.g., swing arm) of a traversing device not illustrated may be detected by a sensor.

[0038]

In FIGS. 4 and 5, the "pallet support points S" are at the lower ends of the traversing rollers 11. In this case, "a time when crossing the boundary portion B" is a time when the lower ends of the traversing rollers 11 pass through the boundary portion B.

[0039]

Unlike FIGS. 4 and 5, when the pallet 10 is a "rollerless pallet", the "pallet support points S" are at the upper ends of the traversing rollers 11 of the cage 3 or the storage shelf 12. In this case, "a time when crossing the boundary portion B" means a time when the pallet support points S are transferred from the traversing rollers 11 on the cage to the traversing rollers 11 on the storage shelf or means vice versa.

[0040]

In FIG. 4, the mechanical parking device 100 further includes a plurality of positioning members 20 and a plurality of position detectors 22.

The plurality of positioning members 20 are fixed at the front and rear on the traverse side of the hoistway 9 in accordance with a pallet support height (hereinafter, "shelf support height") of the storage shelf 12.

The plurality of position detectors 22 are provided on the cage 3, and detect the positioning member 20 to detect a difference between a pallet support height (hereinafter, "cage support height") of the cage 3 and the

shelf support height.

With this configuration, it is possible to detect the shelf support height during lifting the cage 3. Moreover, because the positioning members 20 are
5 respectively provided at the front and rear on the traverse side of the hoistway 9, the pallet support heights of the cage 3 can be respectively corrected at the front and rear on the traverse side of the cage 3.

In FIG. 4, the positioning members 20 are preferably
10 provided at the four corners of the hoistway 9.

[0041]

It is preferable that the position detector 22 can continuously detect a difference (hereinafter, "step") between the cage support height and the shelf support
15 height.

Moreover, the position detectors 22 may have a configuration that the difference (step) between the cage support height and the shelf support height can be detected at a plurality of positions (e.g., upper limit, lower limit,
20 and middle point) in the range of the second threshold value K2. The position detectors 22 are known as a horseshoe sensor.

[0042]

The lifting control device 18 implements the re-leveling R in the re-leveling time Δt from a time when the
25 pallet support point S on one side of the front and rear of the vehicle crosses the boundary portion B to a time when

the pallet support point S on the other side crosses the boundary portion B.

In other words, the "re-leveling time Δt " described above is a time from a time when the pallet support point S on the longitudinal-direction one end of the pallet 10 crosses the boundary portion B to a time when the pallet support point S on the other end crosses the boundary portion B.

[0043]

A control method of the mechanical parking device 100 according to the present invention is a control method of the mechanical parking device 100 described above.

The control method of the present invention is, by the lifting control device 18 described above, to implement the re-leveling R during traversing so that the difference between the pallet support heights of the cage 3 and the storage shelf 12 falls within the second threshold value K2 when each of the pallet support points S at the front and rear of the vehicle crosses the boundary portion B.

[0044]

Moreover, it is preferable to control a traversing speed in a variable manner to change the re-leveling time Δt during traversing the pallet 10.

For example, the detection of "the time when each of the pallet support points S crosses the boundary portion B" may be performed by a time from the start of traversing or a position sensor provided in the traverse direction of the

pallet 10 to secure the re-leveling time Δt by decelerating or suspending a traversing speed before the detection.

[0045]

FIG. 6 is a view explaining the present invention
5 when traversing is performed from the cage 3 to the storage shelf 12.

In this example, it is assumed that the lightweight side of the vehicle (not illustrated) is placed on the wide side of the pallet 10, and the heavyweight side of the
10 vehicle is placed on the narrow side of the pallet 10.

In this drawing, FIG. 6(A) to FIG. 6(C) illustrate states from the start of traversing to the passage of the traversing rollers 11 on the right side of the pallet 10 through the boundary portion B.

15 In this example, traversing to the right-side storage shelf 12 in the drawing is illustrated, but traversing to the left-side storage shelf 12 is also similar.

[0046]

20 FIG. 6(A) illustrates a state where a difference (step) between the pallet support heights of the lightweight-side cage 3 and the storage shelf 12 is located within the second threshold value $K2$. In other words, the lifting of the cage 3 is stopping in a state where the
25 lightweight-side step is not substantially present.

In this case, the pallet support height of the heavyweight-side cage 3 falls down due to the weight

difference between the front and rear of the vehicle, and the step Δh exceeding the second threshold value $K2$ occurs between the pallet support heights of the heavyweight-side cage 3 and the storage shelf 12.

5 [0047]

When traversing is started in this state, as illustrated in FIG. 6(B), the traversing roller 11 on the lightweight side of the pallet 10 smoothly first passes the boundary portion B, and the traversing roller 11 on the
10 heavyweight side of the pallet 10 at this point is located in front (left side in drawing) of the boundary portion B while being placed on the cage 3.

At this point, the heavyweight-side step Δh still exists.

15 [0048]

Next, by the re-leveling R described above, the pallet support heights of the cage 3 are corrected by lifting and lowering the cage 3 during traversing. As a result, as illustrated in FIG. 6(C), the difference (step)
20 between the pallet support heights of the cage 3 on the narrow side (heavyweight side) and the storage shelf 12 is reduced within the second threshold value, and the traversing roller 11 of the pallet 10 on the narrow side (heavyweight side) smoothly passes the boundary portion B.

25 The "re-leveling time Δt " described above is a time from FIG. 6(B) to FIG. 6(C).

[0049]

As illustrated in FIG. 6(C), by the re-leveling R described above, the height difference between the pallet support points S of the left and right traversing rollers 11 on the wide side first passing the boundary portion B becomes large, and the pallet 10 on the wide side inclines slightly. However, the inclination of the pallet 10 after passing the boundary portion B can be absorbed by the elasticity of the pallet itself, and the influence on the vehicle can be almost ignored.

[0050]

After FIG. 6 (C), in order to complete the traversing, the left-side traversing roller 11 of the pallet 10 on the narrow side (heavyweight side) passes the boundary portion B, and then the left-side traversing roller 11 of the pallet 10 on the wide side (lightweight side) passes the boundary portion B.

Also after FIG. 6 (C), it is preferable that the re-leveling R described above is implemented in the re-leveling time Δt described above when each of the pallet support points S of the traversing rollers 11 crosses the boundary portion B.

[0051]

FIG. 7 is a view explaining the present invention when traversing is performed from the storage shelf 12 to the cage 3.

In this example, it is assumed that the lightweight side of the vehicle (not illustrated) is placed on the wide

side of the pallet 10 and the heavyweight side of the vehicle is placed on the narrow side of the pallet 10.

In this drawing, FIG. 7(A) illustrates the start time of traversing, and FIG. 7(B) illustrates a time when the left-side traversing roller 11 on the narrow side (heavyweight side) passes the boundary portion B.

In this example, the traversing from the right-side storage shelf 12 in the drawing is illustrated, but the traversing from the left-side storage shelf 12 is also similar.

[0052]

FIG. 7(A) illustrates a state where the difference (step) between the pallet support heights of the lightweight-side cage 3 and the storage shelf 12 is located within the second threshold value. In other words, in a state where the lightweight-side step is not substantially present, the lifting of the cage 3 is stopping.

In this case, because the pallet 10 is located on the storage shelf 12, the pallet support heights of the cage 3 are the same at the heavyweight and lightweight sides.

[0053]

When the traversing is started in this state, as illustrated in FIG. 7(B), the traversing roller 11 on the lightweight side of the pallet 10 smoothly first passes the boundary portion B, and the traversing roller 11 on the heavyweight side of the pallet 10 at this point is located

in front (right side in drawing) of the boundary portion B while being placed on the storage shelf 12.

[0054]

5 In this state, as illustrated in FIG. 7(B), due to the weight of the lightweight-side traversing roller 11 first passing the boundary portion B, the cage 3 shifts downward, the height difference between the left and right traversing rollers on the wide side becomes large, and thus the pallet 10 on the wide side inclines slightly. However, 10 the inclination of the pallet 10 on the wide side after passing the boundary portion B can be absorbed by the elasticity of the pallet itself and the influence on the vehicle can be almost ignored.

[0055]

15 Next, by the re-leveling R described above, the pallet support heights of the cage 3 are corrected by lifting and lowering the cage 3 during traversing. As a result, as illustrated by the broken line in FIG. 7(B), the difference (step) between the pallet support heights of the 20 heavyweight-side cage 3 and the storage shelf 12 is reduced within the second threshold value, and the traversing roller 11 on the heavyweight side of the pallet 10 can smoothly pass the boundary portion B.

[0056]

25 After FIG. 7(B), in order to complete the traversing, the right-side traversing roller 11 of the pallet 10 on the narrow side (heavyweight side) passes the boundary portion

B, and then the right-side traversing roller 11 of the pallet 10 on the wide side (lightweight side) passes the boundary portion B.

After FIG. 7(B), it is preferable that the re-leveling R described above is implemented in the re-leveling time Δt described above when each of the pallet support points of the traversing rollers 11 crosses the boundary portion B.

[0057]

FIG. 8 is a view illustrating a second embodiment of the pallet 10 according to the present invention. In this drawing, the pallet 10 is a "rollerless pallet". FIG. 8(A) is a plan view, FIG. 8(B) is a view taken in a direction of an arrow B-B, and FIG. 8(C) is a view taken in a direction of an arrow C-C.

In this example, the plurality of traversing rollers 11 for traversing are provided at both ends in the longitudinal direction of the cage 3 (specifically, the on-cage rail 3a) and the storage shelf 12 (specifically, the shelf rail 12a).

In this example, the pallet support points S are at the upper ends of the traversing rollers 11.

[0058]

In FIG. 8, the traverse direction distances L_a and L_b of the traversing rollers 11, on the shelf rails 12a closest to the boundary portion B, up to the boundary portion B are different between the front and rear of the

vehicle, and the difference ΔL therebetween is set to be equal to or greater than the first threshold value.

It is preferable that the traverse direction positions of the traversing rollers 11 other than the traversing rollers closest to the boundary portion B are different between the front and rear of the vehicle.

[0059]

FIG. 9 is a view explaining the present invention when traversing is performed from the cage 3 to the storage shelf 12 in a case where the pallet 10 is a "rollerless pallet".

FIG. 9(A) to FIG. 9(C) respectively correspond to FIG. 6(A) to FIG. 6(C).

[0060]

When the traversing is started in a state of FIG. 9(A) where the lightweight-side step is not substantially present, as illustrated in FIG. 9(B), the pallet support point S of the lightweight-side cage 3 is transferred to the pallet support point S of the storage shelf 12, and thus the pallet support point S smoothly first crosses the boundary portion B.

At this point, the centroid position of the heavyweight-side pallet 10 is located in front (left side in drawing) of the boundary portion B while the heavyweight-side pallet 10 is placed on the pallet support point S of the cage 3, and the heavyweight-side step Δh still exists.

[0061]

Next, by the re-leveling R described above, the
pallet support heights of the cage 3 are corrected by
lifting and lowering the cage 3 during traversing. As a
5 result, as illustrated in FIG. 9(C), the heavyweight-side
step is reduced within the second threshold value, the
heavyweight-side pallet support point S is transferred from
the cage 3 to the storage shelf 12, and thus the
heavyweight-side pallet support point S smoothly crosses
10 the boundary portion B.

The others are the same as those in FIG. 6(A) to FIG.
6(C).

[0062]

As described above, according to the first and the
15 second embodiments of the present invention, the plurality
of traversing rollers 11 for traversing are provided at
both ends in the longitudinal direction of the pallet 10 or
the cage 3 and the storage shelf 12, and the traverse
direction distances of the traversing rollers 11 up to the
20 boundary portion B are different between the front and rear
of the vehicle. The horizontal distance difference ΔL
therebetween is equal to or greater than the first
threshold value K1.

With this configuration, a time difference
25 corresponding to the horizontal distance difference ΔL
between the traverse direction distances occurs when the
front and rear of the vehicle cross the boundary portion B

at the time of traversing of the pallet 10.

[0063]

Moreover, according to the embodiment of the present invention, the lifting control device 18 implements the re-leveling R at the front and rear of the vehicle to correct the pallet support heights of the cage 3 by lifting and lowering the cage 3 during traversing.

As a result, because the pallet support points S at the front and rear of the pallet 10 cross the boundary portion B by the step Δh within the second threshold value K2, the pallet 10 can smoothly traverse with the four corners of the cage 3 suspended by the cord members 2 without being affected by the weight difference between the front and rear of the vehicle.

[0064]

FIG. 10 is a front view illustrating the second embodiment of the mechanical parking device 100 according to the present invention. The mechanical parking device 100 is an elevator type parking device in this example.

[0065]

The mechanical parking device 100 is adapted to traverse the pallet 10 on which the vehicle is placed across the boundary portion B between the cage 3 and the storage shelf 12, by using the traversing mechanism not illustrated.

[0066]

For example, by the horizontal swing of a traversing

arm having an engaging dog at the tip, the traversing mechanism causes the pallet 10 engaging with the engaging dog to move horizontally.

[0067]

5 In FIG. 10, the cage 3 and the storage shelf 12 respectively include the on-cage rail 3a and the shelf rail 12a that support the traversing rollers 11 when traversing.

The on-cage rail 3a is fixed to the cage 3, and horizontally extends in a width direction and supports the traversing rollers 11 to guide its traversing.

10 When the pallet 10 traverses, the upper surfaces of the on-cage rail 3a and the shelf rail 12a correspond to the pallet support heights. In other words, in this case, the pallet support heights are the lower-end heights of the traversing rollers 11.

15 The other configuration is similar to the first embodiment illustrated in FIG. 4.

[0068]

20 FIG. 11 is a view illustrating a third embodiment of the pallet 10 according to the present invention. In this drawing, FIG. 11(A) is a plan view, FIG. 11(B) is a view taken in a direction of an arrow B-B, and FIG. 11(C) is a view taken in a direction of an arrow C-C.

[0069]

25 In FIG. 11, the traverse direction positions of the traversing rollers 11 are different between the front and rear (longitudinal-direction both ends) of the vehicle.

In this example, the traverse direction distances L_a and L_b of the right-side traversing rollers 11 in the drawing up to the boundary portion B with the storage shelf 12 for traversing are different between the front and rear of the vehicle, and the horizontal distance difference ΔL of the traversing rollers 11 is set to be equal to or greater than the first threshold value. The left-side traversing rollers 11 are also similar.

[0070]

In FIG. 11, the intervals L_1 and L_2 between the traversing rollers 11 are set at symmetrical positions with respect to the center of the pallet 10 in the width direction. Note that this configuration is not essential. The intervals may be at asymmetric positions with respect to the width-direction center.

Moreover, in FIG. 11, the traversing rollers 11 on each of the longitudinal-direction both ends of the pallet 10 are one pair (two), but the number of traversing rollers on each end may be three or more.

[0071]

In FIG. 11, the mechanical parking device 100 further includes an auxiliary roller 13.

The auxiliary roller 13 can rotate around a shaft center extending in the longitudinal direction of the pallet 10. The auxiliary roller is provided on the longitudinal-direction opposite side to the traversing roller 11 (hereinafter, "farthest roller 11A") finally

remaining on the cage during traversing to the storage shelf 12.

In other words, the traverse direction distance of the auxiliary roller 13 up to the boundary portion B is set to be the same as that of the farthest roller 11A.

[0072]

In this example, the auxiliary roller 13 has the same diameter and the same support height as the farthest roller 11A. On the other hand, the auxiliary roller 13 may be set to have a smaller diameter than the farthest roller 11A or to have a slightly higher support height (5 mm to 10 mm above) than the farthest roller 11A. The reason for this will be described later.

[0073]

The auxiliary roller 13 and the traversing roller 11 (the farthest roller 11A) finally remaining on the cage are preferably located at the width-direction ends on the opposite side to the storage shelf 12 on which the pallet 10 traverses.

With this configuration, even if the cage 3 shifts upward when the farthest roller 11A and the auxiliary roller 13 cross the boundary portion B at the final stage of the traversing to the shelf side, it is possible to avoid interference between the cage 3 and the pallet 10.

[0074]

The auxiliary roller 13 is located just above the on-cage rail 3a or the shelf rail 12a.

With this configuration, the auxiliary roller 13 can be supported by the on-cage rail 3a and the shelf rail 12a when traversing.

[0075]

5 "A time when each of the traversing rollers 11 crosses the boundary portion B" means a time when a load supporting each of the pallet support points S between the cage 3 and the storage shelf 12 is suddenly changed.

The detection of "the time when each of the
10 traversing rollers 11 crosses the boundary portion B" is set by a time from the start of traversing for example. Moreover, the position of the driving unit (e.g., swing arm) of the traversing device not illustrated may be detected by a sensor.

15 [0076]

The lifting control device 18 implements the re-leveling R in the re-leveling time Δt from a time when the traversing roller 11 on one side of the front and rear of the vehicle crosses the boundary portion B to a time when
20 the other traversing roller 11 crosses the boundary portion B.

In other words, the "re-leveling time Δt " described above is a time from the time when the traversing roller 11 on the longitudinal-direction one end of the pallet 10
25 crosses the boundary portion B to the time when the traversing rollers 11 on the other end crosses the boundary portion B.

[0077]

A control method of the mechanical parking device 100 according to the present invention is a control method of the mechanical parking device 100 described above.

5 The control method of the present invention is, by the lifting control device 18 described above, to implement the re-leveling R during traversing so that the difference between the pallet support heights of the cage 3 and the storage shelf 12 falls within the second threshold value K2
10 when each of the traversing rollers 11 at the front and rear of the vehicle crosses the boundary portion B.

[0078]

FIG. 12 is a view explaining the first half when traversing is performed from the cage 3 to the storage
15 shelf 12.

In this example, it is assumed that the lightweight side of a vehicle (not illustrated) is placed on the wide side of the pallet 10, and the heavyweight side of the vehicle is placed on the narrow side of the pallet 10.

20 In this drawing, FIG. 12(A) to FIG. 12(C) illustrates states from the start of traversing to the passage of the traversing rollers 11 on the right side of the pallet 10 through the boundary portion B.

The operations of FIG. 12(A) to FIG. 12(C) are
25 similar to those of FIG. 6(A) to FIG. 6(C).

[0079]

FIG. 13 is a view explaining the latter half when

traversing is performed from the cage 3 to the storage shelf 12.

In this drawing, FIG. 13(C) is the same as FIG. 12(C) and illustrates a time when the front and rear traversing rollers 11 on the right side of the pallet 10 have passed the boundary portion B. FIG. 13(D) illustrates a time when the left-side traversing roller 11 on the heavyweight side of the pallet 10 has passed the boundary portion B.

10 [0080]

After FIG. 13(C), also when the left-side traversing roller 11 on the heavyweight side of the pallet 10 crosses the boundary portion B, the re-leveling R described above is implemented in the re-leveling time Δt described above.

15 As a result, as illustrated in FIG. 13(D), the difference (step) between the pallet support heights of the heavyweight-side cage 3 and the storage shelf 12 is reduced within the second threshold value, and the left-side traversing roller 11 on the heavyweight side of the pallet 10 smoothly passes the boundary portion B.

[0081]

At this point, one (i.e., the farthest roller 11A) of the traversing rollers 11 and the auxiliary roller 13 remain on the cage.

25 Therefore, when the pallet 10 traverses to the storage shelf 12 and only one of the traversing rollers 11 remains on the cage, it is possible to prevent the cage 3

from jumping up because the auxiliary roller 13 also remains on the longitudinal-direction opposite side of the cage.

[0082]

5 Next, in FIG. 13(D), when the auxiliary roller 13 and the traversing roller 11 (the farthest roller 11A) finally remaining on the cage simultaneously cross the boundary portion B, all the traversing rollers 11 on the auxiliary roller side are placed on the storage shelf 12.
10 Therefore, by causing the finally remaining traversing roller 11 (the farthest roller 11A) to traverse in line with the pallet support height of the storage shelf 12, the auxiliary roller 13 can traverse without impact while floating slightly above the pallet support height of the
15 storage shelf 12.

[0083]

 When traversing the farthest roller 11A, the reason why the auxiliary roller 13 is located slightly above the pallet support height of the storage shelf 12 is that the
20 weight ratio of the pallet 10 supported by the auxiliary roller 13 is smaller than that of the traversing roller 11 finally remaining on the cage.

 For example, assuming that a weight balance between the front wheel side and the rear wheel side of the vehicle
25 is 60:40 and a weight ratio is 60% on the heavyweight side and 40% on the lightweight side, the support weight ratio is, for example, 15% of the auxiliary roller 13 and 20% of

the farthest roller 11A.

[0084]

In order to surely secure this relationship, it is preferable that the diameter of the auxiliary roller 13 is set to be smaller than that of the farthest roller 11A or the support height thereof is set to be slightly higher (5 mm to 10 mm above) than the farthest roller 11A.

[0085]

Next, the farthest roller 11A and the auxiliary roller 13 on the left side of the pallet 10 pass the boundary portion B to complete the traversing.

In this case, because the farthest roller 11A and the auxiliary roller 13 are respectively located at the width-direction ends of the pallet 10 on the opposite side to the storage shelf 12, it is possible to can avoid interference between the cage 3 and the pallet 10 even if the cage 3 suddenly shifts upward due to the sudden decrease in an amount of extension of the cord member 2a.

[0086]

In FIGS. 12 and 13, the traversing to the right-side storage shelf 12 in the drawing is illustrated, but the traversing to the left-side storage shelf 12 is also similar.

In other words, in the pallet 10 that traverses to the right side in the drawing and the pallet 10 that traverses to the left side, the positions of the auxiliary roller 13 are opposite in the traverse direction as

illustrated in FIG. 10.

[0087]

FIG. 14 is a view explaining the present invention when traversing is performed from the storage shelf 12 to
5 the cage 3.

In this example, it is assumed that the lightweight side of the vehicle (not illustrated) is placed on the wide side of the pallet 10 and the heavyweight side of the vehicle is placed on the narrow side of the pallet 10.

10 In this drawing, FIG. 14(A) illustrates the start time of the traversing, and FIG. 14(B) illustrates a time when the left-side farthest roller 11A on the lightweight side (wide side) has passed the boundary portion B.

The operations of FIG. 14(A) and FIG. 14(B) are
15 similar to those of FIG. 7(A) and FIG. 7(B).

[0088]

In FIG. 14(B), because the traversing roller 11 on the heavyweight side of the pallet 10 is placed on the shelf rail 12a, the auxiliary roller 13 is slightly floated
20 from the on-cage rail 3a.

[0089]

FIG. 15 is a view illustrating a fourth embodiment of the pallet 10 according to the present invention. In this drawing, FIG. 15(A) is a plan view, FIG. 15(B) is a
25 view taken in a direction of an arrow B-B, and FIG. 15(C) is a view taken in a direction of an arrow C-C.

In this example, a pair of the traversing rollers 11

for traversing is provided at each of the front and rear (longitudinal-direction both ends) of the pallet 10, similar to the third embodiment.

[0090]

5 In FIG. 15, the horizontal distance difference of the traversing rollers 11 at the front and rear of the vehicle, namely, the horizontal distance difference ΔL of the traversing rollers 11 up to the boundary portion B is set to be equal to or greater than the first threshold
10 value.

 In this example, unlike the third embodiment, the intervals L1 and L2 between the traversing rollers 11 at the front and rear of the pallet 10 may be the same.

 Hereinafter, in FIG. 15(A), it is assumed that the
15 lightweight side of a vehicle (not illustrated) is placed on the upper side of the pallet 10 in the drawing, and the heavyweight side of the vehicle is placed on the lower side of the pallet 10 in the drawing.

[0091]

20 In this example, the lightweight-side farthest roller 11A is located at the width-direction end on the opposite side to the storage shelf 12, and the heavyweight-side auxiliary roller 13 is set to have the same traverse direction distance up to the boundary portion B as that of
25 the farthest roller 11A by facing the farthest roller 11A.

 The other configuration is similar to the third embodiment.

[0092]

When the pallet 10 of FIG. 15 traverses from the cage 3 to the storage shelf 12, the heavyweight-side traversing roller 11 of the pallet 10 can smoothly first
5 pass the boundary portion B, and then the lightweight-side traversing roller 11 can smoothly pass the boundary portion B.

Moreover, when only one (i.e., the farthest roller 11A) of the traversing rollers 11 remains on the cage, it
10 is possible to prevent the cage 3 from jumping up because the auxiliary roller 13 also remains on the longitudinal-direction opposite side of the cage.

[0093]

A case where the pallet 10 of FIG. 15 traverses from
15 the storage shelf 12 to the cage 3 is also similar to the case of FIG. 14.

[0094]

As described above, according to the fourth embodiment of the present invention, the plurality of
20 traversing rollers 11 for traversing are provided at both ends of the pallet 10 in the longitudinal direction, and the traverse direction distances of the traversing rollers 11 up to the boundary portion B are different between the front and rear of the vehicle. The horizontal distance
25 difference ΔL between the traversing rollers 11 is equal to or greater than the first threshold value $K1$.

With this configuration, a time difference

corresponding to the horizontal distance difference ΔL between the traversing rollers 11 occurs when the front and rear of the vehicle cross the boundary portion B at the time of traversing of the pallet 10.

5 [0095]

Moreover, according to the embodiment of the present invention, the pallet 10 further includes the auxiliary roller 13 that is provided on the longitudinal-direction opposite side to the traversing roller 11 (the farthest roller 11A) finally remaining on the cage during traversing to the storage shelf 12.

With this configuration, when the pallet 10 traverses to the storage shelf 12 and only one of the traversing rollers 11 remains on the cage, it is possible to prevent the cage 3 from jumping up because the auxiliary roller 13 also remains on the longitudinal-direction opposite side of the cage.

[0096]

Next, when the auxiliary roller 13 and the traversing roller 11 (the farthest roller 11A) finally remaining on the cage simultaneously cross the boundary portion B, all the traversing rollers 11 on the auxiliary roller side are placed on the storage shelf 12. Therefore, by causing the finally remaining traversing roller 11 (the farthest roller 11A) to traverse in line with the pallet support height of the storage shelf 12, the auxiliary roller 13 can traverse without impact while floating above

the pallet support height of the storage shelf 12.

[0097]

Furthermore, according to the embodiment of the present invention, the lifting control device 18 implements the re-leveling R at the front and rear of the vehicle to correct the pallet support heights of the cage 3 by lifting and lowering the cage 3 during traversing.

As a result, because the pallet support points S at the front and rear of the pallet 10 cross the boundary portion B by the step Δh within the second threshold value K2, the pallet 10 can smoothly traverse with the four corners of the cage 3 suspended by the cord members 2 without being affected by the weight difference between the front and rear of the vehicle.

[0098]

The present invention is not limited to the above-described embodiments, and various modifications can be made without departing from the scope of the present invention.

[0099]

For example, in the above examples, the mechanical parking device 100 is an elevator type parking device, but the present invention is not limited to this. For example, as far as the cage 3 is suspended by the cord members 2 and the pallet on which a vehicle or luggage is placed traverses on the cage, the present embodiments can be also applied to other mechanical parking devices, automatic

warehouses, or the like.

Reference Signs List

[0100]

- 5 B: boundary portion, Δh : step (difference between pallet support heights),
K1: first threshold value, K2: second threshold value,
 ΔL : horizontal distance difference, R: re-leveling,
S: pallet support point, Δt : re-leveling time,
- 10 1: elevator type parking device, 2: cord member,
3: cage, 3a: on-cage rail, 4: lifting mechanism,
5: sheave drive device, 6: driven pulley,
7: drive sheave, 8: counterweight, 9: hoistway,
10: pallet, 11: traversing roller, 11A: farthest roller,
- 15 12: storage shelf, 12a: shelf rail, 13: auxiliary roller,
16: lifting drive device, 16a: electric motor,
16b: inverter, 16c: pulse generator,
18: lifting control device, 18a: storage device,
18b: arithmetic device, 20: positioning member,
- 20 22: position detector, 100: mechanical parking device
(elevator type parking device)

CLAIMS

1. A mechanical parking device comprising storage
shelves that are provided along a hoistway, a cage that is
suspended by cord members and moves up and down the
5 hoistway, and a lifting control device that controls
lifting of the cord members, the mechanical parking device
causing a pallet to traverse across a boundary portion
between the cage and the storage shelf, wherein

the pallet includes or the cage and the storage
10 shelf include a plurality of traversing rollers for
traversing that are provided at both ends in a longitudinal
direction thereof, traverse direction distances of the
traversing rollers up to the boundary portion are different
between front and rear of a vehicle, and a horizontal
15 distance difference thereof is equal to or greater than a
first threshold value, and

the lifting control device implements re-leveling at
the front and rear of the vehicle to correct pallet support
heights of the cage by lifting and lowering the cage during
20 traversing.

2. The mechanical parking device according to claim
1, wherein the lifting control device implements the re-
leveling so that a difference between pallet support
25 heights of the cage and the storage shelf falls within a
second threshold value when each of pallet support points
at the front and rear of the vehicle crosses the boundary

portion.

3. The mechanical parking device according to claim 1, further comprising:

5 a plurality of positioning members that are fixed at front and rear on a traverse side of the hoistway in accordance with pallet support heights of the storage shelves; and

10 a plurality of position detectors that are provided on the cage, each of the position detectors detecting the positioning member to detect the difference between the pallet support heights of the cage and the storage shelf, wherein

15 the lifting control device implements the re-leveling in a re-leveling time from a time when a pallet support point on one side of the front and rear of the vehicle crosses the boundary portion to a time when a pallet support point on another side crosses the boundary portion.

20 4. The mechanical parking device according to claim 1, wherein

the plurality of traversing rollers are provided at front and rear of the pallet,

25 pallet support points are at lower ends of the traversing rollers, and

each of the pallet support points crosses the

boundary portion when the corresponding traversing roller passes the boundary portion.

5 5. The mechanical parking device according to claim 1, wherein

the plurality of traversing rollers are provided at the longitudinal-direction both ends of the cage and the storage shelf,

10 pallet support points are at upper ends of the traversing rollers, and

the pallet support point crosses the boundary portion when the pallet support point is transferred between the cage and the storage shelf.

15 6. The mechanical parking device according to claim 1, wherein

the pallet includes the plurality of traversing rollers for traversing at longitudinal-direction both ends thereof,

20 traverse direction positions of the traversing rollers are different between the front and rear of the vehicle, and

the pallet further includes an auxiliary roller that is provided on a longitudinal-direction opposite side to
25 the traversing roller finally remaining on the cage during traversing to the storage shelf.

7. The mechanical parking device according to claim 6, wherein

the cage and the storage shelf respectively include an on-cage rail and a shelf rail that support the

5 traversing rollers when the traversing is performed, and

the auxiliary roller is located just above the on-cage rail or the shelf rail.

8. The mechanical parking device according to claim 10 6, wherein the auxiliary roller and the traversing roller finally remaining on the cage are respectively located at width-direction ends on an opposite side to the storage shelf on which the pallet traverses.

15 9. A control method of the mechanical parking device according to claim 1, the control method comprising:

implementing, by the lifting control device, the re-leveling during traversing so that a difference between pallet support heights of the cage and the storage shelf falls within a second threshold value when each of pallet support points at the front and rear of the vehicle crosses the boundary portion.

10. The control method of the mechanical parking device according to claim 9, further comprising:

controlling a traversing speed in a variable manner during the traversing to change a re-leveling time from a

time when the pallet support point on one side of the front and rear of the vehicle crosses the boundary portion to a time when the pallet support point on another side crosses the boundary portion.