

DESCRIPTION

HORIZONTAL CONVEYANCE MECHANISM OF SELF-PROPELLED CARRIAGE

Technical Field

[0001]

The present invention relates to a horizontal conveyance mechanism for causing a self-propelled carriage to travel in a horizontal attitude at all times in a conveyance system for causing a conveying body, which is composed of a container and a carriage, to travel along rails laid horizontally on a floor and a ceiling and along rails laid vertically on a wall in a plurality of stories of a building and the like and to unload and load a load such as documents, parts, and the like from and to the container to and from stations disposed along the rails.

Background Art

[0002]

This type of conveyance systems are widely used because they can automatically convey documents, mails, stationery, and the like in an office, medical records in a hospital, parts and products in a factory, and further a load such as a specimen, reagent, and the like to a target location.

[0003]

The conveyance system is composed of rails laid horizontally and vertically in a building, carriages as a plurality of conveyance bodies that travel on the rails, a computer for controlling travel of the self-propelled carriage, and the like. The self-propelled carriage is formed by

attaching a container, on which a load is mounted, to the carriage that travels along rails.

[0004]

A case, in which a lot of a specimen, reagent, and the like are contained and which must be conveyed in a horizontal attitude at all times, is mounted on the container. Accordingly, in many cases, a container is swingably supported by a carriage by a gyro means, and when the container travels in a vertical section, it is turned at 90° on the carriage so that it is maintained in a horizontal state at all times (refer to, for example, Patent Document 1).

[0005]

In contrast, the self-propelled carriage of the conveyance system may be provided with four sets of travel wheels each two travel wheels of which are arranged as one set and which are disposed in front of and behind a travel direction on right and left sides so as to be clamped by rails from above and below them or disposed to clamp the rails from above and below them. In the self-propelled carriage, since the carriage changes its travel attitude from a horizontal attitude to a vertical attitude (or from a vertical attitude to a horizontal attitude) in a section in which the rails shift from a horizontal section to a vertical section, that is, in the section in which the rails are bent 90° from horizontal to vertical or from vertical to horizontal, a container suspended from the carriage by a gyro means turns 90° so that the horizontal attitude of the container is maintained. However, it is known that when

a heavy load is located on one side in the container suspended by the gyro means, since the container is inclined by the unbalanced load, it is difficult to maintain the horizontal attitude.

[0006]

Further, since a turning space of the container and a turning travel space of the carriage are required because the gyro means is provided to maintain the attitude of the container horizontal at all times as well as the carriage travels by turning from horizontal rails to vertical rails, a radius of curve in the section between the horizontal section and vertical section in the rails cannot help being increased. As a result, a problem also arises in that not only an overall system is increased but also the conveyance system cannot be installed because of a reason that a radius of curve is excessively large depending on a location.

Patent Document 1: Japanese Patent Application Laid-Open No. 2005-047369

Disclosure of the Invention

Problems to be Solved by the Invention

[0007]

In view of the present status of the conveyance system, an object of the present invention is to provide a conveyance mechanism for keeping a horizontal attitude of a self-propelled carriage at all times which can maintain an attitude of a container horizontal at all times without a gyro means and which

can construct the overall system compact by reducing a curvature of a curve in a section in which the direction of rails is changed.

Means for Solving the Problems

[0008]

A first arrangement of a horizontal conveyance mechanism of the present invention made to solve the above problems is a horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, the horizontal conveyance mechanism being characterized in that the rails comprises rails for the pinions having racks meshed with the pinions and rails for the travel wheels which are disposed in parallel with the rails for the pinions and separated therefrom in a curved section in which a direction is changed from horizontal to vertical or from vertical to horizontal and in a vertical section continuing to the curved section, and the carriage comprises pinions meshed with the rails for the pinions and travel wheels supported by rails for travel wheels on the right and left sides thereof as well as the rails for the pinions and the rails for the travel wheels are disposed such that the carriage can move while keeping a horizontal attitude in a curved section and in a vertical section continuing to the section.

[0009]

In the present invention, the carriage comprises a first pinion and a first travel wheel on one side orthogonal to a travel direction of the carriage as well as comprises a second travel wheel at the positions of the same phase as that of the first pinion on the other side and a second pinion at the positions of the same phase as that of the first travel wheel, and the carriage is suppressed from inclining by the first and second pinions and the travel wheels whose phases of disposition are different on both the sides in the first arrangement.

[0010]

The present invention can employ a second arrangement in which the carriage coaxially comprises pinions at the positions of the same phase of intermediate portions on both the right and left sides as well as comprises front and rear travel wheels which are disposed on right and left sides in a travel direction of the carriage at positions where they clamp the pinions in front of and behind thereof and clamp rotating shafts of the pinions from above and below thereof and the upper and lower travel wheels of which constitute a pair, and the carriage is caused to travel while keeping a horizontal attitude by that any ones of the front and rear travel wheels and the pinions are supported by the respective rails in the curved section and the vertical section continuing the section.

[0011]

In the above two arrangements, the rails for the pinions and the rails for the travel wheels in the horizontal section

of the rails are formed of a composite rail in which both the rails are disposed in parallel, and the composite rail is disposed by being separated to front and rear from the curved section to the vertical section.

[0012]

Next, a third arrangement of the horizontal conveyance mechanism of the present invention capable of solving the above problems is a horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, the horizontal conveyance mechanism being characterized in that the carriage coaxially comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises front and rear horizontal portion travel wheels arranged as a pair for clamping the pinions in front of and behind them in a travel direction of the carriage and upper and lower vertical portion travel wheels arranged as a pair for clamping rotating shafts of the pinions above and below them, and rails comprise curved rails having racks meshed with pinions and travel surfaces of the horizontal portion travel wheels in a curved section for changing a direction from horizontal to vertical or from vertical to horizontal as well as comprises vertical rails having racks meshed with the pinions and travel surfaces of the vertical portion travel wheels in a vertical section continuing to the curved section, and the horizontal

portion travel wheels and the pinions are supported by the curved rails in the curved section, and the vertical portion travel wheels and the pinions are supported by the vertical rails in the vertical section continuing the curved section.
[0013]

Further, a forth arrangement of the horizontal conveyance mechanism of the present invention capable of solving the above problems is a horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, the horizontal conveyance mechanism being characterized in that the carriage coaxially comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises horizontal portion travel wheels disposed on a bottom of the carriage and upper and lower vertical portion travel wheels disposed such that they are arranged as a pair for clamping rotating shafts of the pinions above and below them, and rails comprise curved rails having curved racks meshed with the pinions and travel surfaces for restricting and guiding the vertical portion travel wheels in a curved section for changing a direction from horizontal to vertical or from vertical to horizontal as well as comprise short vertical rails having short racks meshed with the pinions and travel surfaces of the vertical portion travel wheels in a short vertical section continuing to the curved section, and the pinions are supported

by the curved racks in the curved section as well as the horizontal portion travel wheels are supported by the curved rails and the pinions and the vertical portion travel wheels are supported by the vertical rails having the short racks therein in the short vertical section continuing to the curved section so that the carriage travels in a horizontal attitude at all times.

Advantages of the Invention

[0014]

The horizontal conveyance mechanism of the first arrangement in the present invention is such that in the horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, the rails comprise rails for the pinions having racks meshed with the pinions and rails for the travel wheels which are disposed in parallel with the rails for the pinions and separated therefrom in a curved section in which a direction is changed from horizontal to vertical or from vertical to horizontal and in a vertical section continuing to the curved section, and the carriage comprises pinions meshed with the rails for the pinions and travel wheels supported by rails for travel wheels on the right and left sides thereof as well as the rails for the pinions and the rails for the travel wheels are disposed such that the carriage can move while keeping a horizontal attitude in the

vertical section. As a result, an attitude of a container can be maintained horizontal at all times without a gyro means, and moreover the overall system can be constructed compact by reducing a curvature of curve in a section in which the direction of rails is changed.

[0015]

More specifically, in the horizontal conveyance mechanism of the self-propelled carriage according to the first arrangement of the present invention, since the pinions rotate on their axes while meshed with the racks and the travel wheels roll on the rails for the travel wheels, the carriage travels along the rails. At the time, since the carriage has the pinions meshed with the rails for the pinions and the travel wheels supported by the rails for the travel wheels on the right and left sides thereof, the attitude of the container can be maintained horizontal at all times without a gyro means and thus a load can be conveyed horizontal at all times even if the load is located on one side. Then, since the rails comprises the rails for the pinions having the racks meshed with the pinions and rails for the travel wheels which are disposed in parallel with the rails for the pinions and separated therefrom in a curved section in which a direction is changed from horizontal to vertical or from vertical to horizontal and in a vertical section continuing to the curved section. As a result, the radius of curvature of the rails for the pinions can be set independently of that of the rails for the travel wheels, and thus the radius of curvature of the section between the

horizontal section and the vertical section in the rails can be reduced. That is, since a turning space of the container and a turning travel space of the carriage are not necessary, the overall conveyance mechanism can be constructed compact. [0016]

Further, in the horizontal conveyance mechanism of the second arrangement in the present invention, the carriage also comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises front and rear horizontal portion travel wheels which constitute a pair for clamping the pinions in front of and behind thereof and upper and lower vertical portion travel wheels which constitute a pair for clamping rotating shafts of the pinions above and below them, and rails comprise curved rails having racks meshed with the pinions and travel surfaces of horizontal portion travel wheels in a curved section for changing a direction from horizontal to vertical or from vertical to horizontal as well as comprise vertical rails having racks meshed with the pinions and travel surfaces of the vertical portion travel wheels in a vertical section continuing to the curved section, and the horizontal portion travel wheels and the pinions are supported by the curved racks in the curved section and the horizontal portion travel wheels and the pinions are supported by the vertical rails. As a result, an attitude of a container can be maintained horizontal at all times without a gyro means, and moreover the pinions and the travel wheels can travel on one rail, the overall system can be constructed compact because rails need not be laid

individually.

[0017]

In the horizontal conveyance mechanism of the third arrangement, the pinions also rotate on their axes while meshed with the racks and the travel wheels roll on the rails for the travel wheels, the carriage travels along the rails. At the time, the carriage coaxially comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises horizontal portion travel wheels arranged as a pair for clamping the pinions in front of and behind them in a travel direction of the carriage and vertical portion travel wheels arranged as a pair for clamping rotating shafts of the pinions above and below them and travels by the pinions and the vertical portion travel wheels in a curved section and a vertical section continuing to the section. As a result, a conveyance attitude of a container can be maintained horizontal at all times without a gyro means and thus a load can be conveyed in a horizontal attitude at all times even if the load is located on one side. For this purpose, the rails comprise the curved rails having the racks meshed with the pinions and travel surfaces of the horizontal travel wheels in the curved section for changing the direction from horizontal to vertical or from vertical to horizontal as well as comprise the vertical rails having racks meshed with the pinions and the travel surfaces of the vertical portion travel wheels in the vertical section continuing to the curved section, and the horizontal travel wheels and the pinions are supported by the curved rails in the

curved section and the vertical portion travel wheels and the pinions are supported by the vertical rails in the vertical section continuing to the curved section. The curved section and the vertical section continuing to the section can be composed of a single rail and thus the overall conveyance mechanism can be arranged compact.

[0018]

Further, in the horizontal conveyance mechanism of the forth arrangement of the present invention, the carriage coaxially comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises horizontal portion travel wheels disposed on a bottom of the carriage and upper and lower vertical portion travel wheels disposed such that they are arranged as a pair for clamping rotating shafts of the pinions above and below them, and rails comprise curved rails having curved racks meshed with the pinions and travel surfaces for restricting and guiding the vertical portion travel wheels in a curved section for changing a direction from horizontal to vertical or from vertical to horizontal as well as comprise short vertical rails having short racks meshed with the pinions and travel surfaces of the vertical portion travel wheels in a short vertical section continuing to the curved section, and the pinions are supported by the curved racks in the curved section as well as the horizontal portion travel wheels are supported by the curved rails and the pinions and the vertical portion travel wheels are supported by the vertical rails having the short racks

therein in the short vertical section continuing to the curved section so that the carriage travels in a horizontal attitude at all times. As a result, the overall conveyance system can be arranged compact particularly at positions where a travel direction changes from horizontal to vertical and vice versa likewise the conveyance mechanisms of the present invention having the above arrangements.

[0019]

In the fourth horizontal conveyance mechanism in present invention, the racks and the rails of the curved section are arranged as units so that the carriage can change the travel direction thereof from a horizontal travel to a vertical direction by the above arrangement. In addition to the above-mentioned, when the carriage is caused to travel vertically, the curved section arranged as the units can be evacuated to positions where the vertical travel of the carriage is not interfered with the curved section. As a result, the curved section of the fourth conveyance mechanism also has a function as a diverting apparatus for changing the horizontal travel to the vertical travel.

Best Mode for Carrying Out the Invention

[0020]

Examples of embodiments of a horizontal conveyance mechanism of a self-propelled carriage of the present invention will be explained below referring to drawings. In the accompanying drawings, Fig. 1 is a front elevational view showing an embodiment of a horizontal conveyance mechanism of

a self-propelled carriage according to a first arrangement of the present invention, Fig. 2 is a right elevational view of the horizontal conveyance mechanism shown in Fig. 1, Fig. 3 is a plan view of Fig. 2, Fig. 4 is a perspective view of the horizontal conveyance mechanism of the first arrangement shown in Figs. 1 to 3, Fig. 5 is a front elevational view showing an embodiment of a horizontal conveyance mechanism of a self-propelled carriage according to a second arrangement of the present invention, Fig. 6 is a right elevational view of the horizontal conveyance mechanism shown in Fig. 5, Fig. 7 is a plan view of Fig. 6, Fig. 8 is a perspective view of the horizontal conveyance mechanism shown in Fig. 5 to Fig. 7, Fig. 9 is a front elevational view showing an embodiment of a horizontal conveyance mechanism of a self-propelled carriage according to a third arrangement of the present invention, Fig. 10 is a right elevational view of the horizontal conveyance mechanism shown in Fig. 9, Fig. 11 is a plan view of Fig. 9, Fig. 12 is a perspective view of the horizontal conveyance mechanism of the third arrangement shown in Figs. 9 to 11, Fig. 13 is a side elevational view explaining a moving state of a carriage in a horizontal section in a horizontal conveyance mechanism according to a forth arrangement of the present invention, Fig. 14 is a side elevational view explaining a moving state of the carriage in a curved section in the horizontal conveyance mechanism of the forth arrangement, Fig. 15 is a side elevational view explaining a moving state in a vertical section in the carriage of the horizontal conveyance

mechanism of the forth arrangement, Fig. 16 is a perspective view showing attitudes of the carriage and respective rails in an example in which the carriage travels from the horizontal section to the vertical section, Fig. 17 is a schematic side elevational view of Fig. 16, Fig. 18 is a perspective view showing attitudes of the carriage and the respective rails in an example in which the carriage travels in a horizontal attitude in the vertical section, Fig. 19 a schematic side elevational view of Fig. 18, Fig. 20 is a side elevational view of an example of a carriage used in an applied example of the horizontal conveyance mechanism of the present invention of the forth arrangement, Fig. 21 is a plan view of the carriage of Fig. 20, Fig. 22 is a left side elevational view of the carriage of Fig. 20, Fig. 23 is a schematic perspective view of the carriage shown in Figs. 20 to 22, Fig. 24 is a perspective view schematically showing a mode of direction change rails (left rails) along which the carriage of Figs. 20 to 23 travels, Fig. 25 is a front elevational view of right and left direction change rail portions in a state that the carriage of Fig. 22 enters the rail portions, and Figs. 26(a) to 26(f) are side sectional views time-sequentially showing a state that the carriage passes through the direction change rail portions.

[0021]

In Figs. 1 to 4, a horizontal conveyance mechanism of the present invention according to a first arrangement has a pair of right and left rails 10 laid horizontally and vertically in a building in parallel with respect to a traveling direction

of a carriage 30 and the carriage 30 traveling on the rails 10.

[0022]

As shown in Fig. 2, the respective rails 10 have horizontal rails laid on a floor and the like for forming a horizontal section, curved rails for forming a curved section in which a direction is changed from a horizontal direction to a vertical direction or from a vertical direction to a horizontal direction, and vertical rails laid on a wall, a column, and the like for forming a vertical section continuous to the curved section. The curved section and the vertical section of the respective rails 10 are composed of rails 11 for pinions and rails 12 for travel wheels which are separated from the rails 11 for the pinions in a front and rear direction although they are in parallel with the rails 11 for the pinions. Then, the horizontal section is composed of a unitary composite rail 14 in which both the rails 11, 12 are laid in parallel.

[0023]

As exemplified in Figs. 3 and 4, each of the rails 11 for the pinions is composed of a C-shaped or channel-shaped cross-sectional member composed of front and rear walls 11a, 11b and a side wall 11c. Each of the rails 12 for the travel wheels is also composed of a C-shaped or channel-shaped cross-sectional member composed of front and rear walls 12a, 12b and a side wall 12c. These rails 11, 12 are integrated by a connection wall 13. The connection wall 13 is formed by extending the side wall 12c of the rail 12 for the travel wheel, and an extending end thereof is connected to an open end edge

of the front wall 11a of the rail 11.

[0024]

The composite rail 14 of the horizontal section has a C-shaped or channel-shaped cross-section composed of upper and lower walls 14a, 14b and a side wall 14c with open surfaces of the composite rail 14 in confrontation with each other right and left. The composite rail 14 is connected to the rails 11 for the pinions and the rails 12 for the travel wheels, which are separated before and after the vertical section is formed, through the curved section.

[0025]

The curved section will be explained in detail. In the rails 10 positioned on a right side of Fig. 1 and on proximal sides of Figs. 2 and 3, the front walls 11a of the rails 11 for the pinions of the vertical section extend to the upper walls 14a of the composite rail 14 as well as are connected thereto. As shown in Fig. 2, the rear walls 11b of the rails 11 for the pinions extend to the lower walls 14b of the composite rail 14 through curved walls 15 as well as are integrated with the side walls 14c. The front walls 12a of the rails 12 for the travel wheels are cut off in the upper walls 14a of the composite rail 14, the rear walls 12b thereof extend to the lower walls 14b of the composite rail 14 as well as are connected thereto, and the side wall 12c thereof is connected to the lower walls 14b of the composite rail 14 together with the connection wall 13.

[0026]

Further, in the rails 10 positioned on a left side of Fig.

1 and on an inner side of Figs. 2 and 3, the front walls 11a of the rails 11 for the pinions extend to the upper walls 14a of the composite rail 14 as well as are connected thereto, the rear walls 11b thereof are connected to the lower walls 14b of the composite rail 14 through the curved walls, and the side walls 11c thereof extend to the lower walls 14b of the composite rail 14 as well as are integrated with the side walls 14c. The front walls 12a of the rails 12 for the travel wheels are connected to the upper walls 14a of the composite rail 14, the rear walls 12b thereof are connected to the lower walls 14b of the composite rail 14, and the side walls 12c thereof extend to the upper walls 14a of the composite rail 14 together with the connection wall 13 as well as are connected thereto.

[0027]

Racks 20 (also called rack gears, which are the same in the following description) are disposed to the rear walls 11b of the rails 11 for the pinions, to the curved walls 15, and to the lower walls 14b of the composite rail 14 as well as fixed thereto.

[0028]

The carriage 30 has a travel wheel 31 and a pinion 33 (also called a pinion gear, which is the same in the following description) as a drive wheel disposed to one side (right side) of a carriage body 35 and has a travel wheel 32 and a pinion 34 disposed to the opposite side (left side) of the carriage body 35. The respective travel wheels 31, 32 have shafts held by bearings mounted on the carriage body 35. The pinion 33 is

disposed on the left side of the carriage body 35 where the travel wheel 32 is disposed coaxially with the travel wheel 31, and the pinion 34 is disposed on the right side of the carriage body 35 where the travel wheel 31 is disposed coaxially with the travel wheel 31. The pinions 33, 34 has respective shafts coupled with a drive unit (illustration is omitted) disposed in the carriage body 35 and composed of a motor, a reducer, and the like.

[0029]

When the carriage 30 travels from the vertical section to the horizontal section as an example, it is disposed between the respective rails 10 by positioning peripheral surfaces of the travel wheels 31, 32 between the front and rear walls 12a, 12b of the respective rails 12 for the travel wheels and meshing the pinions 33, 34 with the racks 20 laid on the respective rails 11 for the pinions. The carriage 30 travels along the racks 20 by that the pinions 33, 34 are rotated on their axes in mesh with the racks 20 by the drive unit. That is, the pinions 33, 34 rotate on their axes while meshed with the racks 20 in the vertical section and the curved section of the rails 10 and travel in the rails 11 for the pinions and rotate on their axes while meshed with the racks 20 in the horizontal section and travel in the composite rail 14. At the same time, the travel wheels 31, 32 roll along the front and rear walls 12a, 12b that constitute the rails 12 for the travel wheels in the vertical section and the curved section and roll along the upper and lower walls 14a, 14b of the composite rail 14 in the horizontal section.

Accordingly, since the carriage 30 is supported by the pinions 33, 34 meshed with the racks 20 and by that the travel wheels 32, 33 are supported by the rails 12 for the travel wheels, it moves in parallel while keeping a horizontal attitude and moves from the vertical section to the vertical section passing through the curved section. When the carriage 30 enters the vertical section from the horizontal section passing through the curved section, it moves while keeping a horizontal attitude likewise the above mentioned.

[0030]

Power is supplied to the drive unit by a wiring disposed along the rails 10, a travel control is executed by a communication between a computer apparatus installed externally of the horizontal conveyance mechanism and a controller disposed in the carriage 30, and a signal is transmitted and received between the external computer apparatus and the controller through a communication line that travels in parallel with the wiring.

[0031]

In the embodiment, a container is composed of a container with a lid as an example and installed on an upper surface of the carriage body 35 or assembled in the carriage body 35. Several stations are installed along the composite rail 14.

[0032]

When operation starts, a case in which loads, for example, a specimen and reagent are contained is placed in the container by a worker. When the worker designates a conveyance station

to the external computer apparatus through a terminal, the controller of the carriage 30 operates the drive unit in response to a command from the external computer apparatus, and the drive unit causes the carriage 30 to travel to the target conveyance station so that the loads are conveyed to the target station.

[0033]

At the time, the carriage 30 is caused to travel in the vertical section from the horizontal section of the rails 10 passing through the curved section while with the pinions 33, 34 disposed to the right and left sides of the carriage 30 meshed with the racks 20 so that the carriage 30 moves in parallel. At the same time, the carriage 30 is suppressed from inclining in a traveling direction and in a direction orthogonal to the traveling direction by disposing the pinions 33, 34 in front of and behind the carriage 30 so that the carriage 30 travels keeping a horizontal attitude. Since the horizontal attitude is supported by the travel wheels 31, 32 so that the carriage 30 is caused to move in parallel without inclination. That is, since the carriage 30 can be caused to travel in the horizontal attitude at all times, a gyro means for maintaining the container horizontal is not necessary. Accordingly, even loads to which a horizontal attitude is required at all times can be conveyed without any problem.

[0034]

Since the rails 11 for the pinions, in which the racks 20 meshed with the pinions 33, 34 are laid, and the rails 12

for the travel wheels, on which the travel wheels 31, 32 roll, are separated from each other not only in the vertical section of the rails 10 but also even in front of and behind the curved section, which is a boundary between the horizontal section and the vertical section, the respective rails 11, 12 can be set to a different radius of curvature. With this arrangement, since the radii of curvature of the rails 11, 12 in the curved section can be reduced, an overall conveyance system having the horizontal conveyance mechanism can be constructed compact.

[0035]

In the embodiment of the horizontal conveyance mechanism according to the first arrangement of the present invention described above, the carriage 30 has the first pinion 33 and the first travel wheel 31 on the one side orthogonal to the traveling direction thereof, has the second the travel wheel 32 in the same phase (coaxially with) the first pinion 33 on the opposite side and the second pinion 34 in the same phase (coaxially with) the first travel wheel 31, and has the first and second pinions 33, 34 and the first and second travel wheels 31, 32 whose disposition phase is different on both the sides. Accordingly, when the traveling direction of the carriage 30 is changed from the horizontal attitude to the vertical direction, the carriage 30 is controlled so that it does not incline. Since the horizontal conveyance mechanism of the self-propelled carriage according to the present invention can be also realized by an embodiment of a second arrangement of a conveyance mechanism of the present invention shown in Figs.

5 to 8, the embodiment will be explained next.

[0036]

In the horizontal conveyance mechanism of the present invention of the second arrangement exemplified in Figs. 5 to 8, a carriage 130 coaxially has pinions 133, 134 in the same phase (same position) of intermediate portions of both the right and left sides thereof. A pair of first upper and lower travel wheels 131a, 131b, similar travel wheels 132a, 132b, second travel wheels 136a, 136b, and similar travel wheels 137a, 137b are disposed so that they are positioned to a front side and a rear side with respect to a traveling direction of the pinions 133, 134 as well as above and below with respect to rotating shafts of the pinions 133, 134. In a curved section and a vertical section, any one pair of the pairs of the upper and lower travel wheels and pinions of any of the front side and the rear side are supported by rails 111 and 112. Accordingly, the carriage 130 can travel while keeping its horizontal attitude even in the curved section and the vertical section.

[0037]

That is, in the carriage 130, the pinion 133 and a pair of the travel wheels 131a, 131b and the second travel wheels 136a, 136b, which clamp the pinion 133 from the front and rear sides thereof, are disposed to a central portion (central portion on a right side) of one side of a carriage body 135. In the carriage body 135, the pinion 134, which is positioned coaxially with the pinion 133, and a pair of the travel wheel 132a, 132b and a pair of the travel wheels 137a, 137b, which

clamp the pinion 134 therebetween from the front and rear sides and are positioned coaxially with the travel wheels 131a, 131b and the second travel wheels 136a, 136b on the right side, are also disposed to a central portion (central portion on a left side) of an opposite side of the carriage body 135. Shafts of the pinions 133, 134 on the right and left sides are coupled with a drive unit composed of a motor, a reducer, and the like the shafts of which are disposed in the carriage body 135.

[0038]

A pair of right and left rails 110 is disposed in parallel with each other. The right and left rails 110 disposed in the vertical section are composed of the rails 111 for the pinions and the rails 112 for the travel wheels laid along a wall and a column. As shown in Figs. 7 and 8, each of the rails 111 for the pinions of the vertical section is composed of an approximately L-shaped cross-sectional member, and each of the rails 112 for the travel wheels is composed on a C-shaped or channel-shaped cross-sectional member. In each ones of both the rails 111, 112, rear walls 111b of the rails 111, which form open surfaces, and front walls 112a of the rails 112 are formed integrally with each other. The rails 111, 112 disposed on right and left sides are disposed in parallel with each other with the open surfaces thereof in confrontation with each other. Each ones of the right and left rails 110 of the horizontal section are composed of rails 114 each having an approximately C-shaped or channel-shaped cross-section, and the rails 110 are disposed with the open surfaces thereof in confrontation with

each other.

[0039]

The rear walls 111b (the front walls 112a of the rails 112 for the travel wheels) of the rails 111 for the pinions of the vertical section are connected to lower walls 114b of the rails 114 of the horizontal section through curved walls 115 that form the curved section. Side walls 111c of the vertical section extend to upper walls 114a of the rails 114 of the horizontal section and are integrated with side walls 114c of the rails 114b. The front walls 112a of the rails 112 for the travel wheels of the vertical section extend to the upper walls 114a of the rails 114 of the horizontal section, and passing-through holes 117 are formed in the rails 114. Rear walls 112b of the vertical section extend to the lower walls 114b of the rails 114 of the horizontal section and are connected thereto. Then, side walls 112c of the vertical section extend to the lower walls 114b of the rails 114 of the horizontal section.

[0040]

Openings 116a, which have a width of each of the rails 111 for the pinions of the vertical section, more specifically, a width corresponding to the total of each of the rear walls 111b of the rails 111 for the pinions and each of the front walls 112a of the rails 112 for the travel wheels of the vertical section, are formed to the upper walls 114a of the rails 114 of the horizontal section. Guide walls 118 stand around the openings 116a. Side walls of the guide walls 118 are integrated

with the side walls 111c of the rails 111 for the pinions of the vertical section.

[0041]

Right and left racks 120 for guiding the right and left pinions 133, 134 are laid to front surfaces of the rear wall 111b of the rails 111 for the pinions of the vertical section, to inner surfaces of the curved walls 115 whose inner sides form the curved section, and to upper surfaces of the lower walls 114b of the rails 114 that form the horizontal section.

[0042]

The carriage 130 is mounted on the rails 110 of the vertical section by positioning outer peripheral surfaces of the travel wheels 136a, 136b and the travel wheels 137a, 137b between the front walls 112a and the rear walls 112b of the rails 112 for the travel wheels of the vertical section and meshing the pinions 133, 134 with the racks 120 laid to the lower walls 114b of the rails 114 in the vicinity of a boundary between the horizontal section and the curved section. Here, the carriage 130 is mounted on the rails 110 of the horizontal section by guiding the pair of upper and lower travel wheels 131a to 137b on the right and left sides of the carriage body to the inner surfaces of the upper walls 114a and the lower walls 114b of the rails 114 and meshing the right and left pinions 133, 134 with the right and left racks 120 formed on inner surfaces of the lower walls of the rails 114 so as to be supported thereby. Note that, although not shown, it is assumed that power is supplied to the motor of the drive unit by, as an example, a

wiring disposed along the rails 110, a travel control is executed by, as an example, a communication between a computer apparatus installed externally of the rails 110 and a controller disposed in the carriage 130, and a signal is transmitted and received between the external computer apparatus and the controller through a communication line that travels in parallel with the wiring along the rails 110.

[0043]

The carriage 130 travels in, for example, the horizontal section and the curved section of the rails 110 and then travels in the vertical section by that the not shown drive unit rotates on its axes while meshing the pinions 133, 134 with the racks 120. Here, since the distance between the upper walls 114a and the lower walls 114b of the rails 114 of the horizontal section is approximately the same as the distance between an upper edge of the travel wheel 131a and a lower edge of the travel wheel 131b of the carriage 130, that is, the heights between the respective travel wheels 131a and 131b, 136a and 136b, 132a and 132b, and 137a and 137b, the travel wheels 131a and 131b, 136a and 136b, 132a and 132b, 137a and 137b roll along the upper and lower walls 114a, 114b of the rails 114, and the carriage 130 moves horizontally. After the carriage 130 travels in the horizontal attitude as described above, the right and left travel wheels 136a and 136b and the right and left travel wheels 137a, 137b start to travel along the front and rear walls 112a, 112b that constitute the rails for the travel wheels (composite rail portions) 112 of the vertical section as well as the travel

wheels 131a and 131b, 132a and 132b pass through the opening 116 in a mode that they are guided by the guide walls 118 and move outside of the single rails 114. With this operation, the carriage 130 moves from the horizontal section in which it is in the horizontal attitude to the vertical section while keeping the horizontal attitude and travels in the vertical section in the horizontal attitude (refer to Figs. 6 and 8).

[0044]

The horizontal conveyance mechanism of the present invention of the second arrangement shown in Figs. 5 to 8 also has a not shown container with a lid as an example of a container, and an installation mode is such that the container is installed on an upper surface of the carriage body 35 or assembled in the carriage body 35. For example, a load composed of a case in which a specimen and reagent are placed is accommodated in the container, the motor of the drive unit is operated by indicating a conveyance station through the terminal electrically connected to the external computer, and the carriage 130 is caused to travel to the target conveyance station and stops thereat.

[0045]

As described above, in the horizontal conveyance mechanism of the embodiment according to the second arrangement of the present invention, the pinions 133, 134 are disposed to the right and left sides of the carriage 130, and the carriage 130 is caused to travel along the racks 120 by the pinions. At the same time, the carriage 130 is prevented from inclining by

the pinions 133, 134 and the racks 120, and the pairs of the upper and lower travel wheels 131a and 131b, 132a and 132b, 136a and 136b, and 137a and 137b disposed to the right and left sides of the carriage 30. Thus, even if the carriage 30 inclines, it can move in parallel within an allowable range of inclination. Accordingly, the container installed in the carriage 30 can be caused to travel in the horizontal attitude not only in the horizontal section but also in the curved section and the vertical section. With this arrangement, since a gyro means becomes unnecessary, a type and an amount of the load can be increased.

[0046]

Further, in the horizontal section, the rails for the pinions, on which the right and left racks 120, which are formed to the rails 114 and with which the right and left pinions 133, 134 of the carriage 30 are meshed, are laid, and the rails for the travel wheels, on which the pairs of the upper and lower travel wheels 131a and 131b, 132a and 132b, 136a and 136b, and 137 and 137b roll, are arranged such that the rails from the curved section to the vertical section are formed by being separated to the rails 111 for the pinions and the rails 112 for the travel wheels in the portion that forms from the curved section to the vertical section. As a result, the respective rails 111, 112 can be set to a different radius of curvature. Accordingly, an overall conveyance system can be constructed compact by reducing the radii of curvature of the rails 111 for the pinions and the racks 120.

[0047]

Next, a horizontal conveyance mechanism of a self-propelled carriage according to a third arrangement of the present invention can be realized by an embodiment shown in Figs. 9 to 12. The embodiment of the horizontal conveyance mechanism according to the third arrangement will be explained below referring to Figs. 9 to 12.

[0048]

In the horizontal conveyance mechanism according to the third arrangement of the present invention shown in Figs. 9 to 12, a carriage 230 coaxially has pinions 233, 234 in the same intermediate phase of both the right and left sides thereof. Then, the carriage 230 has horizontal portion travel wheels 231a, 231b, 232a, 232b on a front side and a rear side with respect to a travel direction of the pinions 233, 234 as well as has vertical portion travel wheels 236a, 236b, 237a, 237b on an upper side and a lower side of the pinions 233, 234. In a vertical section, the carriage 230 can travel from a horizontal section while keeping its horizontal attitude by that a pair of the upper and lower vertical portion travel wheels 236a, 236b, a pair of the upper and lower vertical portion travel wheels 237a, 237b, and the pinions 233, 234 are supported by rails 211.

[0049]

That is, in the carriage 230, the pinion 233 is disposed to a central portion (a central portion on a right side) of one side of the carriage body 235, a pair of the horizontal portion travel wheels 231a, 231b are disposed in a front and rear

direction across the pinion 233, and a pair of vertical portion travel wheels 236a, 236b are disposed in an up and down direction across the pinion 233. Then, the pinion 234 is disposed coaxially with the pinion 233 to a central portion (a central portion on a left side) of the opposite side of the carriage body 235, and the horizontal portion travel wheels 232a, 232b and the vertical portion travel wheels 237a, 237b are disposed clamping the pinion 234 therebetween from front and rear sides and from upper and lower sides. Although all the travel wheels are formed in the same diameter, the diameter is smaller than that of the pinions 233, 234.

[0050]

In Figs. 9 to 12, a pair of right and left rails 210 of the horizontal section is disposed in parallel with each other. In the vertical section, the vertical rails 211 are laid along a wall and a column, and the pinions 233, 234 and the vertical portion travel wheels 236a, 236b, 237a, 237b of the carriage 230 travel thereon. As shown in Figs. 11 and 12, each of the vertical rails 211 is composed of a C-shaped cross-sectional member, insides of front and rear walls 211a and 211b act as rack travel paths of the respective travel wheels, and outsides thereof near to connection walls 211c act as rack travel paths on which the pinions 233, 234 travel. The respective rails that form the horizontal section are composed of horizontal rails 214 which are parallel on right and left sides. In the horizontal rails 214, rails for the pinions having a cross section in which an upper wall 214a, a lower wall 214b, and a

connection wall 214c are jointed to each other at right angles have the same cross section as the vertical rails 211 as well as a travel wheel guide wall 219a formed in an inverse L-shaped cross section is formed integrally with the upper wall 214a and an L-shaped cross sectional travel wheel guide wall 219b is formed integrally with the lower wall 214b.

[0051]

The rear walls 211b of the vertical rails 211 are connected to the lower walls 214b of the horizontal rails 214 through curved walls 215 that form a curved section and integrated therewith. Tunnels 217, through which the travel wheels 231b, 232b of the carriage 230 travel, are formed to the rear walls 211b that are formed in curved surfaces for forming the curved section. The tunnels 217 are composed of vertical openings, which have a width obtained by extending the front and rear walls 211a, 211b of the vertical rails 211, and horizontal openings which have a width obtained by extending the horizontal rails 214. Further, although the front walls 211a are formed so that they are connected to the upper walls 214a of the vertical rails, a part of the curved section is cut off and formed as openings 216 through which the travel wheels 236a, 237a of the carriage 130 travel. Then, the side walls 211c extend to the side walls 214c of the horizontal rails 214 and are integrated therewith.

[0052]

In the vertical rails 211 of Figs. 9 to 12, the rail portion for the travel wheels and the rail portion for the pinions of a mode, in which they are clamped by the front and rear walls

211a, 211b, have a different width. That is, portions, which are positioned near to the connection walls 211c and to which travel paths of the travel wheels 236a, 236b and the travel wheels 237a, 237b are formed, are formed to a width near to the diameter of these travel wheels, and portions which act as travel paths of the pinions 233, 234 are formed to a width larger than the diameter of these pinions. Racks 220 for the pinions are laid to the rear walls 211b of the vertical rails 211 that form the vertical section, to the curved walls 215 that form the curved section, and to the lower walls 214b of the horizontal rails 214 that form the horizontal section. Guide members 243, which have curved surfaces for supporting the horizontal portion travel wheels 231b, 232b in the curved section, are disposed on back surfaces of the rear wall 21b.

[0053]

In Figs. 9 to 12, the carriage 230 is mounted on the rails 210 by disposing the peripheral surfaces of the horizontal portion travel wheels 231a, 231b, 232a, 232b between the upper and lower walls 214a, 214b of the horizontal rails 214, disposing the vertical portion travel wheels 236a, 237a on outer surfaces of the upper walls 214a, and disposing the vertical portion travel wheels 236b, 237b on outer surfaces of the lower walls 214b, respectively as well as meshing the pinions 233, 234 with the racks 220 of the horizontal rails 214. Note that, although not shown, shafts of the pinions 233, 234 are coupled with a drive unit composed of a motor, a reducer, and the like the shafts of which are disposed in the carriage body 235. It

is assumed that power is supplied to the motor of the drive unit by, as an example, a wiring disposed along the rails 210, a travel control is executed by, as an example, a communication between a computer apparatus installed externally of the rails 210 and a controller disposed in the carriage 230, and a signal is transmitted and received between the external computer apparatus and the controller through a communication line that travels along the rails 210 in parallel with the wiring.

[0054]

In the horizontal conveyance mechanism of the present invention according to the third arrangement shown in Figs. 9 to 12, the carriage 230 travels in the horizontal section by that the drive unit causes the pinions 233, 234 meshed with the racks 220 to rotate on their axes and subsequently travels in the curved section and the vertical section of the rails 210.

[0055]

When the carriage 230 travels in the horizontal section, it is caused to travel along the horizontal rails 214 in a horizontal attitude by the horizontal portion travel wheels 231a, 231b, 232a, 232b and the pinions 233, 234. At the time, the vertical portion travel wheels 236a, 236b, 237a, 237b roll on outer surfaces of the upper and lower walls 214a, 214b of the horizontal rails 214 and support the horizontal attitude of the carriage 230.

[0056]

As shown in Fig. 10, when the carriage 230 enters the curved section, the pinions 233, 234 roll while meshed with the

racks 220, the vertical portion travel wheels 236a, 237a are guided between the front and rear walls 211a, 211b by curved surfaces of lower edges of the front walls 211a of the vertical rails 211, the vertical portion travel wheels 236b, 237b pass through the tunnels 217 and travel toward between the front and rear walls 211a, 211b, and the horizontal portion travel wheels 231a, 232a are guided upward by slant surfaces at the edge portions of the upper walls 214a of the horizontal rails 214. At the time, the travel wheels 231a roll in contact with the upper walls 214a of the horizontal rails 214 and the travel wheels 231b roll in contact with the guide members 243 on back surfaces of the vertical rails 211 to thereby cause the carriage 230 to move upward while keeping its horizontal attitude.

[0057]

When the carriage 230 is further moved upward by the rotation of the pinions 233, 234, the vertical portion travel wheels 236a, 236b, 237a, 237b move along travel surfaces formed to the front and rear walls 211a, 211b, and the horizontal portion travel wheels 231a, 232a move upward passing through the openings 216, and the travel wheels 231b, 232b move upward exiting from the guide members 243. Since the vertical portion travel wheels 236a, 236b, 237a, 237b roll between the front and rear walls 211a, 211b of the vertical rails 211 clamping the pinions 233, 234, the carriage 230 moves upward in the vertical section while keeping its horizontal attitude.

[0058]

A container is installed on an upper surface of the

carriage 230 or assembled in the carriage body 235 of the carriage 230 also in the horizontal conveyance mechanism of the present invention according to the third arrangement described referring to Figs. 9 to 12. A load composed of a case in which, for example, a specimen and reagent are contained, is accommodated in the container. When a terminal electrically connected to the external computer indicate a conveyance station, a motor of the drive unit is operated, and the carriage 230 travels to the target conveyance station and stops thereat.

[0059]

As described above, in the horizontal conveyance mechanism of the embodiment according to the third arrangement of the present invention, the pinions 233, 234 are disposed to the right and left sides of the carriage 230, and the carriage 230 is caused to travel along the racks 220 by the pinions. The horizontal attitude of the carriage 230 is held by the pinions 233, 234 and a pair of the racks 220 with which these pinions are meshed, the horizontal portion travel wheels 231a, 231b and 232a, 232b and the horizontal rails 214 for supporting them, the vertical portion travel wheels 236a, 236b, and 237a, 237b and the vertical rails 211 for supporting them, and the rails 210 of the curved section having the racks and the rails continuous to the racks 220 and the rails 214, 211. Accordingly, the carriage 230 moves in parallel with almost no inclination so that the container assembled in the carriage 230 can be caused to travel while keeping its horizontal attitude not only in the horizontal section but also even between the curved section and

the vertical section. As a result, since the carriage 230 can travel while keeping its horizontal attitude in any of the horizontal section, the curved section, and the vertical section, a gyro mechanism is not necessary, and thus a load capacity of the container can be increased.

[0060]

Moreover, since the rails, which constitute the curved section and the vertical section continuing thereto are composed of a unitary rail, that is, since the rails for the pinions and the rails for the travel wheels are integrally formed as a composite rail, the respective rails need not be individually laid. Accordingly, spaces occupied by the respective rails can be reduced. In particular, since a curvature of curve in the curved section can be reduced, an overall conveyance system can be constructed compact.

[0061]

Further, since the cross section of the horizontal rails 214 can be formed to the same cross section as that of the vertical rails 211 omitting the travel wheel guide walls 219a, 219b thereof depending on a type of a load, an installation cost and an occupied space can be more reduced.

[0062]

There is a conveyance mechanism of the present invention according to a forth arrangement which can cause a carriage to travel from a horizontal section to a vertical section through a curved section with its attitude maintained horizontal in addition to the embodiments of the conveyance mechanisms

according to the first to third arrangements of the present invention described above. Thus, the embodiment of the horizontal conveyance mechanism according to the forth arrangement will be explained referring to Figs. 13 to 19.

[0063]

A carriage 330, which is used in the horizontal conveyance mechanism according to the forth arrangement of the present invention shown in Figs. 13 to 19, has, as an example, four pieces of horizontal travel wheels 331a, 331b for traveling in the horizontal section each two pieces of which constitute a pair, and these travel wheels are disposed in front and rear portions on a bottom of the carriage body 335. Traveling drive force is input to the horizontal travel wheel 331a or 331b. Further, right and left drive pinions 333 for the vertical section (a pinion disposed on an opposite side of the drawing is not viewed) and two upper and lower travel wheels 336a, 336b for the vertical section (a travel wheel disposed on an opposite side of the drawing is not viewed), which are positioned in such a mode that they are located above and below the pinions 333 so as to clamp them from above and below them, are disposed to approximately intermediate positions of right and left sides of the carriage 330. Note that the pinions 333 may be disposed by being replaced with ones of the travel wheels 336a, 336b for the vertical section and preferably with the travel wheels 336b on a lower side.

[0064]

In contrast, rails of the horizontal conveyance mechanism

according to the forth arrangement are laid in such a mode that horizontal rails 310, on which the travel wheels 331a, 331b roll, intersect vertical rails 311. Then, the horizontal rails 310 are formed of stationary horizontal rail portions 310a and rise and fall rail portions 310b which are pivotally connected and coupled with extreme ends of the rail portions 310a so that they are free to be made horizontal or upright by drive force of a not shown cylinder, motor, and the like.

In contrast, the vertical rails 311 are formed of stationary vertical rail portions 311a, 311b, which are disposed in a direction orthogonal to the stationary horizontal rail portions 310a and cut-off rail portions 311c whose portions having approximately the same length as that of the rise and fall rail portions 310b are cut off and separated above positions on extending lines of the rise and fall rail portions 310b.

The cut-off rail portions 311c are provided with such a function that they are operated by drive force of a cylinder and the like so as to separate from and join to the rail portions 311a, 311b in a direction orthogonal to the vertical rail portions 311a, 311b. The vertical rails 311 have racks 311d on inner surfaces for guiding the stationary vertical rail portions 311a, 311b and the cut-off rail portions 311c by meshing the pinions 333 therewith.

[0065]

In the horizontal conveyance mechanism of the present invention according to the forth arrangement, when the cut-off

rail portions 311c are separated from the stationary vertical rail portions 311a, 311b, they are shifted between the upper and lower stationary vertical rail portions 311a and 311b, and direction change rail portions 312 are disposed as curved rails so as to operate in a horizontal direction in synchronization with the cut-off rail portions 311c to change direction of the carriage 330, which traveled on the horizontal rails 310, to the upper stationary vertical rail portions 311a, in addition to the respective vertical and horizontal rails 310, 311.

[0066]

The direction change rail portions 312 as the curved rails are formed to have vertical portions 312a and three curved portions 312b, 312c and 312d. The vertical portions 312a have upper end portions connected to lower ends of the upper stationary vertical rail portions 311a, and the curved portions 312b, 312c, 312d have three routes disposed side by side in an up and down direction below the vertical portions 312a. The vertical portions 312a have rack 312e joined to the racks 311d.

Here, in the three curved portions 312b, 312c, 312d, the two upper and lower curved portions 312b and 312d are formed as curved rails for guiding the upper and lower travel wheel 336a, 336b which clamp the pinions 333 in the carriage 330 positioned on the horizontal rails 310, and the intermediate curved portion 312c is formed as curved rails having racks 312f for guiding the pinions 333.

[0067]

The curved portions 312c formed to the direction change

rail portions 312 as the curved rails for guiding the pinions 333 are provided with the racks 312f formed on lower surfaces inside thereof so as to be meshed with the pinions 333. When the pinions 333 are disposed in such a mode that they are replaced with the travel wheels 336b for the vertical section, the racks 312f meshed with the pinions 333 are disposed on lower surfaces inside of the lower curved portions 312d.

[0068]

In the conveyance mechanism of the forth arrangement of the present invention having the carriage 330 and the horizontal and vertical rails 310, 311 arranged as described above, when the carriage 330, which is caused to travel on the horizontal rails 310 from left of the drawing by the travel wheels 331a, 331b, reaches the direction change rail portions 312 joined to the upper vertical rail portions 311a as exemplified in Figs. 13 to 15, the upper and lower travel wheels 336a, 336b go in the rails of the upper and lower curved portions 312b, 312d in the direction change rail portions 312, and, at the same time, the pinions 333 go in the rails with the racks 312f of the intermediate curved portions 312c.

[0069]

The travel wheel 336a, 336c and the pinions 333, which went in the respective curved portion 312b, 312d, and 312c, are guided by the curved rails respectively and reach the vertical portions 312a of the direction change rail portions 312 and are caused to go in the upper stationary vertical rail portions 311a and to travel therealong by the action of the pinions 333 and

the racks 312e meshed with the pinions 333 and guiding them (refer to Figs. 14, 16 and 17).

[0070]

Here, the carriage 330 is supported by the vertical rails 311 by three rolling bodies composed of the travel wheels 336a, 336b and the pinions 333 disposed longitudinally in the section of the vertical rail portions 311a including the vertical portions 312a of the direction change rail portions 312. Accordingly, the carriage 330 can pass through the direction change rail portions 312 while keeping its horizontal attitude in its entirety in which it traveled along the horizontal rails 310 and travel along the vertical rails 311 while maintaining its horizontal attitude (refer to Fig. 15).

[0071]

When the carriage 330, which traveled horizontally, go in the upper vertical rail portions 311a, the rise and fall rail portions 310b are risen (refer to Figs. 18 and 19) as well as the direction change rail portions 312 and the vertical rail portions 311a are shifted in a horizontal direction to separate them from each other (to the risen rise and fall rail portions 310b side). Then, since the cut-off rail portions 311c in the vertical rails 311 enter between the upper and lower stationary vertical rail portions 311a and 311b in synchronization with the above operation and couple the overall vertical rails 311 in a passed-through state, the travel direction of the carriage 330, which went in the vertical rail portions 311a can be selected, that is, it can be selected whether the carriage 330

is caused to travel upward along the upper vertical rail portions 311a as it is or whether it is caused to travel to the lower vertical rail portions 311b side.

[0072]

As described above, since the conveyance mechanism of the present invention of the forth arrangement can select the travel direction of the carriage 320, which went in the vertical rails 311 from the horizontal rails 310, to any of an upward direction and a downward direction, the conveyance mechanism also has an action as a diverting mechanism of the travel direction in addition to the function as the mechanism of capable of changing the travel direction of the carriage 320 from the horizontal rails 310 to the vertical rails while keeping its horizontal attitude.

[0073]

Next, an applied example of the horizontal conveyance mechanism according to the forth arrangement of the present invention explained above referring to Figs. 13 to 19 will be explained referring to Figs. 20 to 26. It is assumed in Figs. 20 to 26 that the same reference numerals as those of Figs. 13 to 19 denote the same members or the same portions. A horizontal conveyance mechanism of the present invention, to which the forth arrangement explained referring to Figs. 13 to 19 is applied, uses a carriage 330 having an arrangement exemplified in Figs. 20 to 23. In Figs. 20 to 23, the carriage 330 has horizontal travel wheels 331a and 331b, each two wheels of which are arranged as one set and which are disposed in front and rear

portions of a bottom of a carriage body 335. Assist wheels 331c and 331d having a horizontal attitude for clamping derail prevention guide rails (not shown) from right and left sides. Then, in the illustrated example, horizontal travel driving wheels 331D are disposed at centers of the bottom of the carriage body 335 to obtain horizontal travel force. Note that horizontal travel drive force may be input to any ones of the travel wheels 331a or 331b or to both of them. With this arrangement, the horizontal travel driving wheels 331D become unnecessary.

[0074]

In contrast, right and left drive pinions 333, 334 for a vertical section and two upper and lower travel wheels 336a, 336b, and 337a, 337b for the vertical section are disposed at approximately intermediate positions on the right and left sides of the carriage 330. The drive pinions 333, 334 and the travel wheels 336a, 336b, and 337a, 337b, which are positioned in such a mode that they clamp the pinions 333, 334 from above and below them, respectively, are disposed inward (near to the carriage body) of the pinions 333, 334 when viewed from a front surface (back surface) of the carriage body 335. Further, removal prevention rollers 333a, 334a for preventing the respective pinions 333, 334 from removing from the racks are disposed on the outer surface sides of both the pinions 333, 334 coaxially therewith. Note that the removal prevention rollers 333a and 334a have the same shape and a diameter smaller than that of the pinions 333, 334, respectively. Further, in

Figs. 20 to 23, CT schematically shows a container mounted on the carriage body 335.

Here, the removal prevention rollers 333a, 334a disposed coaxially with the pinions 333, 334 can be also applied to the pinions 133, 134 and the pinions 233, 234 which are disposed to the carriages 130, 230 in the horizontal conveyance mechanisms of the present invention of the second arrangement and the third arrangement in the same purpose as that of the rollers.

[0075]

Direction change rail portions 312 to which the carriage 330 travels and by which its direction is changed from a horizontal direction to a vertical direction while keeping its horizontal attitude, are disposed at an intersecting portion of the horizontal rails 310 and the vertical rails 311 in the conveyance mechanism of the present invention of the forth arrangement and have a mode shown in Fig. 24.

[0076]

The direction change rail portions 312 of Fig. 24 have edge surface (cross-sectional) shape shown in Fig. 25 with respect to the pinions 333, 334, the travel wheels 336a, 336b and 337a, 337b of the vertical section, and the removal prevention rollers 333a, 334a on the right and left sides of the carriage body 335 in a state that the carriage 330 schematically shown in Fig. 25 is viewed from the front surface (or back surface).

Fig. 24 shows a mode of the rail portion 312 on the left

side of Fig. 25 in the right and left direction change rail portions 312 whose cross sectional (edge surface) shape is shown in Fig. 25. Here, since the mode of the right and left direction change rail portions 312 is the same mode having bilateral symmetry, an arrangement of a left direction change rail portion 312 in Fig. 25 will be explained below referring to Fig. 24 (also refer to Fig. 25).

[0077]

It is assumed that the horizontal rails 310 and the vertical rails 311, to which the right and left direction change rail portions 312 is applied, have at least stationary horizontal rail portions 310a and the stationary vertical rail portions 311a likewise the example explained above referring to Figs. 13 to 19.

Then, the direction change rail portions 312 are formed to have vertical portions 312a and three curved portions 312b, 312c, 312d. The vertical portions 312a have upper end portions joined to lower ends of the upper stationary vertical rail portions 311a, and the three curved portions 312b, 312c, 312d have three routes disposed side by side in an up and down direction below the vertical portions 312a. The vertical portions 312a have racks 312e meshed with racks 311d of the vertical rail portions 311a.

[0078]

Here, in three curved portion 312b, 312c, 312d shown in Fig. 24, the two upper and lower curved portions 312b and 312d are arranged as curved rails for guiding the upper and lower

travel wheels 337a and 337b (336a and 336b), which clamp the pinions 334 (333) therebetween, in the carriage 330 located on the horizontal rails 310 from a horizontal direction to a vertical direction. The intermediate curved portions 312c are formed in curved rails of double tracks (composite travel paths) having racks 312f and guide grooves 312g in parallel for guiding the pinions 334 (333) and the removal prevention rollers 334a (333a) disposed coaxially with the respective pinions.

Further, the double track arrangement, which has the guide grooves 312g disposed in parallel with the racks 312f to guide the removal prevention rollers 334a (333a), is also applied to curved rails which are provided with racks meshed with the pinions 133, 134, and the pinions 233, 234 disposed to the carriages of the horizontal conveyance mechanisms of the present invention of the second and third arrangements when these pinions have removal prevention rollers.

[0079]

The curved portions 312c formed to the curved rails of the double tracks for guiding the pinions 334 (333) and the removal prevention rollers 334a (333a) are provided with the racks 312f which are disposed on inside lower surfaces and meshed with the pinions 334 (333).

[0080]

In the conveyance mechanism, to which the forth arrangement of the present invention that has the carriage 330, the respective horizontal and vertical rails 310, 311, and the direction change rail portions 312 having the arrangement

explained referring to Figs. 20 to 25, when the carriage 330, which was caused to travel on the horizontal rails 310 by the travel wheel 331a, 331b from left as exemplified in Fig. 26, reaches the direction change rail portions 312 joined to the upper vertical rail portions 311a, the upper and lower travel wheels 336a, 336b and 337a, 337b for the vertical section on the right and left sides go in the rails of the upper and lower curved portions 312b, 312d in the right and left direction change rail portions 312, and, at the same time, the right and left pinions 333, 334 and the removal prevention rollers 333a and 334a disposed coaxially therewith go in the rails that have the racks 312f and the guide grooves 312g of the intermediate curved portions 312c in parallel.

[0081]

The travel wheels 336a, 336b, and 337a, 337b for the vertical section as well as the pinions 333, 334 and the removal prevention rollers 333a and 334a disposed coaxially therewith, which went in the respective curved portions 312b, 312d and 312c, reach the vertical portions 312a of the direction change rail portions 312 by being guided by the respective curved rails and correctly go in the upper right and left stationary vertical rail portions 311a and travel by the action of the pinions 333, 334 and the right and left racks 312e meshed with the pinions 333, 334 for guiding them as well as by the action of the removal prevention rollers 333a, 334a for preventing the both the pinions 333, 334 from removing from the respective racks 312e and by the action of the guide grooves 312g for guiding the

respective rollers (refer to Figs. 26(a) to (f)).

[0082]

As shown in of Fig. 26(f), the carriage 330 is supported by the right and left vertical rails 311 by the right and left travel wheels 336a, 336b, and 337a, 337b disposed longitudinally and by the three right and left rolling bodies rolled by the right and left pinions 333, 334 in the section of the vertical rail portions 311a including the vertical portions 312a of the right and left direction change rail portions 312. Accordingly, the overall carriage 330 can travel along the vertical rails 311 while being held in the same horizontal attitude as that of the carriage 330 when it traveled along the horizontal rails 310 (refer to Fig. 26(f)). This point is the same as that of the previous embodiment explained referring to Figs. 13 to 19.

Industrial Applicability

[0083]

In the first to forth arrangements described above as well as in the embodiment of the applied example of them, although the horizontal rails of the horizontal section are formed of the one composite rail having the channel-shaped cross section, they may be composed of the rails for the pinions and the rails for the travel wheels likewise the vertical section according to a purpose of installation and an installation environment. As to the travel of the carriage in the horizontal section, since a travel wheel system for receiving drive force can be employed in addition to the racks and the pinions, the conveyance

mechanism which can hold a horizontal attitude at all times can be easily embodied by applying existing technologies. In particular, in the applied example of the forth arrangement of the present invention, the removal prevention rollers are disposed coaxially with the pinions, which are meshed with the racks and output drive force for the travel from the curved section to the vertical section, to prevent the pinions from removing from the racks. As a result, the meshed state of the pinions with the racks can be stably secured in the curved section in which a travel mode is changed from horizontal to vertical.

[0084]

Further, in the embodiments described above, although the vertical rails and the horizontal rails are laid along a floor and a wall of a building, the horizontal conveyance mechanism of the present invention can be also formed when these rails are laid on a column and a ceiling. When, for example, an article to be conveyed is an article which must be maintained in a particular attitude and, moreover, it must be caused to travel along a ceiling, a carriage having a container can be caused to travel along the ceiling and a wall in a state that a horizontal attitude of the container is maintained without a gyro means by laying rails, which constitute a horizontal section, and rails, which constitute a curved section and a vertical section continuing to the curved section, stepwise by appropriately selecting a cross-sectional shape of horizontal rails, a support structure of travel wheels, or a manner of

laying the rails.

Brief Description of the Drawings

[0085]

Fig. 1 is a front elevational view showing an embodiment of a horizontal conveyance mechanism of a self-propelled carriage according to a first arrangement of the present invention.

Fig. 2 is a right elevational view of the horizontal conveyance mechanism shown in Fig. 1.

Fig. 3 is a plan view of Fig. 2.

Fig. 4 is a perspective view of the horizontal conveyance mechanism shown in Figs. 1 to 3.

Fig. 5 is a front elevational view showing an embodiment of a horizontal conveyance mechanism of a self-propelled carriage according to a second arrangement of the present invention.

Fig. 6 is a right elevational view of the horizontal conveyance mechanism shown in Fig. 5.

Fig. 7 is a plan view of Fig. 6.

Fig. 8 is a perspective view of the horizontal conveyance mechanism shown in Figs. 5 to 7.

Fig. 9 is a front elevational view showing an embodiment of a horizontal conveyance mechanism of a self-propelled carriage according to a third arrangement of the present invention.

Fig. 10 is a right elevational view of the horizontal conveyance mechanism shown in Fig. 9.

Fig. 11 is a plan view of Fig. 9.

Fig. 12 is a perspective view of the horizontal conveyance mechanism shown in Figs. 9 to 11.

Fig. 13 is a side elevational view explaining a moving state of a carriage in a horizontal section in a horizontal conveyance mechanism according to a forth arrangement of the present invention.

Fig. 14 is a side elevational view explaining a moving state of the carriage in a curved section in the horizontal conveyance mechanism of the forth arrangement.

Fig. 15 is a side elevational view explaining a moving state of the carriage in a vertical section in the horizontal conveyance mechanism of the forth arrangement.

Fig. 16 is a perspective view showing attitudes of the carriage and respective rails in an example in which the carriage travels from the horizontal section to the vertical section.

Fig. 17 is a schematic side elevational view of Fig. 16.

Fig. 18 is a perspective view showing attitudes of the carriage and the respective rails in an example in which the carriage travels in a horizontal attitude in the vertical section.

Fig. 19 is a schematic side elevational view of Fig. 18.

Fig. 20 is a side elevational view of an example of a carriage used in an applied example of the horizontal conveyance mechanism of the present invention of the forth arrangement.

Fig. 21 is a plan view of the carriage of Fig. 20.

Fig. 22 is a left side elevational view of the carriage of Fig. 20.

Fig. 23 is a schematic perspective view of the carriage shown in Figs. 20 to 22.

Fig. 24 is a perspective view schematically showing a mode of direction change rails (left rails) along which the carriage of Figs. 20 to 23 travels.

Fig. 25 is a front elevational view of right and left direction change rail portions in a state that the carriage of Fig. 22 enters the rail portions.

Figs. 26(a) to 26(f) are side sectional views time-sequentially showing a state that the carriage passes through the direction change rail portions.

Explanation of reference numeral

[0086]

10 rail

11 rail for pinion

12 rail for travel wheel

14 composite rail

15 curved wall

20 rack

30 carriage

31, 32 travel wheel

33, 34 pinion

35 carriage body

110 rail

111 rail for pinion
112 rail for travel wheel
114 single rail
115 curved wall
116 opening
117 hole
118 guide wall
120 rack
130 carriage
131a, 131b travel wheel
132a, 132b travel wheel
133, 134 pinion
135 carriage body
136a, 136b travel wheel
137a, 137b travel wheel
210 rail
211 vertical rail
214 horizontal rail
215 curved wall
216 opening
217 tunnel
220 rack
230 carriage
231a, 231b horizontal portion travel wheel
232a, 231b horizontal portion travel wheel
233, 234 pinion
235 carriage body

236a, 236b vertical portion travel wheel

237a, 237b vertical portion travel wheel

CLAIMS

1. A horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, characterized in that:

the rails comprises rails for the pinions having racks meshed with the pinions and rails for the travel wheels which are disposed in parallel with the rails for the pinions and separated therefrom in a curved section in which a direction is changed from horizontal to vertical or from vertical to horizontal and in a vertical section continuing to the curved section; and

the carriage comprises pinions meshed with the rails for the pinions and travel wheels supported by rails for travel wheels on the right and left sides thereof as well as the rails for the pinions and the rails for the travel wheels are disposed such that the carriage can move while keeping a horizontal attitude in a curved section and in a vertical section continuing to the section,

wherein the carriage comprises a first pinion and a first travel wheel on one side orthogonal to a travel direction of the carriage as well as comprises a second travel wheel at the positions of the same phase as that of the first pinion on the other side and a second pinion at the positions of the same phase as that of the first travel wheel, and the carriage is suppressed from inclining by the first and second pinions and the travel wheels whose phases of disposition are different on both the sides.

2. The horizontal conveyance mechanism according to claim 1, wherein the carriage coaxially comprises pinions at the positions of the same phase of intermediate portions on both the right and left sides as well as comprises front and rear travel wheels which are disposed such that they clamp the pinions in front of and behind thereof in a travel direction of the carriage and clamp rotating shafts of the pinions from above and below thereof and the upper and lower travel wheels of which constitute a pair, and the carriage is caused to travel while keeping a horizontal attitude by that any ones of the front and rear travel wheels and the pinions are supported by the respective rails in the curved section and the vertical section continuing the section.

3. The horizontal conveyance mechanism according to claim 2, wherein the rails for the pinions and the rails for the travel wheels in the horizontal section of the rails are formed of a composite rail in which both the rails are disposed in parallel, and the composite rail is disposed by being separated to front and rear from the curved section to the vertical section.

4. A horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, characterized in that:

the carriage coaxially comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises front and rear horizontal

portion travel wheels arranged as a pair for clamping the pinions in front of and behind them in a travel direction of the carriage and upper and lower vertical portion travel wheels arranged as a pair for clamping rotating shafts of the pinions above and below them; and

rails comprise curved rails having racks meshed with pinions and travel surfaces of the horizontal portion travel wheels in a curved section for changing a direction from horizontal to vertical or from vertical to horizontal as well as comprises vertical rails having racks meshed with the pinions and travel surfaces of the vertical portion travel wheels in a vertical section continuing to the curved section, and the horizontal portion travel wheels and the pinions are supported by the curved rails in the curved section, and the vertical portion travel wheels and the pinions are supported by the vertical rails in the vertical section continuing the curved section.

5. A horizontal conveyance mechanism comprising rails horizontally and vertically laid in a building, racks laid along the rails, and a self-propelled carriage which comprises travel wheels traveling on the rails, pinions meshed with the racks, and a drive unit of the pinions and on which a load is mounted, characterized in that:

the carriage coaxially comprises pinions to the same phase of intermediate portions on both the right and left sides as well as comprises horizontal portion travel wheels disposed on a bottom of the carriage and upper and lower vertical portion travel wheels disposed such that they are arranged as a pair for clamping rotating shafts of the pinions above and below them; and

rails comprise curved rails having curved racks meshed

with the pinions and travel surfaces for restricting and guiding the vertical portion travel wheels in a curved section for changing a direction from horizontal to vertical or from vertical to horizontal as well as comprise short vertical rails having short racks meshed with the pinions and travel surfaces of the vertical portion travel wheels in a short vertical section continuing to the curved section, and the pinions are supported by the curved racks in the curved section as well as the horizontal portion travel wheels are supported by the curved rails and the pinions and the vertical portion travel wheels are supported by the vertical rails having the short racks therein in the short vertical section continuing to the curved section so that the carriage travels in a horizontal attitude at all times.

6. The horizontal conveyance mechanism of the self-propelled carriage according to any of claims 2 to 5, wherein the pinions on the right and left sides of the carriage comprise removal prevention rollers disposed coaxially therewith.

7. The horizontal conveyance mechanism of the self-propelled carriage according to any of claims 2 to 6, wherein the curved rails disposed to the curved section comprise racks meshed with the right and left pinions of the carriage as well as guide grooves for supporting and guiding the removal prevention rollers disposed coaxially with the pinions are disposed so as to constitute double tracks together with the racks.