

DESCRIPTION

DRIVE UNIT AND HORIZONTAL CONVEYANCE CARRIAGE

Field

[0001] The present invention relates to a drive unit and
5 a horizontal conveyance carriage, and particularly to a
drive unit and a horizontal conveyance carriage suitable
for a horizontal conveyance carriage that horizontally
conveys a conveyance object such as materials and equipment
at a construction site and the like.

10 Background

[0002] Conventionally, in the construction industry,
automation of work has been desired in order to make up for
labor shortages. In particular, material conveyance takes
a lot of man-hours at present, and automating this can
15 obtain a great effect on manpower saving. In material
conveyance, there are vertical conveyance that uses a
construction elevator and horizontal conveyance that uses a
carriage or the like to a place of construction. In
horizontal conveyance, because workers convey materials
20 placed on carriages by human power, many labors are spent
on this at present.

[0003] In order to solve this problem, power carriages
that automate the horizontal conveyance have conventionally
been developed and applied to fields (for example, see
25 Patent Literature 1 to 4). While these power carriages
employ a steering system such as a steering-link mechanism
system and an omni wheel/mecanum wheel system, each has the
following problems.

[0004] Steering-link Mechanism System

30 The steering angle of a steering wheel is relatively
small, and the carriage is unable to move freely. Because
the steering directions of the wheels connected by the link
become the same, the free movement such as rotating the

carriage is not possible.

[0005] Omni Wheel/Mecanum Wheel System

While the free movement is possible, it is difficult to run on rough terrain and it is not possible to run through steps and the like that are common on a construction site.

[0006] Meanwhile, as a technique to reduce the force needed in turning the carriage, a caster described in Patent Literature 5 has been known, for example.

10 Citation List

Patent Literature

[0007] Patent Literature 1: Japanese Laid-open Patent Publication No. H06-32227

Patent Literature 2: Japanese Laid-open Patent Publication No. H06-32599

Patent Literature 3: Japanese Laid-open Patent Publication No. 2014-101154

Patent Literature 4: Japanese Laid-open Patent Publication No. 2014-162578

20 Patent Literature 5: Japanese Laid-open Patent Publication No. 2015-202782

Summary

Technical Problem

[0008] The present invention has been made in view of the foregoing, and an object of the invention is to provide a drive unit that enables free movement of a carriage used in a place like a construction site where there are many obstacles such as steps and to provide a horizontal conveyance carriage provided with this drive unit.

30 Solution to Problem

[0009] To solve the above-described problem and achieve the object, a drive unit according to the present invention is a drive unit for a carriage capable of autonomous

running including: a swiveling shaft rotatively provided on a carriage body in a vertical direction; a cartwheel held on the swiveling shaft, a ground contact point of the cartwheel serving as a swiveling center and being arranged on a same axis with the swiveling shaft; a running drive unit configured to rotate the cartwheel as a driving wheel; and a swiveling drive unit configured to swivel the swiveling shaft to steer the cartwheel as a steering wheel.

[0010] Moreover, in the above-described drive unit according to the present invention, the cartwheel includes: a wheel; and a tire made of an elastic material attached on an outer circumference of the wheel.

[0011] Moreover, in the above-described drive unit according to the present invention, the swiveling drive unit includes: an electric motor provided at an eccentric position from the swiveling shaft; and a power transmission unit configured to transmit a driving force of the electric motor to the swiveling shaft.

[0012] Moreover, a horizontal conveyance carriage according to the present invention is a horizontal conveyance carriage for horizontally conveying a conveyance object including the above-described drive unit as a driving steering wheel.

[0103] Moreover, the above-described horizontal conveyance carriage further includes: a carriage main body including: a pedestal portion for depositing a loaded conveyance object; and the drive unit; a forklift attached to the carriage main body and configured to perform loading/unloading the conveyance object from outside on the pedestal portion; an extension mechanism configured to extend and retract the forklift in a front-and-rear direction; an elevating mechanism configured to raise and lower the forklift in an up-and-down direction; a support

mechanism provided for preventing the forklift from being in a cantilever state while loading/unloading the conveyance object and configured to support the forklift from below; an own-location estimation unit configured to
5 estimate an own-location of the carriage main body; a positional-relation recognition unit configured to recognize positional relation between the own-location and the conveyance object; and a control unit configured to control, based on the own-location and the positional
10 relation, a movement of the carriage main body by the drive unit, and operation of the forklift by the extension mechanism and the elevating mechanism.

Advantageous Effects of Invention

[0014] According to the drive unit in the present
15 invention, because it is a drive unit used for a carriage capable of autonomous running, and is provided with the swiveling shaft that is rotatively provided on the carriage body in the vertical direction, the cartwheel that is held on the swiveling shaft and for which the ground contact
20 point serving as a swiveling center is arranged on the same axis as the swiveling shaft, the running drive unit configured to rotate the cartwheel as a driving wheel, and the swiveling drive unit configured to swivel the swiveling shaft to steer the cartwheel as a steering wheel, the
25 cartwheel is operable as a steering wheel and a driving wheel that swivels to any desired direction with the ground contact point as a swiveling center. Thus, it has an effect in that it is possible to achieve free movement of the carriage such as rotation.

30 [0015] Furthermore, according to another drive unit in the present invention, because the cartwheel is constituted by the wheel and by the tire made of an elastic material attached on the outer circumference of the wheel, it has an

effect in that it is possible to achieve free movement of the carriage that is used in a place like a construction site where there are many obstacles such as steps.

[0016] According to another drive unit in the present invention, because the swiveling drive unit includes the electric motor that is provided at an eccentric position from the swiveling shaft, and the power transmission unit that transmits the driving force of the electric motor to the swiveling shaft, it has an effect in that it is possible to provide a drive unit of a simple configuration that achieves free movement of the carriage.

[0017] Furthermore, according to the horizontal conveyance carriage in the present invention, because it is a horizontal conveyance carriage for horizontally conveying a conveyance object and is provided with the above-described drive unit as a driving steering wheel, it has an effect in that it is possible to provide a horizontal conveyance carriage capable of free movement.

[0018] According to another horizontal conveyance carriage in the present invention, because it is provided with the carriage main body having the pedestal portion for depositing a loaded conveyance object and having the drive unit, the forklift that is attached to the carriage main body and configured to perform loading/unloading the conveyance object from the outside on the pedestal portion, the extension mechanism configured to extend and retract the forklift in the front-and-rear direction, the elevating mechanism configured to raise and lower the forklift in the up-and-down direction, the support mechanism provided for preventing the forklift from being in a cantilever state while loading/unloading the conveyance object and configured to support the forklift from below, the own-location estimation unit configured to estimate the own-

location of the carriage main body, the positional-relation recognition unit configured to recognize positional relation between the own-location and the conveyance object, and the control unit configured to control, based on the own-location and the positional relation, the movement of the carriage main body by the drive unit, and the operation of the forklift by the extension mechanism and the elevating mechanism, it has an effect in that it is possible to provide a horizontal conveyance carriage capable of free movement and having high stability.

Brief Description of Drawings

[0019] FIG. 1 is a schematic perspective view (in a conveyance mode) illustrating an embodiment of a horizontal conveyance carriage according to the present invention.

FIG. 2 is a schematic perspective view (in loading) illustrating the embodiment of the horizontal conveyance carriage in the present invention.

FIG. 3 is a schematic perspective view (in loading) of the horizontal conveyance carriage in FIG. 2 as viewed from a lower surface.

FIG. 4 is a front view illustrating an embodiment of a drive unit in the present invention.

FIG. 5 is a rear view illustrating the embodiment of the drive unit in the present invention.

Description of Embodiment

[0020] A horizontal conveyance carriage of the present invention is an automatic conveyance carriage capable of free movement that can flexibly accommodate to a construction site. This horizontal conveyance carriage is, under instructions by a control unit (for example, an integrated management system) described later, able to move while performing own-location estimation, to directly face a load that is a conveyance object, and to perform

loading/unloading by a forklift. In order to achieve these, the free movement of the carriage is indispensable, and to that end, drive units in which each cartwheel independently swivels are employed. Because this drive unit employs a rubber tire as will be described later, it has a high road-handling ability and also has a large steering angle.

[0021] The following describes, based on the accompanying drawings, an exemplary embodiment of a drive unit and a horizontal conveyance carriage according to the present invention in detail. The invention, however, is not intended to be limited by the embodiment.

[0022] Horizontal Conveyance Carriage

First, an embodiment of the horizontal conveyance carriage that the drive unit in the present invention is applied to will be described.

[0023] As illustrated in FIG. 1 to FIG. 3, a horizontal conveyance carriage 10 in the present invention is a carriage for horizontally conveying a load (conveyance object) such as materials and equipment and includes a carriage main body 12 and a forklift 14. In each drawing, the forklift 14 is illustrated not by solid lines but by dashed-dotted lines.

[0024] The carriage main body 12 is a structure having a substantially L-shaped cross-section in a side view and is made up of a standing wall portion 16 and a pedestal portion 18. This carriage main body 12 includes an extension mechanism 20 that makes the forklift 14 extend and retract in a front-and-rear direction and an elevating mechanism 22 that makes the forklift 14 rise and fall in the vertical direction. The standing wall portion 16 is a wall-shaped portion rising upward from the rear end of the pedestal portion 18. The pedestal portion 18 is a flat portion for depositing materials loaded by the forklift 14

and is separated into three pedestal portions 18A, 18B, and 18C on the left side, the central side, and the right side, respectively, interposing the forklift 14. On the respective pedestal portions 18A, 18B, and 18C, three
5 battens of a material palette (not depicted) that is a conveyance object can be loaded. On the front end face of the pedestal portion 18B on the central side, a twin-lens camera sensor 24 (positional-relation recognition unit) is attached. This twin-lens camera sensor 24 is a camera
10 sensor that calculates a relative distance and an angle with respect to a marker (not depicted) affixed to the conveyance object such as a material palette and materials. By reading the marker with this twin-lens camera sensor 24, the positional relation (relative position) between the
15 conveyance object and the carriage main body 12 can be detected, and by utilizing this detection result, the carriage main body 12 can directly face the conveyance object.

[0025] As illustrated in FIG. 3, on four corner sides of
20 the lower surface of the carriage main body 12, a drive unit 26 of the present invention as an electric-driving steering wheel, and a steering wheel 28 is provided. The drive units 26 are positioned on the rear left and right sides of the lower surface of the carriage main body 12
25 (that is, the lower surfaces on the rear sides of the pedestal portions 18A and 18C), and are for making the horizontal conveyance carriage 10 freely move while supporting the load of the horizontal conveyance carriage 10 and of the load loaded on the horizontal conveyance
30 carriage 10. The steering wheels 28 are positioned on the front left and right sides of the lower surface of the carriage main body 12 and are for making the horizontal conveyance carriage 10 freely move. This steering wheel 28

also supports, together with the drive unit 26, the load of the horizontal conveyance carriage 10 and of the load loaded on the horizontal conveyance carriage 10. In order to achieve free movement of the horizontal conveyance carriage 10, the steering wheels 28 and the drive units 26 are steered independently of one another.

[0026] The forklift 14 is for loading/unloading a load from a yard (not depicted) on the horizontal conveyance carriage 10, and is attached to the carriage main body 12 via the extension mechanism 20 and the elevating mechanism 22. This forklift 14 includes two long box-like forks 32 extending in the front-and-rear direction arranged in parallel to grooves 30 on both sides of the pedestal portion 18B of the central side, and a coupling frame 34 coupling rear ends of the forks 32 in an inverted U-shape and attached to the extension mechanism 20 and the elevating mechanism 22.

[0027] On the lower side of the fork 32, a scissors link mechanism 38 (supporting mechanism) in which two link members 36 are assembled in a scissors-like shape (X-shape) is provided. This scissors link mechanism 38 is for preventing the fork 32 of the forklift 14 from being in a cantilever state. Normally, when the fork 32 is in a cantilever state, a counterweight that prevents falling over in lifting a load is needed. This makes the carriage weight increase, and that may exceed the maximum load weight of the building where the horizontal conveyance carriage 10 is arranged. Meanwhile, according to the present embodiment, because the forklift work can be performed without a counterweight by the scissors link mechanism 38, the carriage can be made lightweight and the horizontal conveyance carriage 10 can be applied without floor reinforcement of the building. On the lower portion

of the front end of one link member 36 of this scissors link mechanism 38, a wheel 40 is attached and achieves a smooth movement when the scissors link mechanism 38 is expanded. The upper portion of the rear end of the one
5 link member 36 is rotatively fixed to the lower portion of the rear end of the fork 32. The lower portion of the rear end of the other link member 36 is rotatively fixed to a lower frame 44 as will be described later, and the upper portion of the front end is rotatively fixed to the lower
10 portion of the front end of the fork 32.

[0028] The elevating mechanism 22 of the forklift 14 is made up of a gate-shaped upper frame 42 arranged on the upside straddling the pedestal portion 18B of the central side, the lower frame 44 arranged to be vertically movable
15 in the upper frame 42, a cylinder 46 connecting between the lower frame 44 and the coupling frame 34 of the forklift 14 vertically, and an elevating drive source (not depicted) driving the cylinder 46. The lower end of the cylinder 46 is fixed to the upper-end face of the lower frame 44, and
20 the upper end of a piston rod 48 projecting upward from the cylinder 46 is fixed to the coupling frame 34 via a pin engaging portion 50 and a connecting member 52. In this mechanism, when the piston rod 48 extends upward from the cylinder 46, the forks 32 are raised via the pin engaging
25 portion 50, the connecting member 52, and the coupling frame 34. Meanwhile, when the piston rod 48 retracts, the forks 32 are lowered via the coupling frame 34.

[0029] At a substantially intermediate position in the up-and-down direction of the upper frame 42, an
30 intermediate member 54 extending in the left-and-right direction is provided. On the front side at the central portion in the left-and-right direction of this intermediate member 54, at positions sandwiching the piston

rod 48 of the cylinder 46, two scissors flip-up pins 56 (transformation mechanism) are provided so as to be movable back and forth. The scissors flip-up pins 56 perform transformation into the action of flipping up the scissors link mechanism 38, by limiting the movement of the piston rod 48 via the pin engaging portion 50. By fixing the upper end of the piston rod 48 to the intermediate member 54 by these scissors flip-up pins 56, the lower frame 44 moves up and down via the lower end of the cylinder 46.

10 [0030] The lower frame 44 is made up of a central portion 44A in an inverted U-shape along the upper surface and side surfaces of the pedestal portion 18B of the central side and side portions 44B extending from the lower ends of the central portion 44A outward in the left-and-right direction in the grooves 30. On the front side of the side portion 44B, a connecting member 58 is attached, and on the connecting member 58, the lower portion of the rear end of one link member 36 of the scissors link mechanism 38 is rotatively connected.

20 [0031] In this transformation mechanism, when the scissors flip-up pins 56 are made to protrude from the intermediate member 54 and the pin engaging portion 50 at the upper end of the piston rod 48 and the intermediate member 54 are made into a fixed state, the lower frame 44 is in a state of being movable up and down via the lower end of the cylinder 46. When the piston rod 48 of the cylinder 46 is retracted in this state, the lower frame 44 is raised and the scissors link mechanism 38 floats up from the floor surface via the side portion 44B and the connecting member 58. Accordingly, the horizontal conveyance carriage 10 turns into a movable mode. Conversely, when the piston rod 48 is extended, the lower frame 44 is lowered and the lower portion of the rear end

of the link member 36 of the scissors link mechanism 38 comes into contact with the floor surface via the side portion 44B and the connecting member 58 and serves as a rotation fulcrum, thereby expanding the scissors link mechanism 38 and flipping up the fork 32 from below.

[0032] Furthermore, when the scissors flip-up pins 56 are accommodated into the intermediate member 54 and the engagement between the pin engaging portion 50 at the upper end of the piston rod 48 and the intermediate member 54 is disengaged, the forks 32 are in a state of being movable up and down via the piston rod 48, the pin engaging portion 50, the connecting member 52, and the coupling frame 34. When the piston rod 48 of the cylinder 46 is retracted in this state, the forks 32 are lowered, and when the piston rod 48 is extended, the forks 32 are raised. At this time, the scissors link mechanisms 38 take expansion deformation/shrinkage deformation according to raising/lowering of the forks 32 while supporting the forks 32.

[0033] The extension mechanism 20 of the forklift is made up of rails extending in the front-and-rear direction on the inner side surfaces of the pedestal portions 18A and 18C on the left and right sides, sliders (not depicted) that make the lower ends of the upper frame 42 slide in the front-and-rear direction along the pedestal portion 18 along these rails, and an extension drive source (not depicted) that drives the sliders. In the extension mechanism 20, when the upper frame 42 slides and moves to the rear ends of the rails, the lower frame 44 and the coupling frame 34 also move integrally with the upper frame 42. As a result, the forks 32 are retracted and enter the grooves 30 of the pedestal portion 18 and fit between the pedestal portion 18A and the pedestal portion 18B and

between the pedestal portion 18C and the pedestal portion 18B, and the upper frame 42 also fits into a recessed portion 16A of the standing wall portion 16 of the carriage main body 12. Conversely, when the upper frame 42 slides
5 and moves to the front ends of the rails, the lower frame 44 and the coupling frame 34 also move integrally with the upper frame 42, and the forks 32 are extended and are in a state of projecting forward from the grooves 30 of the pedestal portion 18.

10 [0034] The above-described horizontal conveyance carriage 10 includes a laser sensor 60 (own-location estimation unit) that estimates the own-location of the carriage main body 12, the above-described twin-lens camera sensor 24 (positional-relation recognition unit) that
15 recognizes positional relation between the own-location and the conveyance object, and a control unit (not depicted) that controls, based on the estimated own-location and the recognized positional relation, the movement of the carriage main body 12 by the drive units 26 and the
20 steering wheels 28, and the operation of the forklift 14 by the extension mechanism 20 and the elevating mechanism 22. The control unit can be remotely controlled from the outside via a wireless or wired communication unit.

[0035] The laser sensor 60 is provided at the center of
25 the upper end of the standing wall portion 16 of the carriage main body 12. The laser sensor 60 is a sensor capable of acquiring, by irradiating the periphery with laser light, a situation such as a shape of the periphery as two-dimensional information. By superimposing and using
30 the two-dimensional information acquired by this sensor on known drawing information on a construction site where the horizontal conveyance carriage 10 is used, the current position of the horizontal conveyance carriage 10 can be

calculated.

[0036] Next, a sequence in loading/unloading work by the above-described horizontal conveyance carriage 10 will be described.

5 [0037] First, in a state in which the scissors link mechanisms 38 are retracted by pulling up the lower frame 44 by the cylinder 46, moving to a loading position is performed. Next, by extending the cylinder 46 and lowering the lower frame 44, the scissors link mechanism 38 is
10 expanded. Then, the scissors flip-up pins 56 are retracted and the forklift 14 is raised and lowered by the movement of the cylinder 46.

[0038] At the time of loading, after extending the forklift 14 from the carriage main body 12, the forks 32
15 are inserted into a material palette (not depicted) and raised, and the forks 32 are drawn toward the carriage main body 12 side. Moreover, by lowering the forks 32, the load not depicted is transferred on the pedestal portion 18. By expanding the scissors flip-up pins 56, the movement of the
20 upper end of the piston rod 48 of the cylinder 46 is restrained. Subsequently, by raising the lower frame 44 with the cylinder 46 for which the upper end of the piston rod 48 is restrained, the scissors link mechanisms 38 attached to the lower frame 44 are retracted.

25 [0039] By loading/conveying the conveyance object in this manner, without impairing the adaptability of the forklift carriage to the material, stable material conveyance can be performed while maintaining the center of gravity of the carriage at the time of conveyance low.

30 [0040] Next, conveying operation of the above-described horizontal conveyance carriage 10 will be described.

[0041] As in the foregoing, because the horizontal conveyance carriage 10 includes the laser sensor 60 that

estimates the own-location of the carriage main body 12, the twin-lens camera sensor 24 that recognizes the positional relation between the own-location and the conveyance object, and the control unit that controls, based on the estimated own-location and the recognized positional relation, the movement of the carriage main body 12 by the drive units 26 and the steering wheels 28, and the operation of the forklift 14 by the extension mechanism 20 and the elevating mechanism 22, by superimposing the two-dimensional range information by the laser sensor 60 on the known drawing data of the construction site, the horizontal conveyance carriage 10 can run autonomously while estimating the own-location. For this reason, there is no need for a means to guide the course such as a magnetic tape. Accordingly, making the carriage track trackless can be implemented. Furthermore, by the control unit, it is possible to move while performing own-location estimation, to directly face a load that is a conveyance object, and to perform loading/unloading by the forklift 14.

[0042] For example, when loading, the control unit grasps the distance and the angle to the material palette via the twin-lens camera sensor 24 and makes the carriage main body 12 directly face the material palette, and thereafter, the material palette only needs to be loaded by operating the forklift 14 via the elevating mechanism 22 and the extension mechanism 20. Then, it only needs to move in the construction site while estimating the own-location via the laser sensor 60 and to perform unloading at a predetermined position.

[0043] As just described, according to the present embodiment, it is possible to automate the conveying work at a construction site and/or save man-power in the conveying work. Furthermore, it is possible to construct

an automatic conveyance system that can be applied without reinforcing the floor of the building. Moreover, the stability and the safety of the conveyance system using a forklift carriage of a low center of gravity can be improved. In addition, handling of a wide variety of loads by employing a forklift carriage is possible. Moreover, because there is no need to affix a magnetic tape or the like for guiding the carriage on the floor, the construction of an automatic conveyance system capable of flexibly handling a change of plan is possible.

[0044] Drive Unit

Next, an embodiment of the drive unit 26 of the present invention applied to the above-described horizontal conveyance carriage 10 will be described.

[0045] As illustrated in FIG. 4 and FIG. 5, the drive unit 26 in the present embodiment includes a swiveling shaft 70 rotatively provided on a frame of the pedestal portion 18A (18C) (carriage body) in the vertical direction via a bearing (not depicted), a cartwheel 74, a running drive unit 76, and a swiveling drive unit 78.

[0046] The cartwheel 74 is made up of an axle 80, a wheel 82, and a rubber-made pneumatic tire 84 that is attached to the outer circumference of the wheel 82. The tire 84 is not limited to rubber-made, and it may be any material as long as it is made up of an elastic material.

[0047] The axle 80 is rotatively held onto an inverted U-shaped upright 92 fixed to the lower end portion of the swiveling shaft 70 via a bearing not depicted. A ground contact point 72 of the cartwheel 74 with respect to the floor surface is located on the same axis as the swiveling shaft 70. Thus, the cartwheel 74 can swivel to any direction with the shaft center of the swiveling shaft 70 as a swiveling center.

[0048] The running drive unit 76 is for rotatively driving the cartwheel 74 as a driving wheel and is made up of a driving electric motor 100 and a driving speed reducer 102 fixed onto the upright 92. The output shaft of the driving electric motor 100 is attached to the axle 80 via the driving speed reducer 102.

[0049] The swiveling drive unit 78 is for swiveling the swiveling shaft 70 to steer the cartwheel 74 as a steering wheel, and includes a swiveling electric motor 86 that is provided at an eccentric position from the swiveling shaft 70, a swiveling speed reducer 88, and a swiveling chain 90 (power transmission unit) that transmits to the swiveling shaft 70 the driving force of the swiveling electric motor 86. The swiveling electric motor 86 is connected to an output shaft 96 via the swiveling speed reducer 88.

[0050] The upper-end portion of the swiveling shaft 70 and the upper-end portion of the output shaft 96 are each rotatively fixed onto the frame of the pedestal portion 18A (18C) and are positioned on the upper surface side of the frame. At the upper-end portion of the swiveling shaft 70, a sprocket 94 is provided. Meanwhile, at the upper-end portion of the output shaft 96, a sprocket 98 is provided. The swiveling chain 90 is wound between the sprockets 94 and 98.

[0051] According to the above-described configuration, the cartwheel 74 can operate as a steering wheel and a driving wheel that swivels with the ground contact point 72 as a swiveling center. Thus, it is possible to provide a drive unit of a simple configuration that achieves free movement of the carriage such as rotation. Furthermore, because the cartwheel 74 is made up of the rubber-made pneumatic tire 84, the road-handling ability at a place like a construction site where there are many obstacles

such as steps is improved.

[0052] Operation of Drive Unit

Next, the operation of cartwheel running/steering by the above-described drive unit 26 will be described.

5 [0053] When the driving electric motor 100 of the running drive unit 76 rotatively drives, the axle 80 is rotated via the driving speed reducer 102 and the cartwheel 74 is rotated. In such a manner, it is possible to run by rotatively driving the cartwheel 74. Meanwhile, when the
10 swiveling electric motor 86 of the swiveling drive unit 78 rotatively drives, the swiveling shaft 70 is rotated via the swiveling speed reducer 88 and the swiveling chain 90, and the cartwheel 74 is swiveled. In such a manner, it is possible to swivel by steering the cartwheel 74.
15 Accordingly, the operation of cartwheel running/steering by the drive unit 26 is possible.

[0054] Turning Operation of Carriage

Next, the turning operation of the horizontal conveyance carriage 10 by the above-described drive unit 26
20 will be described.

[0055] The above-described control unit drives and steers the two left and right drive units 26 at the rear portion of the horizontal conveyance carriage 10, and controls the operation of the two left and right steering
25 wheels 28 at the front portion of the horizontal conveyance carriage 10 so as to follow this movement. In such a manner, the free movement of the horizontal conveyance carriage 10 can be achieved. The free movement of the horizontal conveyance carriage 10 means the movement such
30 as straight-line traveling, curve traveling (curve traveling for which the swiveling center can be arbitrarily set), rotation, and the like.

[0056] In the above-described embodiment, the horizontal

conveyance carriage 10 that includes two drive units 26 and two steering wheels 28 has been exemplified. However, the horizontal conveyance carriage of the present invention is not limited thereto, and it may be any form of carriage as long as it includes at least one drive unit of the present invention.

[0057] As in the foregoing, according to the drive unit in the present invention, because it is a drive unit used for a carriage capable of autonomous running, and is provided with the swiveling shaft that is rotatively provided on the carriage body in the vertical direction, the cartwheel that is held on the swiveling shaft and for which the ground contact point serving as a swiveling center is arranged on the same axis as the swiveling shaft, the running drive unit configured to rotate the cartwheel as a driving wheel, and the swiveling drive unit configured to swivel the swiveling shaft to steer the cartwheel as a steering wheel, the cartwheel is operable as a steering wheel and a driving wheel that swivels to any desired direction with the ground contact point as a swiveling center. Thus, it has an effect in that it is possible to achieve free movement of the carriage such as rotation.

[0058] Furthermore, according to another drive unit in the present invention, because the cartwheel is constituted by the wheel and by the tire made of an elastic material attached on the outer circumference of the wheel, it is possible to achieve free movement of the carriage that is used in a place like a construction site where there are many obstacles such as steps.

[0059] According to another drive unit in the present invention, because the swiveling drive unit includes the electric motor that is provided at an eccentric position from the swiveling shaft, and the power transmission unit

configured to transmit the driving force of the electric motor to the swiveling shaft, it is possible to provide a drive unit of a simple configuration that achieves free movement of the carriage.

5 [0060] Furthermore, according to the horizontal conveyance carriage in the present invention, because it is a horizontal conveyance carriage for horizontally conveying a conveyance object and is provided with the above-described drive unit as a driving steering wheel, it is
10 possible to provide a horizontal conveyance carriage capable of free movement.

[0061] According to another horizontal conveyance carriage in the present invention, because it is provided with the carriage main body having the pedestal portion for
15 depositing a loaded conveyance object and having the drive unit, the forklift that is attached to the carriage main body and configured to perform loading/unloading the conveyance object from the outside on the pedestal portion, the extension mechanism configured to extend and retract
20 the forklift in the front-and-rear direction, the elevating mechanism configured to raise and lower the forklift in the up-and-down direction, the support mechanism provided for preventing the forklift from being in a cantilever state while loading/unloading the conveyance object and
25 configured to support the forklift from below, the own-location estimation unit configured to estimate the own-location of the carriage main body, the positional-relation recognition unit configured to recognize positional relation between the own-location and the conveyance object,
30 and the control unit configured to control, based on the own-location and the positional relation, the movement of the carriage main body by the drive unit, and the operation of the forklift by the extension mechanism and the

elevating mechanism, it is possible to provide a horizontal conveyance carriage capable of free movement and having high stability.

Industrial Applicability

5 [0062] As in the foregoing, the drive unit and the horizontal conveyance carriage according to the present invention are useful for a horizontal conveyance carriage that horizontally conveys a conveyance object such as materials and equipment at a construction site and the like,
10 and particularly suitable for enabling free movement of the carriage.

Reference Signs List

[0063] 10 HORIZONTAL CONVEYANCE CARRIAGE
12 CARRIAGE MAIN BODY
15 14 FORKLIFT
16 STANDING WALL PORTION
16A RECESSED PORTION
18, 18A, 18B, 18C PEDESTAL PORTION (CARRIAGE BODY)
20 EXTENSION MECHANISM
20 22 ELEVATING MECHANISM
24 TWIN-LENS CAMERA SENSOR (POSITIONAL-RELATION
RECOGNITION UNIT)
26 DRIVE UNIT (DRIVING STEERING WHEEL)
28 STEERING WHEEL
25 30 GROOVE
32 FORK
34 COUPLING FRAME
36 LINK MEMBER
38 SCISSORS LINK MECHANISM (SUPPORT MECHANISM)
30 40 WHEEL
42 UPPER FRAME
44 LOWER FRAME
44A CENTRAL PORTION

	44B	SIDE PORTION
	46	CYLINDER
	48	PISTON ROD
	50	PIN ENGAGING PORTION
5	52, 58	CONNECTING MEMBER
	54	INTERMEDIATE MEMBER
	56	SCISSORS FLIP-UP PIN (TRANSFORMATION MECHANISM)
	60	LASER SENSOR (OWN-LOCATION ESTIMATION UNIT)
	70	SWIVELING SHAFT
10	72	GROUND CONTACT POINT
	74	CARTWHEEL
	76	RUNNING DRIVE UNIT
	78	SWIVELING DRIVE UNIT
	80	AXEL
15	82	WHEEL
	84	TIRE
	86	SWIVELING ELECTRIC MOTOR
	88	SWIVELING SPEED REDUCER
	90	SWIVELING CHAIN (POWER TRANSMISSION UNIT)
20	92	UPRIGHT
	94, 98	SPROCKET
	96	OUTPUT SHAFT
	100	DRIVING ELECTRIC MOTOR
	102	DRIVING SPEED REDUCER
25		

CLAIMS

1. A drive unit for a carriage capable of autonomous running comprising:
 - a swiveling shaft rotatively provided on a carriage
 - 5 body in a vertical direction;
 - a cartwheel held on the swiveling shaft, a ground contact point of the cartwheel serving as a swiveling center and being arranged on a same axis with the swiveling shaft;
 - 10 a running drive unit configured to rotate the cartwheel as a driving wheel; and
 - a swiveling drive unit configured to swivel the swiveling shaft to steer the cartwheel as a steering wheel.
- 15 2. The drive unit according to claim 1, wherein the cartwheel includes:
 - a wheel; and
 - a tire made of an elastic material attached on an outer circumference of the wheel.
- 20 3. The drive unit according to claim 1 or 2, wherein the swiveling drive unit includes:
 - an electric motor provided at an eccentric position from the swiveling shaft; and
 - 25 a power transmission unit configured to transmit a driving force of the electric motor to the swiveling shaft.
4. A horizontal conveyance carriage for horizontally conveying a conveyance object comprising
- 30 the drive unit according to any one of claims 1 to 3 as a driving steering wheel.
5. The horizontal conveyance carriage according to claim

4, further comprising:

a carriage main body including:

a pedestal portion for depositing a loaded conveyance object; and

5 the drive unit;

a forklift attached to the carriage main body and configured to perform loading/unloading the conveyance object from outside on the pedestal portion;

10 an extension mechanism configured to extend and retract the forklift in a front-and-rear direction;

an elevating mechanism configured to raise and lower the forklift in an up-and-down direction;

15 a support mechanism provided for preventing the forklift from being in a cantilever state while loading/unloading the conveyance object and configured to support the forklift from below;

an own-location estimation unit configured to estimate an own-location of the carriage main body;

20 a positional-relation recognition unit configured to recognize positional relation between the own-location and the conveyance object; and

25 a control unit configured to control, based on the own-location and the positional relation, a movement of the carriage main body by the drive unit, and operation of the forklift by the extension mechanism and the elevating mechanism.