

DESCRIPTION
CONSTRUCTION ROBOT

Field

[0001] The present invention relates to a construction
5 robot for achieving labor and manpower saving in a
construction work.

Background

[0002] As part of conventional construction of an
interior floor of a building, a raised floor (hereinafter,
10 sometimes referred to as a double floor) has been formed by
installing a floor above another, to secure a space that
can be used for network cabling, ventilation, and the like,
between the upper and the lower floor, and installing
supports and panels for the double floor (for example,
15 refer to Patent Literature 1). A worker carries out such
an installation work manually by crouching down, and, in
order to deal with the unevenness of the concrete floor,
adjusts the height using a rotating laser level installed
in the construction site as a reference to ensure
20 horizontality and flatness. Generally, there are a large
number of double floor installations, and it is necessary
to repeat the process of transporting the materials to the
installation site, mounting the materials, and adjusting
the height, a large number of times.

25 [0003] To address this issue, the applicant of the
present patent application has disclosed a construction
robot, as described in Patent Literature 2. The
construction robot disclosed in Patent Literature 2 is a
robot used for mounting a member on a body, the robot
30 including: a base; one or more manipulators that are
provided to the base; an end effector that is removably
provided to a distal end of the manipulator; a recognizing
unit that is provided to the distal end of the manipulator

or to the end effector, and that recognizes the types and the positions of the member and the body; and a measuring unit that measures a positional relation between the distal end of the manipulator or the end effector and the body.

5 The manipulator includes a movement control unit that moves the distal end of the manipulator closer to a preset position of the body, and the end effector includes a member holding unit for holding the member, a mounting operating unit for making an operation of mounting the
10 member held by the member holding unit on the body, and a monitoring unit for monitoring the condition of the mounting.

Citation List

Patent Literature

15 [0004] Patent Literature 1: Japanese Patent Application Laid-open No. 2018-178473

Patent Literature 2: Japanese Patent Application Laid-open No. 2017-110466

Summary

20 Technical Problem

[0005] When the construction robot disclosed in Patent Literature 2 is to be used in the construction of a double floor, possible applications of the construction robot include those in a task of fixing a support held by the end
25 effector to the floor using adhesive while adjusting the height of the support, and a task of mounting a double floor panel on the support using the end effector. Among these tasks, to improve the efficiency of the task of the support installation, it is necessary to perform the task
30 in a short time, by installing a support and to adjust the height of the support based on the unevenness of the concrete floor simultaneously. Therefore, there has been a demand for a technology making it possible to install a

support and to adjust the height of the support simultaneously.

[0006] The present invention is made in consideration of the above, and an object of the present invention is to
5 provide a construction robot that is capable of installing a support and to adjust the height of the support simultaneously.

Solution to Problem

[0007] To solve the above-described problem and achieve
10 the object, a construction robot according to the present invention for mounting a member with a changeable height on a body at a predetermined height includes: a manipulator; an end effector provided at a distal end of the manipulator; a recognizing unit configured to recognize
15 positions of the member and the body; and a measuring unit configured to measure a positional relation between the member and the body, wherein the end effector includes a holding unit configured to hold the member in a releasable manner, and a height adjusting unit configured to adjust a
20 height of the member by moving the member in contact with the body in a direction moving closer to or in a direction moving away from the body.

[0008] Moreover, in the above-described construction robot according to the present invention, the member is a
25 support including: a screw shaft positioned on a side of the body; and a seat screwed onto the screw shaft and configured to move in a direction along the screw shaft, and the height adjusting unit is configured to adjust a height of the support by rotating the seat of the support
30 about the screw shaft.

[0009] Moreover, in the above-described construction robot according to the present invention, the height adjusting unit includes: a sliding mechanism provided

slidably along an axial direction with respect to the holding unit; a rotating mechanism configured to move integrally with the sliding mechanism, and rotate the seat of the support; and a recognizing mechanism configured to
5 move integrally with the sliding mechanism, recognize the height of the support, and adjust the height of the support by rotating the seat of the support based on the height recognized by the recognizing mechanism.

Advantageous Effects of Invention

10 [0010] Regarding a construction robot according to the present invention, the construction robot is a construction robot for mounting a member with a changeable height on a body at a predetermined height, the construction robot including: a manipulator, an end effector that is provided
15 to a distal end of the manipulator, a recognizing unit that recognizes positions of the member and the body, and a measuring unit that measures a positional relation between the member and the body, in which the end effector includes a holding unit that holds the member in a releasable
20 manner, and a height adjusting unit that adjusts a height of the member by moving the member having been brought into contact with the body in a direction moving closer to or in a direction moving away from the body. Thus, an advantageous effect is exerted in which it is possible to
25 install the member such as a support and to adjust the height of the member simultaneously.

[0011] Furthermore, regarding another construction robot according to the present invention, the member is a support including a screw shaft that is positioned on a side of the
30 body, and a seat that is screwed onto the screw shaft and is movable in a direction along the screw shaft, and the height adjusting unit adjusts a height of the support by rotating the seat of the support about the screw shaft.

Thus, an advantageous effect is exerted in which it is possible to install the support and to adjust the height of the support simultaneously.

[0012] Furthermore, regarding another construction robot according to the present invention, the height adjusting unit includes a sliding mechanism that is provided slidably along an axial direction with respect to the holding unit, a rotating mechanism that is movable integrally with the sliding mechanism and configured to rotate the seat of the support, and a recognizing mechanism that is movable integrally with the sliding mechanism and that recognizes the height of the support, and the height adjusting unit adjusts the height of the support by rotating the seat of the support based on the height recognized by the recognizing mechanism. Thus, an advantageous effect is exerted in which it is possible to install the support and to adjust the height of the support simultaneously, and therefore, it is possible to carry out the installation efficiently, advantageously.

Brief Description of Drawings

[0013] FIG. 1 is a schematic illustrating an embodiment of a construction robot according to the present invention, where (1) is a front view, and (2) is a side view.

FIG. 2 is a schematic illustrating a first installation step according to the embodiment, where (1) is a front view, and (2) is a side view.

FIG. 3 is a schematic illustrating a second installation step according to the embodiment, where (1) is a front view, and (2) is a side view.

FIG. 4 is a schematic illustrating a third installation step according to the embodiment, where (1) is a front view, and (2) is a side view.

Description of Embodiments

[0014] An embodiment of the construction robot according to the present invention will now be explained in detail with reference to the drawings. This embodiment is, however, not intended to limit the scope of the present invention.

[0015] As illustrated in FIG. 1, a construction robot 10 according to the embodiment is used for mounting a support S (a member with a changeable height) for a double floor, on a concrete floor F (body) at a predetermined height. This construction robot 10 includes a manipulator 12, a support installing unit 14 (end effector) provided to a distal end of the manipulator 12, a camera 16 (recognizing unit), and a laser distance sensor 18 (measuring unit). The manipulator 12 is a robot arm for handling the support installing unit 14.

[0016] The support S has a base plate S1 that is brought into contact with the floor F, a screw shaft S2 (height adjustment screw) that is provided upright to the base plate S1, and a seat S3 that is screwed onto the screw shaft S2. By rotating the seat S3 about the screw shaft S2, it is possible to move the seat S3 in a direction along the screw shaft S2, and to adjust the height H of the support S.

[0017] The camera 16 and the laser distance sensor 18 are mounted on a sensor base 22 provided laterally in a manner overhanging from a base portion 20 of the support installing unit 14, and the axes of the camera and the sensor are directed to a distal end side in the axial direction C of the support installing unit 14. The camera 16 acquires an image at a given time interval. By causing a control unit not illustrated to apply an analyzing process to the acquired image, it is possible to recognize the support S and a standard marking (position) on the

floor F. The laser distance sensor 18 is configured to measure the height H of the support and the floor level with a laser beam. With this laser distance sensor 18, it is possible to understand the positional relation between the support S and the floor F.

[0018] The support installing unit 14 includes a support holding cylinder 24, a support holding unit 26, and a support height adjusting unit 28.

[0019] The support holding cylinder 24 is provided on a distal end flange 30 of the base portion 20, and includes a cylinder that is extendable and contractible in a direction perpendicular to the axial direction C. Extending and contracting operations of the support holding cylinder 24 are controlled by the control unit not illustrated.

[0020] The support holding unit 26 is a holding unit that holds the seat S3 of the support S in a releasable manner, and includes L-shaped members extending from respective ends of the support holding cylinder 24 toward the distal end side in the axial direction C and bending inwards, in a front view. When the support holding cylinder 24 contracts, the claws of the support holding unit 26, the claws being bent inwards, move in the directions approaching each other, and go under the respective edges of the seat S3. In this manner, it is possible to hold the support S. By contrast, when the support holding cylinder 24 extends, the claws move in the directions separating from each other, and become separated from the respective edges of the seat S3. In this manner, it is possible to release the support S.

[0021] The support height adjusting unit 28 is a height adjusting unit for adjusting the height H of the support S by moving the support S brought into contact with the floor F in a direction moving closer to the floor F or a

direction moving away from the floor F, and includes sliding mechanisms 32, a support rotating mechanism 34, and a rotating laser level light receiver 36.

[0022] The sliding mechanisms 32 are provided at four
5 points around the base portion 20, on the distal end flange 30 of the base portion 20. Each of the sliding mechanisms 32 includes a sliding pole 38 that is positioned in a manner passing through the distal end flange 30 and in a
10 slidable manner with respect to the distal end flange 30 in the axial direction C, and a coil spring 40 that is wound around the sliding pole 38 on the side of the base portion 20. The coil spring 40 is positioned between the distal end flange 30 and one end of the sliding pole 38 on the
15 side of the base portion 20, and is provided in a manner capable of applying a biasing force in the direction separating the one end of the sliding pole 38 from the distal end flange 30. To the other end of the sliding pole 38, a height adjustment plate 42 is fixed. Because the
20 support height adjusting unit 28 is connected to the base portion 20 with the sliding poles 38 therebetween, the support height adjusting unit 28 moves freely only in the axial direction C by sliding with its own weight, and follows the movement of the support S with a changing height H.

25 [0023] The support rotating mechanism 34 is a rotating mechanism that is movable integrally with the sliding mechanisms 32, and that is configured to rotate the seat S3 of the support S. This support rotating mechanism 34 is provided to the height adjustment plate 42, and includes a
30 support rotating servo motor 44, a belt 46, pulleys 48, 50, and a rotor 52. The output shaft of the support rotating servo motor 44 is coupled to the pulley 48, and the belt 46 is wound around the pulleys 48, 50. The pulley 50 is

coupled to the rotor 52. The rotor 52 is provided coaxially with the axial direction C, and is engageable with an end of the seat S3 of the support S. By causing the control unit not illustrated to drive the support
5 rotating servo motor 44 and to rotate the seat S3 of the support S about the screw shaft S2 via the belt 46, the pullies 48, 50, and the rotor 52, it is possible to adjust the support height H. The support height adjusting unit 28 can also follow a change in the height H of the support,
10 the change caused by the support rotating mechanism 34.

[0024] The rotating laser level light receiver 36 is movable integrally with the sliding mechanism 32, and implements a recognizing mechanism for recognizing the support height H. This rotating laser level light receiver
15 36 is provided on the height adjustment plate 42. This rotating laser level light receiver 36 receives a laser beam from a rotating laser level, not illustrated, that is installed in the construction site, and detects the support height H in real-time, using the laser beam as a reference.
20 The operation of the support rotating servo motor 44 is controlled by the control unit not illustrated, based on the height H detected by the rotating laser level light receiver 36. The control unit drives the support rotating servo motor 44 and rotates the seat S3 of the support S
25 based on the height H detected by the rotating laser level light receiver 36 so as to adjust the support height H to a preset support installation height.

[0025] Steps for installing a support using the construction robot 10 described above will now be
30 explained.

[0026] First, the manipulator 12 moves the support installing unit 14 near a support holding position in a material storage, for example, and the support holding

position is detected using the camera 16 and the laser distance sensor 18.

[0027] The support holding unit 26 is then opened, and the manipulator 12 is caused to move the support installing unit 14 to the support holding position by approaching the support S from immediately above. After the rotor 52 is brought into contact with the support S, and the sliding poles 38 are moved by a certain length, the support holding unit 26 is closed to hold the support S.

10 [0028] The manipulator 12 is then caused to move the support S to an adhesive applying unit, and the laser distance sensor 18 is caused to recognize the height position of the liquid surface of the adhesive. By moving the support S to the height position, the adhesive is applied to the lower surface of the base plate S1 of the support S.

[0029] The manipulator 12 is then caused to move the support S near a support installation position, and the camera 16 is caused to detect the reference marking of the support installation position, the reference marking having been provided in advance, and the laser distance sensor 18 is caused to recognize the floor level.

20 [0030] The manipulator 12 is then caused to move the support S to the support installation position, and causes the base plate S1 of the support S to land on the floor F, as illustrated in FIG. 2. The support holding unit 26 is then opened, as illustrated in FIG. 3. In this manner, it is possible to install the support S on the floor F.

[0031] The rotating laser level light receiver 36 is then caused to detect the laser beam from the rotating laser level, not illustrated, installed in the construction site, and the support height H is recognized using the detected laser beam as a reference. The support height H

is then adjusted to the preset support installation height, by driving the support rotating servo motor 44, and causing the rotor 52 to rotate the support S about the screw shaft S2, as illustrated in FIG. 4. Illustrated in FIG. 4 is an example in which the support height H is lowered. To elevate, the support S is rotated in a reverse direction.

[0032] In the manner described above, by installing the support S using the construction robot 10, it is possible to install the support S on the floor F and to adjust the support height H simultaneously. In this manner, it is possible to carry out the installation efficiently.

[0033] Explained above in the embodiment is an example in which the construction robot is used in installing a support of a double floor such as a raised floor, but applications of the construction robot according to the present invention are not limited thereto, and the construction robot may be used in any construction work for mounting a member with a changeable height on a body at a predetermined height.

[0034] As described above, regarding the construction robot according to the present invention, the construction robot is a construction robot used for mounting a member with a changeable height on a body at a predetermined height, the construction robot including: a manipulator, an end effector that is provided to a distal end of the manipulator, a recognizing unit that recognizes positions of the member and the body, and a measuring unit that measures a positional relation between the member and the body, in which the end effector includes a holding unit that holds the member in a releasable manner, and the height adjusting unit that adjusts a height of the member by moving the member having been brought into contact with the body in a direction moving closer to or in a direction

moving away from the body. Thus, it is possible to install the member such as a support and to adjust the height of the member simultaneously.

[0035] Furthermore, regarding another construction robot according to the present invention, the member is a support including a screw shaft that is positioned on a side of the body, and a seat that is screwed onto the screw shaft and is movable in a direction along the screw shaft, and the height adjusting unit adjusts a height of the support by rotating the seat of the support about the screw shaft. Thus, it is possible to install the support and to adjust the height of the support simultaneously.

[0036] Furthermore, regarding another construction robot according to the present invention, the height adjusting unit includes a sliding mechanism that is provided slidably along an axial direction with respect to the holding unit, a rotating mechanism that is movable integrally with the sliding mechanism and configured to rotate the seat of the support, and a recognizing mechanism that is movable integrally with the sliding mechanism and that recognizes the height of the support, and the height adjusting unit adjusts the height of the support by rotating the seat of the support based on the height recognized by the recognizing mechanism. Thus, it is possible to install the support and to adjust the height of the support simultaneously, so that it is possible to carry out the installation efficiently.

Industrial Applicability

[0037] As described above, the construction robot according to the present invention is useful as a construction robot for achieving labor and manpower saving in a construction work, and is particularly suitable for efficiently installing a support in the construction of a

double floor.

Reference Signs List

	[0038]	10	construction robot
		12	manipulator
5		14	support installing unit (end effector)
		16	camera (recognizing unit)
		18	laser distance sensor (measuring unit)
		20	base portion
		22	sensor base
10		24	support holding cylinder
		26	support holding unit (holding unit)
		28	support height adjusting unit (height adjusting unit)
		30	distal end flange
15		32	sliding mechanism
		34	support rotating mechanism
		36	rotating laser level light receiver
		38	sliding pole
		40	coil spring
20		42	height adjustment plate
		44	support rotating servo motor
		46	belt
		48, 50	pulley
		52	rotor
25	C		axial direction
	F		floor (body)
	H		support height
	S		support (member)
	S1		base plate
30	S2		screw shaft
	S3		seat

CLAIMS

1. A construction robot for mounting a member with a changeable height on a body at a predetermined height, the construction robot comprising:

5 a manipulator;

an end effector provided at a distal end of the manipulator;

a recognizing unit configured to recognize positions of the member and the body; and

10 a measuring unit configured to measure a positional relation between the member and the body, wherein

the end effector includes

a holding unit configured to hold the member in a releasable manner, and

15 a height adjusting unit configured to adjust a height of the member by moving the member in contact with the body in a direction moving closer to or in a direction moving away from the body.

20 2. The construction robot according to claim 1, wherein the member is a support including:

a screw shaft positioned on a side of the body;

and

a seat screwed onto the screw shaft and

25 configured to move in a direction along the screw shaft, and

the height adjusting unit is configured to adjust a height of the support by rotating the seat of the support about the screw shaft.

30

3. The construction robot according to claim 2, wherein the height adjusting unit includes:

a sliding mechanism provided slidably along an

axial direction with respect to the holding unit;
a rotating mechanism configured to
move integrally with the sliding mechanism,
and
5 rotate the seat of the support; and
a recognizing mechanism configured to
move integrally with the sliding mechanism,
recognize the height of the support, and
adjust the height of the support by rotating
10 the seat of the support based on the height recognized by
the recognizing mechanism.