

DESCRIPTION

Title of the Invention

CONTAINER CRANE

Technical Field

[0001]

The present invention relates to a container crane, and particularly, to container detection of the container crane. Priority is claimed on Japanese Patent Application No. 2013-013468, filed January 28, 2013, the content of which is incorporated herein by reference.

Background Art

[0002]

In container ships or container terminals that perform loading, unloading, or the like of containers to visitor chassis or the like, full automation or manpower saving has proceeded from viewpoints of cost reduction or the like.

Particularly, when containers are stacked and stored, the positional deviation of stored containers may occur under the influence of wind, deformation of the containers, or the like. Therefore, in order to avoid contact with a held container under carrying and a stored container, it is necessary to detect an obstacle around the held

container and avoid interference of the obstacle.

[0003]

Thus, PTL 1 proposes a technique of measuring the position of a target and the position of an obstacle and storing a held container, using laser scanners arranged at a trolley.

Additionally, PTL 2 proposes a technique of attaching CCD cameras to a spreader, and detecting respective edges of a held container and a target container through image processing of a camera image.

Moreover, PTL 3 describes that the position of a row adjacent a target container is detected in advance and the envelope of the adjacent row is evaluated.

Additionally, PTL 4 describes that an obstacle in the vicinity of a lower end of a held container is detected by an infrared beam sensor provided at a spreader.

Citation List

Patent Literature

[0004]

[PTL 1] JP-T-2002-527317

[PTL 2] JP-A-2002-205891

[PTL 3] JP-A-2003-034490

[PTL 4] JP-A-2006-232496

Summary of Invention

Technical Problem

[0005]

However, in the technique described in the above-described PTL 1, the laser scanners are provided at the trolley. Therefore, particularly when the spreader is lowered, there is a problem in that a region where the spreader becomes obstructive and measurement cannot be performed may be formed. Additionally, since the distance between a target container on which the held container is placed or a row adjacent to the target container and the above-described laser scanner is large, a problem occurs in that an improvement in detection precision is difficult.

[0006]

Furthermore, in the case of the techniques described in PTLs 1 to 4, it is necessary to individually provide a number of sensors, such as sensors for landing of the held container that detect the respective edges of the held container and the target container, and a sensor for collision avoidance that measures the position of the adjacent row. Therefore, there is a problem in that cost is increased due to an increase in the number of parts, complication of a control system, or the like.

[0007]

The invention has been made in view of the above circumstances, and an object thereof is to provide a container crane that can widely and accurately detect an

obstacle or the like, and can suppress a cost increase caused by an increase in the number of parts, complication of a control system, or the like.

Solution to Problem

[0008]

According to a first aspect of the invention, a container crane includes a gantry device; a girder that is supported by the gantry device and extends in a horizontal direction; a trolley that is capable of traveling along the girder; a spreader that is hung from the trolley and is capable of engaging and disengaging a container; a hoist mechanism that moves the spreader up and down; a laser scanner that is provided at the spreader, and emits laser light to obtain the coordinates of a measuring point of an article of interest; and a crane control apparatus that controls the driving of the trolley and the spreader based on the coordinates of the measuring point obtained using the laser scanner.

By configuring the invention in this way, since the laser scanner moves up and down together with the spreader, a region where the spreader becomes obstructive and measurement cannot be performed by the laser scanner can be prevented from being formed. Additionally, the distances between the laser scanner, and the target container and a row adjacent to the target container can

be shortened. Additionally, simply by the laser scanner disposed at the spreader without individually providing a sensor for causing the held container engaged with the spreader to be landed or a sensor for preventing a collision, the positions of the held container and the target container can be detected, and the position of the adjacent row can be measured.

[0009]

According to a second aspect of the invention, the laser scanner may be provided at a side portion of the spreader in a width direction.

By configuring the invention in this way, a gap between adjacent containers can be accurately detected.

[0010]

According to a third aspect of the invention, the crane control apparatus may include a deviation calculating unit that makes the laser scanner perform scanning in a range in a horizontal direction from below the spreader, obtains an envelope of a held container engaged with the spreader and a target container having the held container placed on an upper surface thereof, based on the coordinates of the measuring point obtained using the laser scanner, and obtains a positional deviation between the held container and the target container based on the envelope.

By configuring the invention in this way, the positional deviation between the held container and the target container can be calculated based on a detection result of the laser scanner.

[0011]

According to a fourth aspect of the invention, the crane control apparatus may include an obstacle distance determining unit that determines the distance between a surrounding obstacle and the laser scanner based on the coordinates of the measuring point obtained using the laser scanner; and a lowering limiting control unit that limits the lowering operation of the spreader based on the distance between the surrounding obstacle and the laser scanner.

By configuring the invention in this way, the lowering operation of the spreader can be limited before the held container collides against an obstacle, based on the distance between the laser scanner and the obstacle.

[0012]

According to a fifth aspect of the invention, the container crane may further include an accumulating unit that accumulates the coordinates of the measuring point.

By configuring the invention in this way, the coordinates of the measuring points detected at various trolley positions can be accumulated. As a result, the

driving of the spreader, also including the coordinates of a measuring point at a place that cannot be detected at a current trolley position, can be controlled so that the held container does not interfere with an obstacle.

Advantageous Effects of Invention

[0013]

According to the container crane related to the aspects of the above invention, an obstacle or the like can be widely and accurately detected, and a cost increase caused by an increase in the number of parts, complication of the control system, or the like can be suppressed.

Brief Description of Drawings

[0014]

Fig. 1 is a perspective view of a container crane in an embodiment of the invention.

Fig. 2 is a front view of the container crane and a lane.

Fig. 3 is a plan view of a spreader included in the container crane.

Fig. 4 is a functional block diagram for performing the control of lowering a held container on a target container on which the held container is stacked, in a crane control apparatus of the container crane.

Fig. 5 is a perspective view illustrating the held container, the target container, and a scanning range of a

laser scanner.

Fig. 6 is an explanatory view of an envelope between the held container and the target container.

Fig. 7 is a functional block diagram for performing the control of preventing the held container from colliding against an obstacle, in the crane control apparatus.

Fig. 8 is an explanatory view of an envelope between the held container and a container in an adjacent row.

Fig. 9 is a functional block diagram for obtaining a container stack shape in each bay of the lane in the crane control apparatus.

Fig. 10 is a front view illustrating an example of the arrangement of a laser scanner that detects measuring point coordinates, in the container crane.

Fig. 11 is a front view illustrating an example of the arrangement, which is different from Fig. 10, of the laser scanner that detects measuring point coordinates, in the container crane.

Fig. 12 is an explanatory view illustrating a container stack shape determined in the arrangement of the laser scanner of Fig. 10.

Fig. 13 is an explanatory view illustrating a container stack shape determined in the arrangement of the laser scanner of Fig. 11.

Fig. 14 is an explanatory view of a method for obtaining measuring point coordinates in the container crane.

Description of Embodiments

[0015]

Next, a container crane in an embodiment of the invention will be described with reference to the drawings. A container crane 1 in this embodiment is provided in a container yard of a container terminal that performs unloading of containers C, loading of the containers C, or the like with respect to a container ship that has come alongside a quaywall, for example.

[0016]

Figs. 1 and 2 are views illustrating a schematic configuration of the container crane 1 of this embodiment.

As illustrated in Figs. 1 and 2, the container crane 1 is disposed at each of a plurality of lanes 2 provided in the container yard to perform loading and unloading of the containers C. The container crane 1 is made mobile by a gantry device 4 having wheels with a tire. The container crane 1 is formed in a substantially portal shape including two pairs of leg portions 5 that are supported by the gantry device 4, and a crane girder 6 that connects upper end portions of these leg portions 5. The container crane 1 includes a trolley 7 that is able to

traverse on the crane girder 6. The trolley 7 includes a hoisting device 8 (refer to Fig. 1), and a spreader 10 is hung in a hoistable manner from the hoisting device 8 via a hoisting wire 9.

[0017]

Here, the containers C stored in the lanes 2 are containers such as ISO standard containers. The containers C are formed in a rectangular parallelepiped shape with a predetermined length that is represented by 20 feet or 40 feet. A plurality of bays where the longitudinal dimension of one of the containers C is a unit length are set in a longitudinal direction of each lane 2. Additionally, a plurality of rows 12 where the transverse dimension of the containers C is a unit length are set in each bay. A plurality of stages of the containers C are capable of being stacked and stored in the rows 12. In each lane 2, the positions of the containers C are capable of being specified based on the positions of the bays, the positions of the rows 12, and the number of stages in the rows 12. The spacing between the rows 12 adjacent to each other is set as narrowly as possible for the purpose of improving storage density.

[0018]

Additionally, a traveling path 14 of a carriage 13, such as an automated guided vehicle (AGV), is laid between

the leg portions 5 of the container crane 1, and the container crane 1 receives a container C that is carried by the carriage 13, and stores the container C at a predetermined storage position of the lane 2. On the other hand, the container crane 1 transfers a container C stored in the lane 2 to the carriage 13, thereby carrying out the container C to the outside of the lane 2.

[0019]

As illustrated in Fig. 3, the spreader 10 is a device for hoisting up a container C, and includes a spreader body 15, engaging and disengaging mechanisms 16, and sliding mechanisms 17.

The spreader body 15 includes horizontal frames 15a and vertical frames 15b that form a skeleton of the spreader 10, and pulleys 18 (refer to Fig. 1) around which the hoisting wire 9 is stretched are disposed at a central upper portion of the spreader body.

[0020]

The engaging and disengaging mechanisms 16 include locking pieces (not illustrated), such as so-called twist locks, which engage and disengage engagement holes (not illustrated) that are respectively formed at upper four corners of the container C. The engaging and disengaging mechanisms 16 are able to be arranged at positions that face the engagement holes of the container C. More

specifically, the engaging and disengaging mechanisms 16 are disposed at end portions of supporting frames 19 that respectively extend parallel to the horizontal frames 15a.

[0021]

Each sliding mechanism 17 includes guide rods 20 that extend in a longitudinal direction of the container C.

The sliding mechanism 17 slidingly moves the engaging and disengaging mechanisms 16 together with the supporting frame 19 along the guide rods 20. That is, by adjusting the positions of the engaging and disengaging mechanisms 16 by means of the sliding mechanisms 17, it is possible to hoist up even containers C having different lengths by means of one spreader 10.

[0022]

Additionally, the spreader 10 includes sensor brackets 21 that extend substantially parallel to the guide rods 20 from respective end portions of the supporting frames 19 toward the spreader body 15 side. Laser scanners 22 are respectively attached to end portions of the sensor brackets 21.

That is, the laser scanners 22 are arranged on outer sides (side portions) in a width direction of a container (hereinafter simply referred to as a held container C1) held by the spreader 10. Here, the width direction of the container C is a horizontal direction orthogonal to the

longitudinal direction of the container C.

[0023]

Each laser scanner 22 is a device capable of acquiring three-dimensional coordinate data of a measuring article of interest using laser light. More specifically, the laser scanner 22 calculates a distance to a measuring article of interest, from the time that is taken until laser light is reflected and returned by the measuring article of interest. Then, the coordinates of a measuring point (hereinafter simply referred to as measuring point coordinates) are obtained depending on the distance to the measuring article of interest and the irradiation angle of the laser light. Information on the measuring point coordinates is output to a crane control apparatus 23 that controls the driving of the above-described hoisting device 8 and trolley 7, and a skew device (not illustrated).

[0024]

As illustrated in Fig. 4, the crane control apparatus 23 includes a sensor data fetching unit 24, an envelope determination processing unit 25, a deviation calculating unit 26, and a control amount calculating unit 27. The sensor data fetching unit 24, the envelope determination processing unit 25, the deviation calculating unit 26, and the control amount calculating

unit 27 are control blocks of performing a series of control when the held container C1 is lowered on a target that is set in advance on the ground of the lane 2 or on a target container (hereinafter simply referred to as a target container C2) on an upper surface of which the held container C1 is stacked (placed), based on the detection results of the laser scanners 22.

[0025]

The sensor data fetching unit 24 is an interface that fetches the detection results obtained using the respective laser scanners 22. The data of the measuring point coordinates fetched into the sensor data fetching unit 24 is output toward the envelope determination processing unit 25.

[0026]

The envelope determination processing unit 25 obtains an envelope 28 of the held container C1 and the target container C2, based on the measuring point coordinates fetched via the sensor data fetching unit 24. Here, the envelope 28 substantially coincides with a contour in the outside surfaces of the held container C1 and the target container C2 in the width direction. As illustrated in Fig. 5, the laser scanners 22 of this embodiment perform scanning with laser light from a vertically lower portion to a substantially horizontal

position in an extending direction of a bay (a traversing direction of the trolley 7), thereby obtaining the envelope 28.

[0027]

The deviation calculating unit 26 calculates a relative deviation L1 between the held container C1 and the target container C2, based on the envelope 28 obtained using the envelope determination processing unit 25. For example, when a deviation in the horizontal direction has occurred between the held container C1 and the target container C2, as illustrated in Fig. 6, an apparent step is formed in the distance to a measuring point of laser light. Therefore, measuring points of a stage near the laser scanners 22 are aligned in a substantially horizontal direction, and the deviation L1 between the held container C1 and the target container C2 can be calculated by obtaining the lengths of the envelope 28 in the horizontal direction at positions where these measuring points are aligned.

[0028]

The control amount calculating unit 27 calculates control amounts for moving the spreader 10 in a direction in which the deviation L1 decreases, based on the deviation L1 calculated by the deviation calculating unit 26. More specifically, control amounts required for the

hoisting device 8, the trolley 7, the skew device (not illustrated) that controls the inclination of the spreader 10, and the like are calculated. The crane control apparatus 23 controls the driving of the hoisting device 8, the trolley 7, and the spreader 10, based on information on the control amounts calculated by the control amount calculating unit 27.

[0029]

As illustrated in Fig. 7, the crane control apparatus 23 further includes an obstacle distance determining unit 29 and a lowering speed limit calculating unit 30. The obstacle distance determining unit 29 and the lowering speed limit calculating unit 30 perform a series of control processing that prevents the held container C1 from colliding against an obstacle.

[0030]

The obstacle distance determining unit 29 determines a distance between the held container C1 (held load) and the container C (surrounding obstacle) in the row 12 adjacent to the target container C2, based on envelopes 28a and 28b obtained using the envelope determination processing unit 25. More specifically, as illustrated in Fig. 8, as the envelope 28 obtained using the envelope determination processing unit 25, there are the envelope 28a that extends on a side surface between the held

container C1 and the target container C2, and the envelope 28b of the container C that is stored in the row 12 (hereinafter simply refereed to an adjacent row 12a) adjacent to the target container C2. The obstacle distance determining unit 29 obtains the distance between the held container C1 and a container C in the adjacent row 12a based on the distance between the envelopes 28a and 28b, and outputs information on the distance to the lowering speed limit calculating unit 30.

[0031]

The lowering speed limit calculating unit 30 determines whether or not the distance between the held container C1 and the container C in the adjacent row 12a is less than a predetermined distance. When it is determined that the distance between the held container C1 and the container C in the adjacent row 12a is less than the predetermined distance, it is determined that there is a possibility of collision between the held container C1 and the container C in the adjacent row 12a, and limitations on a lowering operation, such as lowering of the spreader 10 by the hoisting device 8, that is, setting the lowering speed of the hoisting wire 9 to "0", are set. In addition, the lowering operation may be set so as to be slowed as the distance between the held container C1 and the container C in the adjacent row 12a becomes narrower.

[0032]

As illustrated in Fig. 9, the crane control apparatus 23 further includes the measuring point coordinate calculating unit 31, a measuring points accumulating unit 32, and a container stack shape determining unit 33. The measuring point coordinate calculating unit 31, the measuring points accumulating unit 32, and the container stack shape determining unit 33 perform control processing for obtaining a container stack shape in each bay of the lane 2. Here, the container stack shape is substantially equal to a cross-sectional contour shape when it is assumed that all containers C stored in one bay are integral in the traversing direction of the trolley 7. The container stack shape is obtained for each bay in one lane 2. By obtaining the container stack shape, it is possible to move the height of the held container C1 to a proper position and rapidly and efficiently carry the held container, when the held container C1 is carried in the horizontal direction, irrespective of the detection result of the distance between the spreader 10 and an obstacle.

[0033]

The sensor data fetching unit 24 fetches detection data from an encoder 34 and a shaking sensor 35, which are provided at the trolley 7 or the like, in order to obtain

the position of the spreader 10, that is, the position of the laser scanner 22, in addition to the measuring point coordinates obtained using the above-described laser scanners 22. Here, the encoder 34 detects the traversing position of the trolley 7 and the traveling position of the container crane 1 by the gantry device 4. Additionally, the shaking sensor 35 detects the shaking amount of the spreader 10 that is hung with respect to the trolley 7. In addition, the traveling position of the container crane 1 may be obtained by receiving signals of a global positioning system (GPS) or the like.

[0034]

The measuring point coordinate calculating unit 31, as illustrated in Figs. 10 and 11, detects measuring point coordinates with the laser scanners 22 during carrying of the held container C1, or the like. The data of the respective measuring point coordinates is output toward the measuring points accumulating unit 32 in relation to the position information of the laser scanners 22. In addition, a scanning range by the laser scanners 22 is illustrated so as to be surrounded by a two-dot chain line section in Figs. 10 and 11.

[0035]

The measuring points accumulating unit 32 includes storage means, such as a memory, and associates and

accumulates the data of the measuring point coordinates input from the measuring point coordinate calculating unit 31 with the position information of the laser scanners 22. Additionally, the measuring points accumulating unit 32 performs the processing of eliminating previous measuring point coordinate data to update the previous measuring point coordinate data to the newest measuring point coordinate data, when a change has occurred in measuring point coordinates in the same bay.

[0036]

The container stack shape determining unit 33 determines the container stack shape of a target bay, based on the measuring point coordinate data accumulated in the measuring points accumulating unit 32 and the position information of the laser scanners 22.

The container stack height of each row 12 can be known from this container stack shape.

[0037]

Here, for example, when the spreader 10 is at the position illustrated in Fig. 10, a container C in the uppermost stage in the row 12 (the second row from the left in Fig. 10) surrounded by a one-dot chain line in Fig. 10 is concealed with a container C in the adjacent row 12a, and the laser light emitted from the laser scanners 22 does not arrive at this container. In this case, the

container stack shape determining unit 33 determines a container stack shape as illustrated by a thick line in Fig. 12. Here, the shape illustrated by a dashed line in Fig. 12 is a container stack shape at the maximum height of each row 12. As a default value of the container C in the row 12 where laser light does not arrive as described above, the coordinates of the maximum height position of the row 12 are used instead of the measuring point coordinates.

[0038]

Meanwhile, for example, if the spreader 10 moves from a position illustrated in Fig. 10 to a position illustrated in Fig. 11, the laser light from the laser scanners 22 is able to arrive at a container C where the laser light has not arrived, at the position of Fig. 10. Accordingly, new measuring point coordinates are detected by the measuring point coordinate calculating unit 31. Then, data, as the measuring point coordinates of a newly detected position, is added and updated to the data of the measuring point coordinates accumulated in the measuring points accumulating unit 32. Then, as illustrated in Fig. 13, a container stack shape (illustrated by the thick line in Fig. 13) to which the measuring point coordinates of a container C where laser light is able to arrive are added is obtained through calculation by the container stack

shape determining unit 33.

[0039]

Here, as illustrated in Fig. 14, measuring point coordinates (X_t, Y_t) are calculated based on main coordinates (X_s, Y_s) of the spreader 10. More specifically, if the distance in the traversing direction from the center of the spreader 10 to a laser scanner 22 is defined as "W", the distance from the laser scanner 22 to a measuring point is defined as "L", and the angle of the laser scanner 22 with respect to the vertical direction is defined as " θ ", measuring point coordinates can be obtained using the following Formula (1) and Formula (2).

[0040]

$$X_t = X_s + W + L \cdot \sin\theta \quad (1)$$

$$Y_t = Y_s - L \cdot \cos\theta \quad (2)$$

[0041]

The measuring point coordinate calculating unit 31 carries out the calculation of the measuring point coordinates with respect to respective angles at which the laser scanner 22 performs scanning. The obtained measuring point coordinates are sequentially accumulated in the measuring points accumulating unit 32.

[0042]

Accordingly, according to the container crane 1 of

the above-described embodiment, since the laser scanners 22 are movable up and down together with the spreader 10, a region where the spreader 10 becomes obstructive and measurement cannot be performed by the laser scanners 22 can be prevented from being formed. Additionally, the distances between the laser scanners 22, and the target container C2 and the container C in the adjacent row 12a can be shortened.

Moreover, simply by the laser scanners 22 disposed at the spreader 10 without individually providing a sensor for causing the held container C1 engaged with the spreader 10 to be landed or a sensor for preventing a collision, the positions of the held container C1 and the target container C2 can be detected, and the position of the container C in the adjacent row 12a can be measured.

As a result, an obstacle or the like can be widely and accurately detected, reduction of the number of parts and simplification of control can be achieved, and a cost increase can be suppressed.

[0043]

Additionally, since the gap between the respective rows 12 adjacent to each other can be accurately detected, and even if the container crane 1 is fully automated or saved in manpower, the gap between the containers C can be minimized to improve the storage density of the containers

C.

[0044]

Moreover, since the positional deviation between the held container C1 and the target container C2 can be calculated based on the detection results of the laser scanners 22, the held container C1 can be accurately caused to land on the target container C2.

[0045]

Additionally, since the lowering operation of the spreader 10 can be limited based on a distance from an obstacle, such as the container C in the adjacent row 12a before the held container C1 collides against the obstacle, damage to the held container C1 can be prevented.

[0046]

Moreover, since measuring point coordinates detected at various traversing positions of the trolley 7 are accumulated, measuring point coordinates that cannot be detected at the current traversing position of the trolley 7 can be accumulated, and the container stack shape of a target bay can be more accurately detected. Therefore, the driving of the spreader 10 can be controlled so that the held container C1 does not interfere with an obstacle. As a result, since the height of the spreader 10 can be adjusted in advance based on the situation of a bay of a container yard, the carrying time of the held container C1

can be shortened compared to a case where the spreader 10 is moved so as to detect the distance from an obstacle and avoid the obstacle.

[0047]

In addition, the invention is not limited to the above-described embodiment, and design changes can be made without departing from the concept of the invention.

For example, although a case where the laser scanners 22 detect a container C stored in a bay has been described in the above-described embodiment, the object to be detected is not limited to the container C, and may be objects other than the container C.

[0048]

For example, as illustrated in Fig. 14, a carriage 13 that travels between container cranes 1 may be detected. Moreover, it may be detected whether the carriage 13 is in a state where a container C is loaded or in an empty state. When such a configuration is adopted, an exclusive sensor for detecting the carriage 13 can be omitted, and the number of parts can be further reduced.

[0049]

Additionally, although a case where the container stack shape of a target bay is determined only based on the measuring point coordinates obtained using the laser scanners 22 has been described in the above-described

embodiment, the invention is not limited to this.

For example, when a stored container C is held by the spreader 10 or when the container C is stacked, the coordinates of a container C that is being stacked on the row 12 may be determined based on the height position of the spreader 10 detected by the encoder or the like, and the determination results may be stored in the measuring points accumulating unit 32.

[0050]

Moreover, although the portal-shaped container crane has been described as an example in the above-described embodiment, the shape of the container crane is not limited to the portal shape and is also not limited to the crane including the gantry device 4 having the wheels with tires. Moreover, the invention can be applied to cranes in which the traveling path 14 is not laid between the leg portions 5. Additionally, although a case where the held container C1 is landed on the target container C2 has been described in the above-described embodiment, the held container may be landed within a division of a row 12 on the ground. Additionally, when there is a row 12 with no containers C, the measuring point coordinates of the ground may be obtained.

Industrial Applicability

[0051]

According to this container crane, an obstacle or the like can be widely and accurately detected, and a cost increase caused by an increase in the number of parts, complication of the control system, or the like can be suppressed.

Reference Signs List

[0052]

4: GANTRY DEVICE

6: CRANE GIRDER (GIRDER)

7: TROLLEY

10: SPREADER

8: HOISTING DEVICE (HOIST MECHANISM)

22: LASER SCANNER

23: CRANE CONTROL APPARATUS

C1: HELD CONTAINER

C2: TARGET CONTAINER

26: DEVIATION CALCULATING UNIT

29: OBSTACLE DISTANCE DETERMINING UNIT

30: LOWERING SPEED LIMIT CALCULATING UNIT (LOWERING
LIMITING CONTROL UNIT)

32: MEASURING POINTS ACCUMULATING UNIT (ACCUMULATING
UNIT)

[Claim 1]

A container crane comprising:

- a gantry device;
- a girder that is supported by the gantry device and extends in a horizontal direction;
- a trolley that is capable of traveling along the girder;
- a spreader that is hung from the trolley and is capable of engaging and disengaging a container;
- a hoist mechanism that moves the spreader up and down;
- a laser scanner that is provided at the spreader, and emits laser light to obtain the coordinates of a measuring point of an article of interest; and
- a crane control apparatus that controls the driving of the trolley and the spreader based on the coordinates of the measuring point obtained using the laser scanner;

wherein the laser scanner is provided at a side portion of the spreader in a width direction, and

wherein the crane control apparatus includes a deviation calculating unit that makes the laser scanner perform scanning in a range in a horizontal direction from below the spreader, obtains an envelope of a held container engaged with the spreader and an envelope of a target container having the held container placed on an upper surface thereof, based on the coordinates of the measuring point obtained using the laser scanner, and obtains a positional deviation in the horizontal direction between the held container and the target container based on a horizontal distance between the envelope of the held container and the envelope of the target container.

[Claim 2]

The container crane according to Claim 1,

wherein the crane control apparatus includes:

- an obstacle distance determining unit that determines the distance between a surrounding obstacle and the laser scanner based on the coordinates of the measuring point obtained using the laser scanner; and
- a lowering limiting control unit that limits the lowering operation of the spreader based on the distance between the surrounding obstacle and the laser scanner.

[Claim 3]

The container crane according to Claim 1 or 2, further comprising:
an accumulating unit that accumulates the coordinates of the measuring point.