

Description**Method to determine the location of a vehicle**

- 5 The invention concerns a method to determine the location of a vehicle pursuant to the main term of the 1st patent claim.

10 The invention may be used everywhere where vehicles, particularly portal stackers, have to be brought into precise position at a container crane in order that the container crane need not be repositioned.

15 Container cranes are particular container bridge cranes used for the unloading of ships as well as stacking cranes used in container yards. It has previously been the case that container transshipment using container cranes/portal stacking cranes have taken place under manual control only. When the load is transferred to the container crane, it is the task of the driver of the transport vehicle to place the container approximately centrally below the container crane. As a rule the container crane then has to be repositioned in order to pick up the load. The problem in configuring a fully automatic container crane is therefore to always position the transporting vehicle
20 exactly centrally below the container crane for the transfer of the load, such that the container crane can pick up the load without being repositioned. This presumes that the transport vehicle is precisely oriented to the container crane such that it is possible to place the container in a precise fashion.

25 DE 36 06 363 describes equipment to determine the location of a vehicle relative to container lifting equipment in which at least two sensors functioning using ultrasonics, and installed with parallel axes, take up an unchanged position with respect to a frame on the lifting equipment, in which the transport vehicle has reflectors with evaluation equipment coupled to a detection device, and in which
30 holding marks are required in order to implement the positioning.

The disadvantages of this method are also that in order to enable orientation certain equipment is required, such as holding marks, reflectors and similar, in order to determine the position of the transportation vehicle or the container.

35 The task facing standard engineering practice is therefore to develop a method with which a transportation vehicle, preferentially a portal stacker, can orient itself with respect to a container crane without the need to attach markers to the container crane such that the vehicle can be operated automatically in that the position of the
40 vehicle with respect to the container crane is always exactly known.

According to the characteristics of the first patent claim these problems are solved. Sub-claims describe advantageous configurations of the invention.

The method pursuant to the invention to determine the location of a vehicle relative to a container crane is based on the principle that container cranes have, in the area of the support legs, a specific particular contour up to a certain height created by the support legs. This specific contour can be used for the orientation of the vehicle, for example a portal stacker. For orientation purposes, it is necessary that for example the portal stacker has a piece of scanner equipment. This scanner, for example a laser scanner, can be arranged on the upper edge of the portal stacker, looking in the direction of travel. The laser scanner scans the support legs of the portal crane and uses them as a positioning aid. This can be implemented in that the angle of the scanner and the spacing of the support legs of the portal crane are scanned and input into an evaluating processor. The software of the evaluating processor contains data on the contour of the support legs of the container crane and therefore can determine the exact location of the transportation vehicle relative to the support legs of the container crane.

Following calculation of the actual position of the portal stacker by the evaluation processor, this location is then compared with the target position into which a container is to be positioned. The vehicle transporting the container then moves itself into the desired position using the vehicle drive and drive control systems and a continuous comparison of the actual and the target data in a position controller for as long as is required until the data of the actual position and the target position match. The orientation therefore takes place in real time via the data input by the scanner scanning the support legs of the container crane.

It is beneficial to this method if several laser scanners are attached to the vehicle. These scanners can be attached either vertically or horizontally. The decisive factor is that their position is adjusted according to the vehicle. It is, however, advantageous if the laser scanners are attached horizontally on the vehicle at a height which provides for clear orientation to the support legs of the container crane.

There follows a detailed description of the invention based on an example and three figures. The figures show the following:

Fig. 1: Schematic representation of a container bridge and a portal stacker with laser scanner when approaching a container bridge, with three views;

Fig. 2 Schematic representation of a container bridge and a portal stacker with laser scanner with three views during positioning below a container bridge;

Fig. 3 Schematic representation of the function of the evaluating processor.

Figure 1 shows three views of a portal stacker 2, to which a laser scanner 3 is arranged and in the scan field of which the support leg of a container crane 1 is to be found, whereby the portal stacker is standing in front of the container crane 1. The laser beam 4 detects two support legs of the portal crane 1 at the level of the upper edge of the portal stacker 2. In the position shown in figure 1, the portal stacker 2 first detects the front support legs of the portal crane 1 and stores these to memory. In order to scan the rear support legs of the portal crane 1 the portal stacker 2 moves into the position as shown in figure 2. After the portal stacker has moved into these two positions, in which it is able to determine its own location compared with the support legs of the container crane, the portal stacker can then work continuously with data input from the laser scanner into the evaluation processor concerning the position of the container crane support legs. The schematic representation of the function of the evaluation processor is shown in figure 3. The laser scanner 3 continuously inputs five data 6, relevant to the front support leg 7, and the rear support leg 8. These data 9 are stored to memory, and are used to determine the location of the vehicle 10. Furthermore, the distance of the vehicle 11 to the target is also determined. The actual position 12 calculated in this fashion is then compared with the pre-set target position 13. In this fashion the positioning controller 14 continuously compares the input data with the pre-set data. The positioning controller 14 commands the drive control 15 and the vehicle drive 16 for as long as necessary until the data of the target position 13 match the data of the actual position 12. At this time the portal stacker 2 has reached its target position and can place the container in the desired position.

List of reference marks used

1. Container crane
2. Portal stacker
3. Laser scanner / scanner
4. Laser beam
5. Data read-in
6. Scanner data
7. Read-in of data of front support leg
8. Read-in of data of rear support leg
9. Stored data of support leg
10. Contour search and position determination
11. Distance of vehicle to target
12. Actual position
13. Target position
14. Position controller
15. Drive control
16. Vehicle drive

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Patent claims

- 5 1. Method to determine the location of a vehicle (2), preferably a portal stacker (2), relative to a container crane (2), in which a sensor(3) is used to determine the location of the vehicle (2) and in which evaluation equipment is coupled with a detection device characterised in that

10 the support legs of a container crane (1) are used as positioning aids by scanning them using at least one scanner (3) attached to the vehicle whereby the scanner (3) determines the angle and distance to the support leg and transfers the acquired data to the evaluating unit which compares the signals with pre-set signals in its program and so determines the exact position of the vehicle compared with the support legs of the container whereby based on this
15 determination, the vehicle can manoeuvre into a previously specified target position compared with the support legs of the container.

2. Method as per Claim 1, characterised in that the evaluating unit learns the contour of any container plant

**Patent claims**

1. Method to determine the location of a vehicle, preferably a portal stacker, relative to a container crane, in which a sensor is used to determine the location of the vehicle and in which evaluation equipment is coupled with a detection device characterised in that

the support legs of a container crane are used as positioning aids by scanning them using scanners attached to the vehicle and

transferring the acquired data to an evaluating processor which compares the signals with pre-set signals in its program and

determines the exact position of the vehicle compared with the support legs of the container and

based on this manoeuvres into a precisely specified position compared with the support legs of the container.

2. Method as per Claim 1, characterised in that the evaluating unit learns the contour of any container plant.