

The invention relates to a container crane installation which is intended to transfer containers between various standing positions, particularly between standing positions in the hull or on the deck of a container transport ship on the one hand and standing positions on the quay or on transport means which travel on the quay, on the other and which is for the purpose constructed with a hoisting cable carrier adapted for mobility along at least one horizontal axis by means of horizontal running gear and with, suspended by hoisting cables of the hoisting cable carrier, a container-accommodating frame, hereinafter referred to as a spreader, the height of which can be adjusted by means of a cable hoist mechanism.

Such a container crane installation is known for example from US-PS 4 172 685. Where this container crane installation is concerned, a plurality of touching contact sensors are mounted on the spreader to ascertain contact between the spreader and another container or the like disposed under or alongside it. Furthermore, on the spreader of this container crane installation there is a visual remote recognition system which, in its operating position, is disposed substantially beneath a container mounted on the spreader and which, via transmission and reception units, is capable of ascertaining the vertical distance between the spreader and the ground or another container. Where this prior art container crane installation is concerned, the visual remote recognition system cannot be used in order to ascertain a lateral position of the spreader in relation to the underlying surface so that this lateral position of the spreader is not ascertained by the appropriate sensor means until there is contact with a further container.

Furthermore, there is known from DE-A-34 45 830 a crane installation in which a remote recognition system is mounted on a crane trolley and, by using laser beam scanning, detects a marking disposed on the ground beneath the crane trolley. However, where this apparatus is

concerned, it is only the position of the crane trolley in relation to the ground which is determined. However, no information of any kind can be obtained in respect of a lateral offset of the spreader or container in respect of a lateral location boundary. Also, where this apparatus is concerned, a running time measuring device is pointless because the vertical distance between the crane trolley and the ground remains substantially constant.

With increasing size of container vessels, also the crane installations used for loading and unloading these ships become increasingly larger. The crane driver is then necessarily increasingly more remote from the critical point, i.e. he is farther away from the point at which the spreader or container enters the respective stand, i.e. the point at which the spreader enters the ship's compartment. His angle of view becomes increasingly less favourable because he has to look almost vertically downwards and loses his perspective. Therefore, he does not know how far the container or spreader still has to go before it reaches the guide situated at the start of the container. The difficulties are aggravated in that the spreader suspended from the hoisting cable is subject to unavoidable swinging movements and often also to deflections due to wind influence. Only very skilful crane drivers can think sufficiently in advance that they are able to deal with the swinging problem.

The invention is based on the problem of indicating a crane installation which makes it easier for the crane driver to guide the spreaders or containers into their respective locations, in other words particularly into a ship's compartment.

In order to resolve this problem, it is proposed that to recognise a lateral standing position boundary of the

standing position to be approached by the spreader or container there is on the spreader a remote recognition system with a pulsed directional beam emitter for emitting rays which can be reflected by the lateral standing position boundary, with a reflected ray receiver and a running time measuring device for receiving data concerning the position of the spreader or of the container in a horizontal direction in relation to the profile of the standing position boundary and in that these data are used for controlling the horizontal running gear and/or a spreader slewing mechanism so that the spreader or the container, as it is lowered, encounters the contours of the standing position boundary.

If a directional beam emitter is referred to here, then this relates particularly to the emission of electromagnetic rays and there again, this refers particularly to impulse lasers which therefore are worthy of priority because they permit of a particularly narrow beam limiting. In addition, and particularly for simpler situations, also other electromagnetic radiation facilities and in some circumstances even sound waves, particularly ultrasonic waves, are conceivable.

Regardless of which recognition problem is imposed on the remote recognition system, the following problem remains: the remote recognition system cannot be mounted on the underside of the spreader since it is there that the container is coupled on. This means that the remote recognition system has to be mounted on the spreader but outside the contours of whichever containers are expected. In order, then, to allow the remote recognition system an angle of view which is not restricted by the container in question, the remote recognition system has to be mounted outside the contours of the container and thus of the spreader. However, particularly when loading ships' compartments which are closely adapted to the overall size

of the condenser, this can result in the problem that a remote recognition system which projects beyond the outline of the spreader may collide with the lateral boundary when the container enters the ship's compartment. It is therefore suggested that the remote recognition system be adjustable on the spreader between a recognition position outside the contours of the container and a retracted position which makes it possible for the spreader or container to enter a position boundary, e.g. a container-accommodating shaft of a ship.

One of the problems for the crane driver is that of reducing the lowering speed as the container or spreader approaches the top end or the floor of the ship's container or is getting close to the top of a container which has already been set down, in order to ensure that setting down or even contact with another container can be gentle. With increasing lowering speeds, this problem is becoming increasingly greater. Nor can the problem be solved by working in large safety gaps and incorporating a creep speed because this in turn reduces the handling capacity. Therefore, it is further suggested that the remote recognition system be used for recognising the vertical distance between the spreader or container and the setting down area on the location in question and/or for recognising the gap between the spreader or container and the top end of a location boundary which is constructed in the form of a shaft. Thus, a signal is available which can be used for directly controlling the hoisting mechanism. However, it is also conceivable for the result of the distance measurement to be shown on a display instrument allocated to the crane driver so that the crane driver can operate the hoisting mechanism accordingly and by hand. On this point, it should be noted that in order to display the relevant height of the spreader for the crane driver, so-called depth-measuring equipment is already in use to show the height of the

spreader as a function of the extent to which the hoisting cable has been hauled in. Therefore, only the height of the spreader compared with the hoisting cable carrier can be ascertained but not the measurement which is of the greatest interest: the height of the spreader compared with the top end of the ship's compartment or the floor of the ship's compartment or compared with an already present container. On the other hand, depth measuring equipment of the aforementioned type can be used for height measurements if the container is already in the compartment - if, therefore, for the reasons described above, the remote recognition systems are in their retracted state and can no longer be used for vertical distance measurement. Therefore, it is further suggested that if a distance-measuring device is present which is controlled by the hauled-in condition of a hoisting cable, hereinafter referred to as a depth-measuring instrument, then this should be capable of calibration by the result of the distance measurement taken by the remote recognition system.

This embodiment of the invention provides the following facility: as long as the spreader is situated high above the compartment and the remote recognition system is in its extended operating position, the distance between the spreader and the top end of the compartment and the floor or bottom of the particular position is being measured, whether it is the floor of the compartment which is concerned, or the top of a container which is already standing there. The depth-measuring arrangement is then so calibrated that when the measurement is taken, it displays the distance values as they are detected by the remote detection system. Once this calibration has been carried out, the depth-measuring system continues to indicate the actual distance values representing the gap between the container or spreader and the critical heights.

Furthermore, in accordance with the invention, the work of the crane driver can be facilitated in that a scanner drive is associated with the directional beam emitter, this scanner drive delivering a position coordinate concerning the relevant position of the directional beam to a computer which simultaneously receives running time and thus distance data, whereby, on the basis of this information, this computer supplies data concerning the position of the spreader or container in a horizontal direction in relation to the profile of the standing position boundary and which can be used for controlling the running gear drive. In this respect, the information obtained from the computer can be used directly for controlling the running gear drive. The hoisting cable carrier is then positively so controlled on a basis of the data obtained from the computer that the spreader or container arrives precisely at the location where it is to stand, in other words particularly in the shaft of the ship's compartment. This control is so carried out that the correctional movement of the hoisting cable carrier is initiated with the least possible acceleration and is braked so that the correctional movement cannot give rise to swinging motions which would then have to be corrected but which possibly might no longer be capable of correction due to the relatively short time available for the operation. The system which is used for remote recognition in accordance with the invention makes it possible to apply various control methods. For example, a simple differentiating circuit might possibly determine the horizontal relative speed of the spreader in relation to the standing position, in other words particularly the shaft entrance so that the control command can be corrected beforehand, allowing for said speed data.

Alternatively, it is also possible here for the data obtained from the computer to be used for controlling a display instrument at the location of the crane driver to

display the position of the spreader or container in relation to the profile of the standing position boundary. In this respect, it is for example possible to show on a screen the profile of the compartment entrance and the container with its outline or at least a central point. If the container outlines and the compartment outlines are displayed, then on a basis of this image, the crane driver can control all the translatory movements in a horizontal direction, in other words he can substantially control a movement of the hoisting cable carrier along a crane jib (first coordinate axis) or a movement of the crane along a crane track (second coordinate axis). Furthermore, with such a display, the crane driver can also carry out slewing corrections if the spreader or the hoisting cable carrier has a slewing facility. The aforementioned displays in respect of height can also be faded directly into the screen which shows the profile of the compartment and the container. Finally, also the relevant hoisting and/or the travelling speed can be displayed on the screen.

It should also be mentioned that to recognise an edge of the compartment profile, the edge is detected by the remote recognition system if there is a jump in running time during the course of scanning. At this moment, the absolute value of the running time is measured before and after the jump and can be graphically shown.

For scanning, it is recommended that the directional beam be caused to pivot. For example, this can happen if the scanner drive is used for pivoting a deflector mirror which is in the path of the directional beam. The scanning movement can take place in one plane. In this case, two remote recognition systems are needed to display one corner of the standing position profile. However, it is also possible to carry out a superimposed scanning movement in two planes which are at right-angles to each

other (corresponding to an encircling movement of the directional beam), so that a specific corner of the profile can be displayed with one remote recognition system. In order to ascertain the overall profile of a standing position, at least two corners must be displayed.

Furthermore, the installation can be further refined in that in order to detect the spreader position in relation to the hoisting cable carrier a position recognition system is fitted which has a pulsed directional beam emitter for sending out rays which can be reflected by the hoisting cable carrier, a reflected beam receiver and a running time measuring device for ascertaining data concerning at least one coordinate relating to the position of the spreader in respect of the hoisting cable carrier, this positional data also serving to control the hoisting mechanism or the running gear. In this way, it is possible for example to ascertain the wind influence, namely from the position of the spreader at any given time and in relation to the hoisting cable carrier. Once the wind influence is known, this can basically be taken into account beforehand when targeting a specific position, so that the correction achieved by comparing the container position with the profile of the standing position only has to take into account other influences, for example swing. Furthermore, the position recognition system provides data concerning the relative horizontal speed between spreader and hoisting cable carrier. Then, by subtractive superimposition on the relative horizontal movement speed of the spreader in respect of the profile of the standing position, also the rolling motion of the ship can be ascertained and this rolling motion can be fed into the computer as a further control variable, still with an eye minimising the correctional movement of the hoisting cable carrier particularly in the final phase of approach to the relevant critical position, so that the

approach can be conducted with the least possible acceleration and at the slowest of speeds.

According to a further development of the invention, it is suggested to provide a stepping control system for the running gear in order to perform travel steps along the horizontal axis of the hoisting cable carrier according to the location coordinates difference between standing positions which have to be approached in succession, whereby the step corresponding to the location coordinate difference always starts from that position of the hoisting cable carrier which, during performance of a preceding step and taking into account the wind conditions prevailing at that time, and which are assumed to be the same, has resulted in a spreader position appropriate to the standing position. This further development is based on the consideration that the wind conditions do not generally undergo any substantial change between two successive lowering operations. Therefore, if the crane driver has once controlled the container or spreader to occupy the standing position, perhaps after repeated trials, then it is established how much offset the currently prevailing wind can cause between the spreader and the hoisting cable carrier. It is possible now to store in the memory the position of the hoisting cable carrier which, during a first lowering operation, produced the positionally correct location of the spreader or container in respect of the standing position so that subsequent switching steps can be performed from this position, the length of each switching step corresponding to the difference in coordinates between the standing position to be approached at the first lowering and at the second lowering. Consequently, if the wind conditions have remained the same, then during this second lowering operation, too, the spreader will necessarily be correctly positioned at the current standing position. Even if the wind conditions do change somewhat between two lowering

operations, the correction to be carried out by the crane driver will be relatively minimal.

Furthermore, cooperating swing-damping means can be mounted on the hoisting cable carrier and on the spreader which come into mutual contact when the spreader approaches the hoisting cable carrier.

Such a development of the crane installation permits of an operating procedure whereby, prior to commencement of a lowering movement of the spreader, the hoisting cable carrier is moved into that position which corresponds to the particular standing position which is to be approached and whereby swinging motions of the spreader can be suppressed before the lowering movement commences. Where this method is concerned, at the start of the lowering movement, the hoisting cable carrier is so adjusted that under ideal lowering conditions the spreader or container will arrive precisely at the required standing position, i.e. particularly at the entrance to the ship's compartment. Since, furthermore, at the start of the lowering process, swing has been suppressed by the engagement of the swing-damping means on the spreader and on the hoisting cable carrier, it can be anticipated that no substantial swinging motion will occur during the lowering process. The spreader or container is then only subject to any wind pressure which may be present. However, the crane driver is then substantially unburdened if he then only has to pay heed to shifts caused by wind pressure.

The invention is explained in detail hereinafter with reference to examples of embodiment shown in the accompanying drawings in which:

Fig. 1 shows a crane installation during loading of a ship at the quayside,

Fig. 1a shows a modification of Fig. 1,

Fig. 2 shows an enlarged detail from Fig. 1,

Fig. 3 shows a spreader with remote recognition system,

Fig. 4 shows a mirror arrangement for three-dimensional scanning,

Fig. 5 shows a block circuit diagram of the remote recognition system featuring image screen display of container deviations and

Fig. 6 shows the block circuit diagram of the remote recognition system featuring direct actuation of hoisting cable mechanism and running gear.

Fig. 1 shows a quay 10 of a harbour installation and against which a container ship 12 is lying. Standing on the quayside is a container crane 14 adapted to travel on rails parallel with the longitudinal direction of the quay, i.e. at right-angles to the plane of the drawing. The crane 14 carries a crane bridge 16. Adapted to travel on this crane bridge 16 are two crane trolleys 18 and 20 which may also be understood as being hoisting cable carriers. Suspended by hoisting cables 22 from each of the crane trolleys is a spreader 24 constructed for the separable supporting of containers. The crane trolley 18 is intended for removing containers from and placing containers in the ship 12. On the crane bridge 16, apart from the crane trolleys 18 and 20 and on a separate pair of rails, there is a mobile transfer trolley 25 which, in the plane of the drawing, can be moved to coincide with each of the crane trolleys 18 and 20. The crane trolley 18 with the associated spreader handles the transporting from the transfer trolley 25 to the ship and back. The crane trolley 20 with its associated spreader handles

transporting of the containers between the transfer trolley 25 and the quayside installation 10 or transporting means 26 which are mobile on the quayside installation 10. The transfer trolley 25 provides transport along the bridge beam 16 between the two crane trolleys 18 and 20.

An enlarged view of the bottom part of the crane trolley 18 can be seen in Fig. 2. The spreader 24 is suspended by hoisting cables 22 from this crane trolley 18. The said spreader 24 has couplings 28 for the attachment of a container 30. Mounted on the spreader 24 are wedge-shaped swing-damping surfaces 31 which, when the spreader is fully raised, engage matching swing-damping surfaces 32 on the crane trolley 18. Fig. 2 also shows that the container 30 is to be inserted into a container-receiving shaft 34 of a ship's compartment. The width b of this container-receiving shaft corresponds to the width b' of the container. The length of the container-receiving shaft 34 is subdivided by profiled ribs 36 so that a container can be inserted between two consecutive pairs of ribs 36. According to the height of the container-receiving shaft, so a plurality of containers 30 can be disposed above one another.

When a container 30 is to be placed into a container-receiving shaft 34, the crane trolley 18 approaches the relevant container-receiving shaft. While approaching a container-receiving shaft which is offset at right-angles to the plane of the drawing, the entire crane 14 is moved in Fig. 1 at right-angles to the plane of the drawing.

When a container is to be lowered into a specific container-receiving shaft, then firstly the crane trolley 18 is moved to that position which corresponds to this container-receiving shaft. During this travelling movement, lifting movements can be superimposed so that

the travelling and hoisting times are not necessarily superimposed additively but overlap. However, what is essential is that at the commencement of lowering of the spreader 24 in the direction of the container-receiving shaft, swinging movements are suppressed by engagement of the swing-damping surfaces 31 of the spreader and 32 of the crane trolley 18. Therefore, the lowering movement of the spreader 24 can only start once the crane trolley 18 has reached its position which corresponds to the particular shaft which is to be approached. Or, in other words, upon completion of the travelling movement of the crane trolley 18, the swing-damping surfaces 31 must also have made contact with the swing-damping surfaces 32. Then, during subsequent lowering of the spreader, there can be no or at least very slight swing movements of the spreader 24 and there is every prospect of the container 30 passing by the top edges of the container-receiving shaft 34 without any collision.

It must be noted that the illustration in Fig. 2 is not to scale. In reality, the lengths of the hoisting cables 22 are very much greater. Free swing lengths of between 20 and 25 mm must be anticipated before the container reaches the top end of the container-receiving shaft 34.

Fig. 2 also shows how different container-receiving shafts 34 can be disposed beside one another and have to be approached one after another. In the past, wind influences were not taken into account. In view of the considerable free swing lengths however these wind influences are not negligible, particularly when a container is hanging from the spreader 24 during the lowering process and offers a relatively large area against which the wind is able to strike. Experience has shown that it is only in exceptional circumstances that the wind conditions suddenly alter between two successive lowering processes. Therefore, if after loading one

container-receiving shaft 34, the other container shaft 34 has to be loaded, then the crane trolley 18 must be moved between the successive container-receiving shafts 34 according to the intervening distance t , in fact, starting from that position of the crane trolley 18 which produced a precise alignment of the container 30 with the top edge of the first container-receiving shaft 34 under the wind conditions which are assumed to be constant. In this way, there is an opportunity once the crane trolley 18 has travelled on by the amount t for the container 30 in turn to be precisely disposed in the new container-receiving shaft 34. On this point, it must be further mentioned that there are at the top ends of the container-receiving shafts guide surfaces 38 for which there is however only a limited amount of space available.

Fig. 1a only differs from Fig. 1 in that one has dispensed with the transfer trolley 25. The two crane trolleys 118 and 120 here take over the transporting of the container from the ship to container-receiving platforms 140 which are mounted on the crane structure 114 in the form of a buffer store. The crane trolley 120 provides for container transport between the platforms 140 and the set-down points on the quayside. The afore-described method can likewise be applied to this embodiment. This method can also be modified in that the crane driver does not necessarily have to raise the spreader until it abuts the crane trolley at every transfer operation, but only when there are in actual fact swing movements which cannot be controlled. Therefore, it is entirely possible under favourable conditions also to move a container over the nearest distance from a position A to a position B, possibly while superimposing lowering and hoisting movements on the travelling movement.

Again, Fig. 3 shows a container 230 on a spreader 224 which is suspended from the crane trolley 218 by hoisting

cables 222. Once again, it is a shaft 234 which is to be loaded or unloaded, as shown in Fig. 3. Now, remote recognition systems 244 are disposed on the spreader 224. Each of these remote recognition systems 244 comprises a pulsed laser 244a, a deflector mirror 244b and a reflected beam receiver 244c.

Fig. 4 shows that the deflecting mirror 244b is pivoted by pivoting motors not shown in the drawings about two axes of rotation 244d and 244e which are at right-angles to each other. The laser pulses, in the form of a directional beam 246, strike the boundary edges 248 of the container-receiving shaft 234, on the top 230a of a container 230 already present in the shaft 234 and, if no such container is present, then they strike the floor 234a of the container-receiving shaft 234. The laser pulses are reflected at these impact points and then strike the reflected beam receiver 244c. By measuring the running time, the respective running time of the laser pulse can be measured. In this way, it is possible to determine the vertical distance between the spreader 224 and the surfaces 248, 230a or 234a.

Furthermore, as a result of the pivoting movement of the deflecting mirror 244b, the profile of the top edge 248 of the container-receiving shaft 234 can be scanned. If there is a running time jump, then this means that the edge between the upper end face 248 and the shaft 234 has been passed. At this point in time, whichever is the shorter running time and thus the shorter running time path according to the distance between the remote recognition system 244 and the surface 248 must be established. At the same time, at this point in time, the angular position of the deflecting mirror 244b must be established. From this angular data and the running time data, a computer can then determine the relative position

of the spreader 224 in respect of the upper boundary profile 248 of the container-receiving shaft 234.

Fig. 5 again shows the pulse laser 244a, the reflected beam receiver 244b and a running time meter 244f. The running time meter 244f supplies a running time and therefore path information to a computer 250. Furthermore, Fig. 5 shows a scanner drive 244g for the deflecting mirror 244b. Associated with this scanner drive 244g is an angle meter 244h which delivers to the computer 250 data concerning the relevant angular position of the mirror 244b. At the moment when a running time jump occurs, a running time datum and an angle datum are supplied to the computer 250 which then determines the spatial coordinates of whichever edge has been overrun. From a plurality of such spatial coordinates, then, the profile in a corner can be determined. Fig. 5 shows two remote recognition systems I and II so that two corners of the profile of the container-receiving shaft can be detected. Basically, this is sufficient in order to determine the relative location of the spreader or container in relation to the profile of the container-receiving shaft. For example, two diagonally opposite corners can be associated with one remote recognition system.

At the output from the computer 250 there is an image screen 252 to display the four corners of the profile of the container-receiving shaft. These four corners are designated 234w, 234x, 234y and 234z. At the same time, it is possible to see the central point of the spreader indicated by the crossed threads 254. From the translatory offsets of the corners 234w to 234z, it is possible then to ascertain what correctional movements have to be imparted to the crane running gear and the crane trolley running gear. Along with the image screen 252, the crane driver has in front of him a control panel

256 on which there are manual means of actuating the various running and hoisting operations, namely a manual actuating member 258 which controls a crane running mechanism 260, namely a running mechanism for moving the crane framework 14 at right-angles to the plane of Fig. 1. Furthermore, it is possible to see a manual actuating means 262 for controlling a trolley running gear 264 which ensures movement of the crane trolley 18 along the crane bridge 16 in Fig. 1. The crane driver actuates the two manual actuating means 258 and 262 so that the four corners 234w to 234z arrive at a position in which the centre of the cross-threads 254 coincide with the centre of the four corners 234w to 234z.

In addition, a manual actuating means 266 is provided which controls a slewing mechanism 268 of the crane trolley so that the container can also be rotated into the correct angular position in relation to the entrance to the container-receiving shaft. Also the rotating movement can be followed on the image screen 252. The correct angular position is reached when the two corners 234w and 234x with their connecting line appear horizontally on the image screen.

The computer 250 delivers a further output which is applied to a height indicator 270. In this height indicator, the relative height of the spreader 224 compared with the surfaces 248 and 230a are indicated so that the crane driver knows when, as he draws close to these surfaces, the lowering speed has to be reduced to creep speed by actuation of a member 274. The manual actuating member 274 is connected to the cable-hoisting mechanism 276.

It goes without saying that it is also possible to fade the display marks 224, 248 and 230a into the screen 252 or to have it appear on the screen as numerical values.

Also worthy of mention is the possibility of combining the height display with a conventional depth-measuring unit 278 which is actuated by a hoisting cable drum 288. And so the following particular circumstances arise:

As can be seen from Fig. 3, the remote recognition systems 244 extend beyond the contours of the spreader 224 and of the container 230. Before the container is lowered into the container-receiving shaft 234, the remote recognition systems 244 must be retracted out of the position shown in Fig. 3 and into a position in which they are inside the spreader contours so that they do not collide with the edges 248. However, there is then no longer any opportunity for the remote recognition system 244 to determine the distance between the container 230 and the surface 230a of another container 230 which has already been lowered into the shaft. At this point, one can switch over to the depth-measuring instrument 278. Immediately prior to the remote recognition system 244 having to be retracted from the position shown in Fig. 3, it transmits to the depth-measuring instrument 278 the vertical distance values known at that time and calibrates the depth-measuring instrument 278 to the values previously ascertained by laser. This calibration is retained so that henceforth the depth-measuring instrument 278 operates the vertical distance display unit 270 and this latter can continue by displaying the vertical distances between the container and the edge 248 of the surface 230a or surface 234a.

The crane driver also has the opportunity of operating various knobs on a switchboard 290, the knobs corresponding to the existing container-receiving shafts. From the crane running gear and the crane trolley running gear, respective feedback lines 292, 294 lead to memories 296, 298. These memories store the data relating to the wind strength prevailing at the last lowering operation so

that upon formation of control signals in the unit 290 for the running gear 260 and 264, the wind strength is taken into account, i.e. the offset by the interval length is in each case based on the location occupied by the crane trolley or crane framework during the preceding lowering operation which resulted in the container just fitting into the container-receiving shaft 234.

The circuit shown in Fig. 6 corresponds substantially to that in Fig. 5. Similar parts are identified by the same reference numerals as in Fig. 5 but in each case increased by 100.

Firstly, reference should be made once again to Fig. 3. This shows not only the remote recognition systems 244 but also a position recognition system 399 which, like the remote recognition systems 244, is disposed on a support adapted for movement in relation to the spreader and the purpose of which is to establish the position of the spreader 224 in relation to the crane trolley 218. According to Fig. 6, this position recognition system is composed of a directional beam emitter 399a, a reflected beam receiver 399b, a scanner drive 399g and an angle meter 399h as well as a running time meter 399f. The output signals from the running time meter 399f and from the angle meter 399h are additionally applied to the computer 350. The output signals from the computer 350 are applied directly to the crane trolley running gear 364, to the crane running gear 360, to the hoisting mechanism 368 and the spreader slewing mechanism 376. The coordinates transmitter 390 is likewise applied to the input of the computer 350. Contained in the computer 350 are sub-assemblies 397 and 395 the purpose of which is to determine the swing speed of the spreader and the rolling speed of the ship. The swing speed is obtained in the sub-assembly 397 simply by a differentiating process, in that the first derivation of the particular relative

location of the spreader in relation to the entrance to the container-receiving shaft is formed according to the time. The rolling speed is obtained in the sub-assembly 395 by using the signal obtained in the sub-unit 397 in that additionally the relative location of the spreader position in respect of the crane trolley is differentiated according to time and then, by subtractive superimposition, the two derivations according to time, obtained in 397 and 395, are superimposed on one another.

In this way, it is possible to ascertain and use for control purposes the wind velocity on a basis of the data obtained at the position recognition unit 399. Furthermore, the rolling speed of the ship can be taken into account when controlling the running gear.

PATENT CLAIMS



1. A container crane installation which is intended to transfer containers (230) between various standing positions, particularly between standing positions in the hull or on the deck of a container transport ship (12) on the one hand and standing positions on the quay (10) or on transport means (26) which travel on the quay, on the other and which is for the purpose constructed with a hoisting cable carrier (218) adapted for mobility along at least one horizontal axis (16) by means of horizontal running gear (260, 264) and with, suspended by hoisting cables (222) of the hoisting cable carrier (218), a spreader (224) the height of which can be adjusted by means of a cable hoist mechanism (268), characterised in that to recognise a lateral standing position boundary (248) of the standing position to be approached by the spreader (224) or container (230) there is on the spreader (224) a remote recognition system (244) with a pulsed directional beam emitter (244a) for emitting rays (246) which can be reflected by the lateral standing position boundary (248), with a reflected beam receiver (244c) and a running time measuring device (244f) for receiving data concerning the position of the spreader (224) or of the container (230) in a horizontal direction in relation to the profile of the standing position boundary (248) and in that these data are used for controlling the horizontal running gear (260, 264) and/or a spreader slewing mechanism (268) so that the spreader (224) or the container (230), as it is lowered, encounters the contours of the standing position boundary (248).
2. A container crane installation according to Claim 1, characterised in that the remote recognition system (244) on the spreader (224) is adjustable between a recognition position outside the container contours



and a retracted position which makes it possible for the spreader (224) or container (230) to travel into a standing position boundary (248, 230a), e.g. a container receiving shaft (234) of a ship (12).

3. A container crane installation according to one of Claims 1 and 2, characterised in that the remote recognition system (244) for recognising the distance between the spreader or container and the setting down area (230a) at the respective standing position and/or for recognising the vertical distance between the spreader (224) or container (230) and the top end (248) of a standing position boundary (248, 230a) is constructed as a shaft (234).
4. A container crane installation according to Claim 3, characterised in that the result of the vertical measurement is used for directly controlling the hoisting mechanism (268).
5. A container crane installation according to Claim 3, characterised in that the result of gap measurement is shown on a display unit (270) associated with the crane driver.
6. A container crane installation according to one of Claims 3 to 5, characterised in that if there is a distance measuring instrument (278) which is actuated by the hauling in of a hoisting cable (222) and which is hereinafter referred to as a depth measuring instrument, this latter can be calibrated by the result of the distance measurement acquired by the remote recognition system (244).



7. A container crane installation according to one of Claims 1 to 6, characterised in that a scanner drive (224g) is associated with the directional beam emitter (224a) and in that this scanner drive (244g) delivers a position coordinate concerning the position of the directional beam (246) to a computer (250) which at the same time receives running time and thus distance data (from 244f), this computer (250) supplying, from this data (from 244f and 244h) information concerning the position of the spreader (224) or container (230) in a horizontal direction in relation to the profile (248) of the standing position boundary (248, 230a), and which can be used for controlling the running gear drive (264).
8. A container crane installation according to Claim 7, characterised in that the data obtained from the computer (350) serve directly for controlling the running gear drive (264).
9. A container crane installation according to Claim 7, characterised in that the data obtained from the computer (250) serve to control a display instrument (252) at the location of the crane driver and display the position of the spreader (224) or container (230) in relation to the profile (248) of the standing position boundary (248, 230a).
10. A container crane installation according to one of Claims 7 to 9, characterised in that the scanner drive (244g) is used for pivoting the directional beam (246).
11. A container crane installation according to Claim 10, characterised in that the scanner drive (244g) is used



for pivoting a deflecting mirror (244b) which is in the path of the directional beam (246).

12. A container crane installation according to one of Claims 1 to 11, characterised in that for recognising the spreader position in relation to the hoisting cable carrier (218), a further optoelectronic position recognition system (399) is provided which is used for ascertaining data concerning at least one location coordinate of the spreader position in relation to the hoisting cable carrier (218), said location information also serving to control the hoisting mechanism (368) or the running gear (364).
13. A container crane installation according to Claim 12, characterised in that the further optoelectronic position recognition system (399) is constructed with a pulsed directional beam emitter (399a) for sending out rays which can be reflected by the hoisting cable carrier (218), and with a reflected beam receiver (399b) and a running time measuring instrument (399f).
14. A container crane installation according to one of Claims 1 to 13, characterised by a stepping control system (290) for the running gear (264) for executing travel steps along the horizontal axis (16) of the hoisting cable carrier (18) in accordance with the location coordinates difference between standing positions which have to be approached in succession, whereby the step (t) corresponding to the location coordinate difference takes place in every case from that position of the hoisting cable carrier (18) which, during execution of a preceding step and taking into account the wind conditions prevailing at that



time, has resulted in a spreader position appropriate to the standing position.

15. A container crane installation according to one of Claims 1 to 14, characterised in that there are mounted on the hoisting cable carrier (18) and on the spreader (24) cooperating swing-damping means (31, 32) which come into mutual contact when the spreader (24) approaches the hoisting cable carrier (18).

Six sheets of drawings