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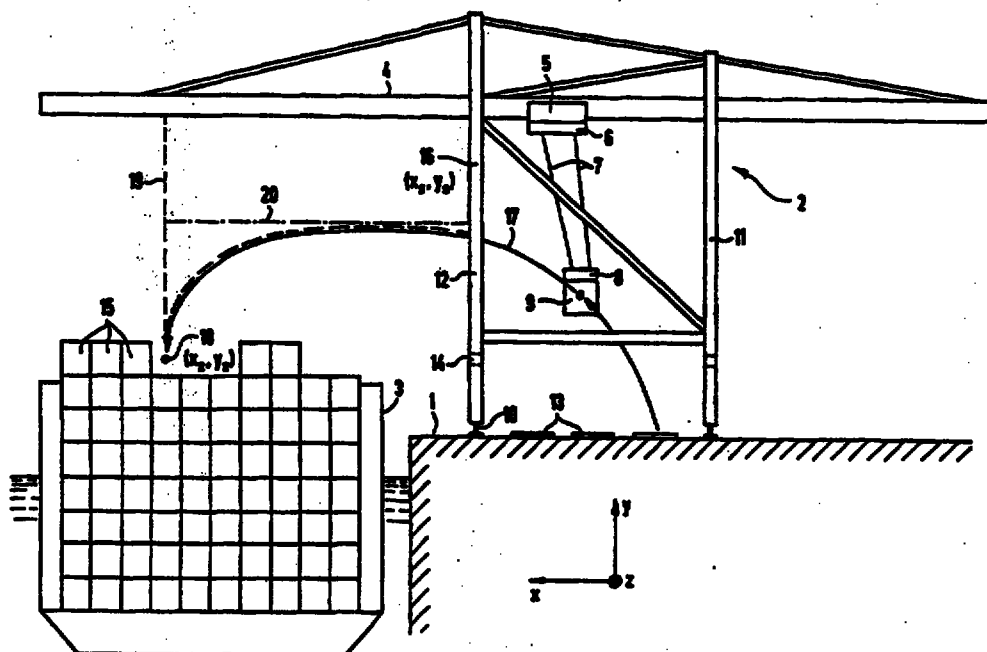
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(54) Title: PROCESS AND DEVICE FOR TRANSPORTING A LOAD

(54) Bezeichnung: VERFAHREN UND VORRICHTUNG ZUM TRANSPORT EINER LAST

(57) Abstract

In prior art processes for transporting a load using a crane from a starting position over obstacles to a target position, the transport process may be optionally manually or automatically controlled. To permit the secure automatic transport of a load without collisions by simple means, the transport movement within a predetermined area with unknown or changing obstacles (15) with the transport process manually controlled is recorded and used to find a free transport region (19); the automatic control of the transport process in the predetermined area is limited to the free transport region (19) found.





Description

Method of, and arrangement for, transporting a load

The invention relates to a method of transporting a load by means of a crane from a starting position, beyond obstructions, to a target position, it being possible for the transporting operation to be controlled optionally manually or automatically. The invention also relates to a corresponding arrangement comprising a crane with a means for controlling the transporting operation optionally manually or automatically and with a means of recording the transporting movement.

With modern crane installations, it is possible for loads, e.g. containers, to be transported fully automatically, and without swinging, beyond any obstructions present from a starting position to a target position. As a precondition for this, however, the height profile given by the position and size of the obstructions has to be known. This is the case, for example, with a land-side container crane in docks, since the obstructions there, e.g. safety heights or cross-members of the crane which run transversely with respect to the transporting direction, are known. Over the ship which is to be loaded or unloaded, on the other hand, the height profile of the obstructions is not known, which makes it difficult to automate the transporting operation without additional measures and involves high safety risks.

DE 31 99 784 A1 discloses a means for operating a grab crane of a loading bridge for loading or unloading a ship, in which means the actual position of the grab within an operating area delimiting the permissible desired positions is displayed on the screen of a video receiver. This means serves specifically for loading the ship with bulk material or for unloading bulk material from the ship, for which purpose the edges of the ship's hatches are depicted on the screen as bars. Furthermore, DE 38 16 988 A1 describes a container crane installation



in which swinging is suppressed during lowering of the so-called spreader in that, after the desired position of the lifting-cable carrier has been reached in each case, the spreader is brought into swing-damping contact with the travelling trolley.

Finally, DE 40 05 066 A1 discloses a container crane which has, on its travelling trolley, a distance-measuring device in the form of a laser-type distance-measuring device, by means of which optical scanning of the height profile of the obstructions is possible. The height profile thus recorded and the load position recorded continuously via position pickups on the crane jib, the travelling trolley and lifting gear make it possible for the transporting operation to be carried out automatically without any collisions between the load and the obstructions.

Nevertheless, optical scanning of the height profile of the obstructions requires a relatively high outlay in terms of hardware and software.

The object of the invention is thus to permit automatic load transportation with a smaller degree of outlay.

As regards the method of the type specified in the introduction, the object is achieved according to the invention in that, within a predetermined area with unknown or changing obstructions, with the transporting operation being controlled manually, the transporting movement performed is recorded and used to determine a free transporting zone, and in that the automatic control of the transporting operation in the predetermined area is restricted to the free transporting zone determined.

As regards the arrangement specified in the introduction, the object is achieved by a memory for storing the transporting movement recorded in a predetermined area with unknown or changing obstructions, with the transporting operation being controlled manually, by a means for determining a free transporting zone from the transporting movement recorded, and by means for restricting the automatic control of the



transporting operation in the predetermined area to the free transporting zone determined.

5 This means that automatic control of the transporting operation is not initially possible within the predetermined area with the unknown obstructions, because there has been no determination of a free transporting zone for this purpose. In order to determine the free transporting zone, the crane operator has to carry out a transporting operation manually, with or without a load,
10 in the predetermined area. A free transporting zone is determined on the basis of the transporting movement recorded for the distance up to the target, up to which the manually controlled transporting operation has taken place. Automatic control of the transporting operation is
15 then possible within this free transporting zone.

When the crane or its jib is displaced, there is a change in the surroundings of the crane with the obstructions in relation to the transporting path for the load. After the crane has been switched off or in
20 relatively long operation stoppages, the obstructions in the surroundings of the crane may change, e.g. when another ship docks at the quay or the containers in the operating area of the crane are otherwise transported. As a result, changes in the crane position, switching off of
25 the crane and/or relatively long operation stoppages are advantageously recorded automatically and the free transporting zone determined is indicated as being invalid. As a result, the crane operator must first of all carry out another manually controlled transporting
30 operation, in which case the transporting movement recorded is used to determine a new free transporting zone for automatic control of the transporting operation.

The action of loads being picked up or set down changes the height profile of the obstructions in the
35 operating area of the crane. As a result, it is provided, within the context of the invention, that, when the load is lowered to the target position and/or when the load is picked up, the vertical transporting path is recorded and the lower limit of the free transporting zone is

corrected in dependence on the vertical transporting path recorded. The setting-down or pick-up operation can be controlled manually or, if means for optically recording the surroundings of the load are present, automatically.

5 For the purpose of explaining the invention further, reference will be made hereinbelow to the figure of the drawing, which shows a container crane with a container ship which is to be loaded or unloaded.

10 A container crane 2, which is to load or unload a container ship 3, is located on a quay 1 in docks. The crane 2 has a jib 4, along which a travelling trolley 5 can be displaced in the x-direction. The trolley 5 bears a lifting gear 6 on which there is suspended, via cables 7, a load-carrying frame 8 (spreader) for the load 9 which is to be transported, in this case a container. The 15 crane 2 can be displaced, on rails 10, along the quay 1 in the z-direction, transversely with respect to the displacement of the trolley 5. Running in the same direction between the crane legs 11 and 12 are tracks 13 for container transport vehicles, between which and the 20 ship 3 the containers, e.g. 9, are to be transported.

 During transportation of the container 9, in particular a crossmember 14 between the water-side crane legs 12 has to be passed over reliably, although this 25 does not constitute any problem for automatic control of the transporting operation since the position of the crossmember 14 is known. On the water side of the crane legs 12, however, there is an area with unknown or changing obstructions, the latter being formed essen- 30 tially by the ship 3 with the loaded containers 15. In order for it also to be possible to transport loads in this area automatically without any risk of collision, a free transporting zone is determined for this area, as explained hereinbelow, within which zone automatic 35 control of the transporting operation is possible.

 Initially, the free transporting zone is still unknown, with the result that automatic transporting movements to targets on the water side and beneath a starting point 16 with the coordinates x_s , y_s are

prevented automatically. However, if this is attempted, then the crane advances automatically to the starting point 16. In order to permit future automatically controlled transporting operations on the water side, the crane operator has to use manual control of the transporting operation in order to move the load-carrying frame 8 with the load 9, or optionally without the load 9, along a transporting path 17, which is to be determined by him, to a target 18. In this case, the transporting movement is recorded automatically by distance pickups on the trolley 5 and the lifting gear 6 and is stored in a memory. A free transporting zone 19 is automatically determined from the transporting movement recorded, and, in accordance with the dashed lines, this free transporting zone is delimited, at the bottom, by the transporting path 17 and, on the water side, by the coordinate x_z of the target 18 to which the crane has advanced. The lower limit of the free transporting zone 19 may, for example, also be established by the vertex of the transporting path 17 recorded, as is indicated by the chain-dotted line 20. Automatically controlled transporting operations are then possible within the free transporting zone 19 up to the x-coordinate x_z .

If the load is to be transported automatically to a target on the far side of the coordinate x_z , then the crane operator once again must first of all carry out a manually controlled transporting movement beyond the coordinate x_z , in order for the memory to be able to learn a new free transporting zone on the far side of the coordinate x_z .

In order to adapt the free transporting zone 19 determined to the changing load state of the ship 3, it is the case that, when a load 9 is lowered to the respective target position or when a load 9 is picked up, the lower limit of the free transporting zone 19 is corrected in dependence on the vertical transporting path recorded by means of the position pick up on the lifting gear 6.

The currently determined free transporting zone

is deleted automatically if there is any chance of it no longer being valid. This is the case, in particular, when the crane 2 is displaced along the rails 10, when the crane jib 4 is lifted, when the crane 2 is switched off, or after relatively long operation stoppages. In the first case, one can assume that the crane is advanced to a new container bay on the ship 3, whereas, in the three last-mentioned cases, it is possible that another ship has docked at the quay 1 for loading or unloading.



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Patent Claims

1. Method of transporting a load (9) by means of a crane (2) from a starting position, beyond obstructions (14, 15), to a target position (18), it being possible
5 for the transporting operation to be controlled optionally manually or automatically, characterized in that, within a predetermined area with unknown or changing obstructions (15), with the transporting operation being controlled manually, the transporting movement (17)
10 performed is recorded and used to determine a free transporting zone (19), and in that the automatic control of the transporting operation in the predetermined area is restricted to the free transporting zone (19) determined.
- 15 2. Method according to Claim 1, characterized in that changes in the crane position, switching off of the crane (2) and/or relatively long operation stoppages are recorded automatically and cause the free transporting zone (19) determined to be indicated as being invalid.
- 20 3. Method according to Claim 1 or 2, characterized in that, when the load (9) is lowered to the target position (18) and/or when the load (9) is picked up, the vertical transporting path is recorded, and in that the lower limit of the free transporting zone (19) is
25 corrected in dependence on the vertical transporting path recorded.
4. Arrangement for transporting a load (9) from a starting position, beyond obstructions (14, 15), to a target position (18), comprising a crane (2) with a means
30 for controlling the transporting operation optionally manually or automatically and with a means for recording the transporting movement, characterized by a memory for storing the transporting movement (17) recorded in a predetermined area with unknown or changing obstructions
35 (15), with the transporting operation being controlled manually, by a means for determining a free transporting zone (19) from the transporting movement (17) recorded, and by means for restricting the automatic control of the

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transporting operation in the predetermined area to the free transporting zone (19) determined.



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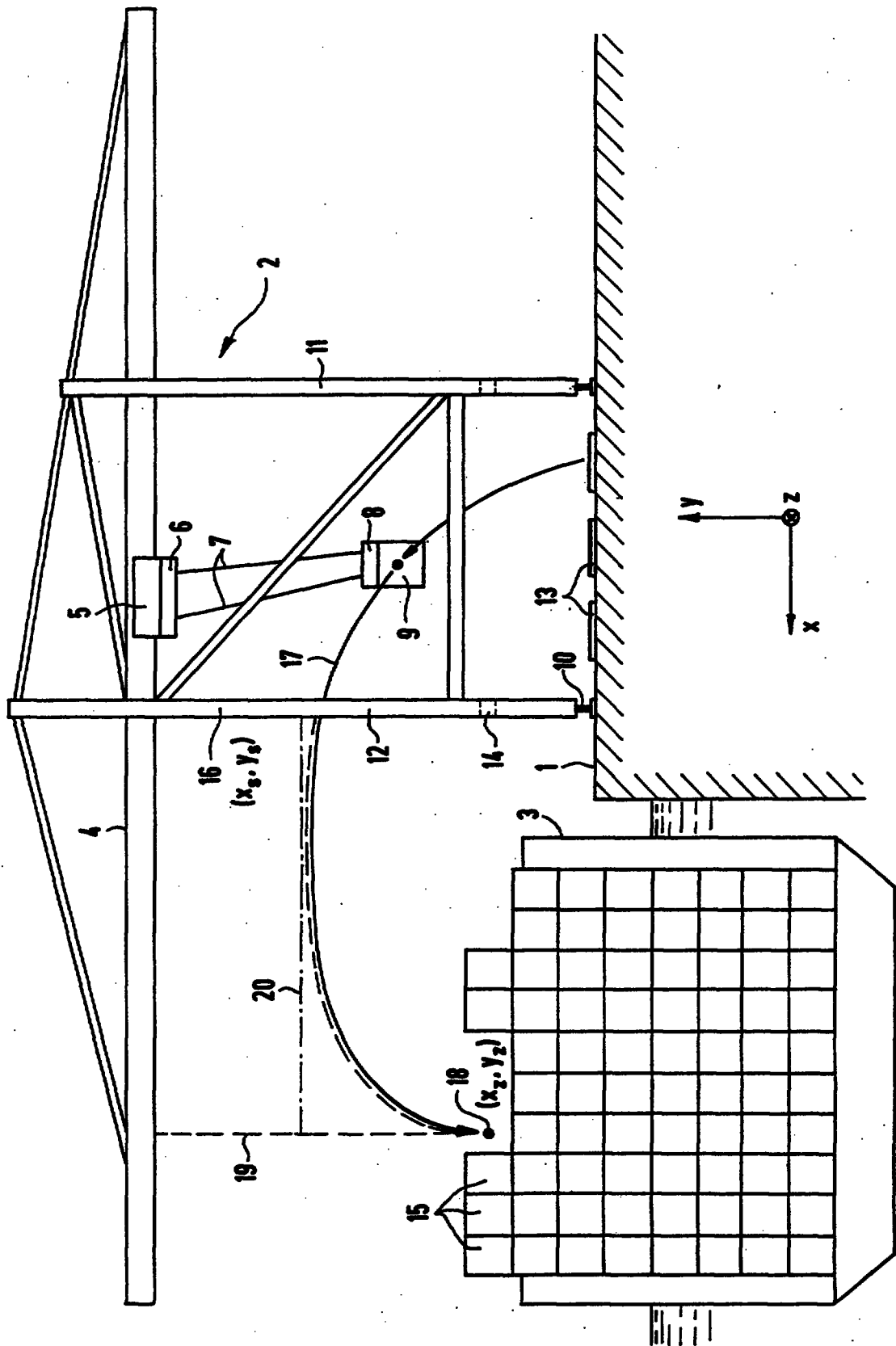
Abstract

Method of, and arrangement for, transporting a load

5 In the case of known methods of transporting a load by means of a crane from a starting position, beyond obstructions, to a target position, the transporting operation can be controlled optionally manually or automatically.

10 In order to permit, by straightforward means, reliable and collision-free automatic load transportation, it is the case that, within a predetermined area with unknown or changing obstructions (15), with the transporting operation being controlled manually, the transporting movement (17) performed is recorded and used to determine a free transporting zone (19); the automatic
15 control of the transporting operation in the predetermined area is restricted to the free transporting zone (19) determined.

FIGURE 1



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Description

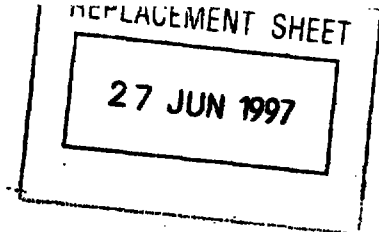
Method of, and arrangement for, transporting a load

The invention relates to a method of transporting a load by means of a crane from a starting position, beyond obstructions, to a target position, it being possible for operational control of the transporting operation to take place optionally manually or automatically. The invention also relates to a corresponding arrangement comprising a crane with a means for controlling the transporting operation optionally manually or automatically and with a means for recording and storing the transporting movement.

With modern crane installations, it is possible for loads, e.g. containers, to be transported fully automatically, and without swinging, beyond any obstructions present from a starting position to a target position. As a precondition for this, however, the height profile given by the position and size of the obstructions has to be known. This is the case, for example, with a land-side container crane in docks, since the obstructions there, e.g. safety heights or cross-members of the crane which run transversely with respect to the transporting direction, are known. Over the ship which is to be loaded or unloaded, on the other hand, the height profile of the obstructions is not known, which makes it difficult to automate the transporting operation without additional measures and involves high safety risks.

DE 31 99 784 A1 discloses a means for operating a grab crane of a loading bridge for loading or unloading a ship, in which means the actual position of the grab within an operating area delimiting the permissible desired positions is displayed on the screen of a video receiver. This means serves specifically for loading the ship with bulk material or for unloading bulk material

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from the ship, for which purpose the edges of the ship's hatches are depicted on the screen as bars. Furthermore, DE 38 16 988 A1 describes a container crane installation in which swinging is suppressed during lowering of the so-called spreader in that, after the desired position of the lifting-cable carrier has been reached in each case, the spreader is brought into swing-damping contact with the travelling trolley.

Finally, DE 40 05 066 A1 discloses a container crane which has, on its travelling trolley, a distance-measuring device in the form of a laser-type distance-measuring device, by means of which optical scanning of the height profile of the obstructions is possible. The height profile thus recorded and the load position recorded continuously via position pickups on the crane jib, the travelling trolley and lifting gear make it possible for the transporting operation to be carried out automatically without any collisions between the load and the obstructions.

Nevertheless, optical scanning of the height profile of the obstructions requires a relatively high outlay in terms of hardware and software.

It is known from E&I Electrotechnik und Informationstechnik, Vol. 110 (1993), pages 251 to 253, that it is possible to improve container handling by means of a microcomputer, and that, in particular in order to assist the crane operator, the microcomputer can effect precise positioning and a combined x-, y-movement sequence in order to produce a time-optimized path. Furthermore, GB-A-1 557 540 discloses a method of, and the associated arrangement for, unloading container ships, in which first of all specific paths are learned in a teach-in process, and these paths are stored and then called up automatically. Similarly, in EP-A-0 387 399, for a hydraulic crane drive of a mobile telescopic jib crane, first of all the crane functions and the load paths are input manually and received,

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processed and stored by an electronic control module. It is then possible for the crane functions to be called up from the control module for the purpose of automatic control of the load path with manual speed regulation. In this case, it should also be possible for the load paths to be changed at any time by renewed manual intervention.

Taking the latter prior art as departure point, the object of the invention is to permit automatic load transportation with a smaller degree of outlay, in particular without a teach-in process having to be carried out beforehand.

As regards the method of the type specified in the introduction, the object is achieved according to the invention in that, with manual control of the transporting operation within a predetermined area with unknown or changing obstructions, the transporting movement performed by the load is recorded and used for determining a free transporting zone for the load, automatic control of the transporting operation into [sic] the predetermined area being restricted to the free transporting zone determined in each case.

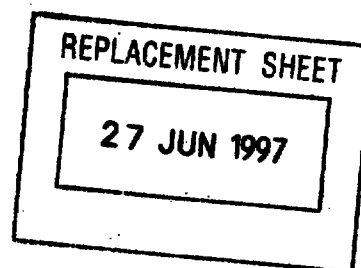
As regards the arrangement specified in the introduction, the object is achieved in that the memory is designed for storing the transporting movement recorded in a predetermined area with unknown or changing obstructions, with operationally manual control of the transporting operation, and in that a means for determining a free transporting zone from the transporting movement recorded, and means for restricting automatic control of the transporting operation in the predetermined area to the free transporting zone determined, are provided.

This means that automatic control of the transporting operation is not initially possible within the predetermined area with the unknown obstructions, because there has been no determination of a free transporting zone for this purpose. In order to determine the free

transporting zone, the crane operator has to carry out a transporting operation manually, with or without a load, in the predetermined area. A free transporting zone is determined on the basis of the transporting movement recorded for the distance up to the target, up to which the manually controlled transporting operation has taken place. Automatic control of the transporting operation is then possible within this free transporting zone.

When the crane or its jib is displaced, there is a change in the surroundings of the crane with the obstructions in relation to the transporting path for the load. After the crane has been switched off or in relatively long operation stoppages, the obstructions in the surroundings of the crane may change, e.g. when another ship docks at the quay or the containers in the operating area of the crane are otherwise transported. As a result, changes in the crane position, switching off of the crane and/or relatively long operation stoppages are advantageously recorded automatically and the free transporting zone determined is indicated as being invalid. As a result, the crane operator must first of all carry out another manually controlled transporting operation, in which case the transporting movement recorded is used to determine a new free transporting zone for automatic control of the transporting operation.

The action of loads being picked up or set down changes the height profile of the obstructions in the operating area of the crane. Since [sic] it is provided, within the context of the invention, that, when the load





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Patent Claims

1. Method of transporting a load (9) by means of a crane (2) from a starting position, beyond obstructions (14, 15), to a target position (18), it being possible
5 for operational control of the transporting operation to take place optionally manually or automatically, characterized in that, with manual control of the transporting operation in a predetermined area with unknown or changing obstructions (15), the transporting movement
10 (17) performed by the load is recorded and used to determine a free transporting zone (19) for the load, automatic control of the transporting operation in the predetermined area being restricted to the free transporting zone (19) determined in each case.
- 15 2. Method according to Claim 1, characterized in that changes in the crane position, switching off of the crane (2) and/or relatively long operation stoppages are recorded automatically and cause the free transporting zone (19) determined to be indicated as being invalid.
- 20 3. Method according to Claim 1 or 2, characterized in that, when the load (9) is lowered to the target position (18) and/or when the load (9) is picked up, the vertical transporting path is recorded, and in that the lower limit of the free transporting zone (19) is
25 corrected in dependence on the vertical transporting path recorded.
4. Arrangement for transporting a load (9) from a starting position, beyond obstructions (14, 15), to a target position (18), comprising a crane (2) with a means
30 for controlling the transporting operation optionally manually or automatically and with a means for recording and storing the transporting movement, characterized in that the memory is designed for storing the transporting movement (17) recorded in a predetermined area with
35 unknown or changing obstructions (15), with operationally manual control of the transporting operation, and in that a means for determining a free transporting zone (19)



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from the transporting movement (17) recorded, and means for restricting the automatic control of the transporting operation in the predetermined area to the free transporting zone (19) determined, are provided.

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