

Floor-Bound Transport Vehicle for Containers, Featuring a Lifting Function

The invention relates to a ground transport vehicle for the transportation of containers having at least one load surface disposed on a vehicle frame of the transport vehicle and able to be raised from a lowered transport position by a lifting drive to a raised transfer position or lowered reversely, wherein the lifting drive is part of a height-adjustable wheel suspension of a running gear of the transport vehicle.

From European patent document EP 0 302 569 B1 a system is already known for loading and unloading a ship with containers. This system comprises at least one quay crane for loading and unloading the container ships moored at the quay. Using the quay cranes, the containers are picked up from a transport vehicle or the containers are set down on this transport vehicle. This transport vehicle is able to travel on the quay without the use of rails and is guided automatically by a control device. The container is unloaded from the transport vehicle or picked up from the transport vehicle at a stationary transfer station. This transfer station consists essentially of stationary support tables onto which the containers are set down or from which the containers are picked up. These support tables are formed in the manner of a support arm and support the container from below in the region of their long sides. Accordingly, the space between the opposing support tables is narrower than the width of the containers. In order to be able to pick up the container from the support table or to set it down thereon, provision is made for the transport vehicle to have a platform for transportation of the containers, which platform is raised relative to a vehicle frame of the transport vehicle in order to receive a container and then the transport vehicle is driven out of the region of the support tables with the container now resting on the platform thereof. When using a platform which can be raised and lowered, the platform is to be lowered for onward travel of the transport vehicle. The setting down of the containers on the support table is effected in reverse order. In order that the transport vehicle is able to receive the containers from the transfer station, the platform which can be raised and lowered has a width which is narrower than the space between the opposing support tables. From this transfer station, the containers are then picked up by a gantry crane operating automatically and set down in a container storage depot or set down therein by the gantry crane.

Furthermore, in relation to the transport vehicle it is stated that the platform can be raised and lowered by a mechanical, pneumatic or hydraulic lifting drive.

DE 10 2007 039 778 A1 discloses a ground transport vehicle for the transportation of containers having at least one lifting platform disposed on a vehicle frame of the transport vehicle, which lifting platform can be raised from a lowered transport position by a lifting drive to a raised transfer position or conversely lowered from the one to the other. For this purpose, the lifting platform is fastened via at least one knee lever on the vehicle frame so that the lifting platform can be raised or lowered via the at least one knee lever, for which purpose the lifting drive acts on the at least one knee lever. The lifting platform for the lifting and lowering movement is guided on the transport vehicle.

Proceeding from this prior art, it is the object of the present invention to create an automatically guided, rubber-tyred ground vehicle, preferably a so-called AGV (Automatic Guided Vehicle), in particular for containers, which comprises improved pick-up and set-down of the loads, in particular containers.

This object is achieved by a transport vehicle having the features of claim 1. Advantageous embodiments of the invention are found in claims 2 to 12.

In accordance with the invention, in the case of a ground transport vehicle for the transportation of containers having at least one load surface which is disposed on a vehicle frame of the transport vehicle and can be raised from a lowered transport position by a lifting drive to a raised transfer position or lowered reversely, wherein the lifting drive is part of a height-adjustable wheel suspension of a running gear of the transport vehicle, improved pick-up and set-down of the containers is achieved in that the wheel suspension is formed in the manner of a hinged joint. In this way, a simple possibility is created of raising or lowering the load surface. By integration of the lifting drive into the running gear and the hinge-like formation of the wheel suspension thus provided, an even lower construction height in the region of the vehicle frame is also achieved. The container load surface can also be designed in a simpler manner since it is static. Only the entire vehicle frame is moved.

In a constructionally simple manner, provision is made for the wheel suspension to comprise a strut articulated on the vehicle frame and a rocker pivotably articulated on the strut via a horizontal lifting spindle.

Furthermore, provision is made in a constructionally simple manner for the lifting drive to be connected in an articulated manner at least to the rocker and preferably additionally to the strut.

- 5 In particular, the running gear is a multi-axle running gear having a plurality of wheel suspensions.

In a particularly preferred embodiment, each wheel suspension comprises a swing axle which is attached to a strut via a respective rocker, wherein an adjustable
10 hydraulic cylinder is articulated between the rocker and the strut for the lifting motion. The strut is connected at one end to the vehicle frame and, by means of the arrangement of the rocker between the swing axle and the strut, the vehicle frame or the container load surface can be raised and lowered by means of the hydraulic cylinder for pick-up or set-down purposes.

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For this reason, the rocker is preferably articulated at one end on the swing axle and at the other end on the strut.

In order to permit steering (straight travel, travel on a curve, travel on an incline,
20 backwards movement etc.) of the individual axles, the strut is articulated on the vehicle frame via a rotary bearing which can rotate about an approximately vertically oriented axis. In order to effect the steering movement, the strut can have an externally toothed centre pivot plate for rotation about the rotary bearing. Monitoring of the steering deflection can be effected via angle transmitters (e.g. potentiometers).
25 Alternatively, the steering movement can be effected via hydraulic cylinders, of which the changes in length are monitored.

The strut is preferably a profile part which is open on one side, has a substantially U-shaped cross-section and is narrowed from the vehicle frame towards the rocker.
30 Therefore, a high level of rigidity can be achieved with low weight. In addition, the hydraulic cylinder can therefore be centrally articulated on the vehicle frame within the profile below the fastening point of the strut, which is advantageous with respect to the absorption of force.

35 When the strut is inclined in the longitudinal direction of the vehicle such that the swing axle is disposed approximately vertically below the fastening point of the strut

on the rotary bearing when the rocker is oriented approximately horizontally, an advantageous absorption of weight by the tyres or swing axles can be achieved.

The lift of the hydraulic cylinder is preferably 600 mm.

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The preferred field of application of the transport vehicle in accordance with the invention is in its use as a container transport vehicle for port facilities, in particular in the form of an AGV.

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In the present case, the running gear is considered to be the entirety of all moveable parts of the vehicle which serve for connection to the travel lane. The running gear comprises wheels, the wheel suspension, the suspension system, shock absorbers, steering means and brakes. The wheel suspension is understood to be all components for moveable connection between the wheel/tyre and the vehicle frame.

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Further details of the invention will become clear from the following description of an exemplified embodiment with reference to the drawing in which:

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Figure 1 is a perspective view of an automatically guided vehicle in a transfer station,

Figure 2 is a perspective view of a vehicle in accordance with figure 1 outside a transfer station,

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Figure 3 is a front view of figure 1 in which the vehicle frame of the vehicle is raised,

Figure 4 is a view in accordance with figure 3 with the vehicle frame lowered and

Figure 5 is a view of the height-adjustable wheel suspension on the vehicle frame.

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Figure 1 shows a perspective view of an automatically guided vehicle 1 within a transfer station 2. The vehicle 1 can travel freely on the ground and not on rails but on tyres 1a in the sense of air-filled rubber tyres. A transfer station of this type can serve as an interface between the automatically guided vehicles 1 and another

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transport means such as e.g. an automatic, semi-automatic or manual gantry crane with a spreader frame as the load pick-up means or a high-leg, manned or unmanned straddle carrier device.

The transfer station 2 consists essentially of a stationary support frame 3 which has legs 3a in the form of vertical posts and horizontal support surfaces 3c fastened thereto to receive containers 5 to be set down thereon. The legs 3a rest at their lower end on ground 4 which, in a port area, is usually part of a quay. At the upper ends 3d thereof remote from the ground 4 the legs 3a are angled inwards and each form the horizontal support surface 3c so that the legs 3a appear L-shaped as seen in the direction of travel F of the vehicle 1. All in all, eight legs 3a are provided, of which in each case four legs adjoining an entry channel 6 for the vehicle 1 to the right and left as seen in the direction of travel F are disposed spaced apart from one another and from the vehicle 1 driven into the transfer station 2. The right and left legs 3a are also each disposed in an opposing arrangement. A space a (see figures 3 and 4) between two oppositely disposed legs 3a is selected to be greater than the width b of the vehicle 1 in order to permit entry of the vehicle 1. In this connection, the space a is approximately 100 mm greater than the width b.

The containers 5 rest with their stable corner fittings 5a (corner castings), which are preferably disposed in their lower corners, on the support surfaces 3c when they have been set down thereon by the vehicle 1 or another transport means. Furthermore, the eight legs 3a or the associated support surfaces 3c are disposed with respect to one another such that 20-foot, 40-foot or 45-foot containers 5 can be set down with their corner fittings 5a on the support surfaces 3c. In figure 1, two 20-foot containers 5 have been set down one behind the other on the eight support surfaces 3c in the transfer station 2. In order to be able to set down 40-foot or 45-foot containers 5 in the transfer station 2, the first and last pairs of legs 3a, as seen in the direction of travel F, are wider in order to be able to receive, in the region of the upper ends 3b thereof, two support surfaces 3c which are spaced apart from one another and located one behind the other as seen in the direction of travel F. A total of ten support surfaces 3c are therefore provided. The outermost support surfaces 3c on the first and last pairs of legs 3a serve to receive a 45-foot container 5; the inner support surfaces 3c on the first and last pairs of legs 3a serve to receive a 40-foot container 5.

In the preferred exemplified embodiment described above, individual, flat and rectangular support surfaces 3c are disposed on the legs 3a. Instead of the individual support surfaces 3c, a support rail which is continuous as seen in the direction of travel F and has an L-shaped cross-section can also be used, wherein one limb is

fastened to the upper end 3b of the legs 3a and the other limb forms the horizontal, inwardly facing support surface 3c.

In order to set down the containers 5 on the support surfaces 3c or in order to pick up
 5 the containers 5 from the support surfaces 3c, the vehicle 1 has a load surface 7 in the form of a box-like platform which is disposed on a vehicle frame 8 and can be vertically raised and lowered together with the vehicle frame 8 of the vehicle 1 by means of a running gear 10 of the vehicle 1. The lifting height of the load surface 7 or of the running gear 10 is about 600 mm. Furthermore, the load surface 7 extends, as
 10 seen in the direction of travel F of the vehicle 1, over almost the entire length of the vehicle 1 and is of a size appropriate for receiving two 20-foot containers 5 one behind the other or one 40-foot or one 45-foot container 5.

In figure 1, the vehicle 1 has just entered the transfer station 2. This is usually carried
 15 out automatically so that the entry channel 6 with the width a between the opposing legs 3a of the support frame 3 also only has to be slightly larger than the width b of the vehicle 1. Prior to entry of the vehicle 1 into the transfer station 2, the vehicle 2 was halted briefly in order to raise the load surface 7 jointly with the vehicle frame 8 from its lower transport position into its upper lifting position.

20 In this lifting position, the upper side of the load surface 7, on which the container 5 rests, protrudes, as seen in the vertical direction, over the support surfaces 3c which extend horizontally inwards. As seen in the direction of travel F, the load surface 7 has a narrower width c than the space d (see figure 4) between the support surfaces
 25 3d of the opposing legs 3a of the support frame 3. Therefore, the vehicle 1 can enter the transfer station 2 with its load surface 7 raised in the lifting position, without the support platform 7 coming into contact with the support surfaces 3c. The upper side of the support platform 7 is also located above the support surfaces 3c so that when the vehicle 1 is entering the transfer station 2, the lower surface 5c (see figure 3) of
 30 the container 5, in particular the corner fittings 5a thereof, is located above the support surfaces 3c.

Furthermore, provision is made for guide elements 9, conventionally designated as container position adapters, which are disposed at the lateral edges, as seen in the
 35 direction of travel F, on the vehicle frame 8 and protrude vertically upwards, to be able to pivot inwards, fold away or to be sunk in order not to collide with the support

surfaces 3c as the vehicle 1 is entering the transfer station 2. The guide elements 9 are therefore moved out of a structural clearance required for entry of the vehicle 1 into the transfer station 2. The guide elements 9 consist essentially of ramp-like guide surfaces 9a, preferably made of sheet metal, which, as seen in the lowering direction of the container 5, taper in the direction of the load surface 7 and which serve to align a container 5 set down on the load surface 7 with respect to the load surface 7 and therefore in the direction of travel F and transversely with respect thereto. Accordingly, the guide elements 9 are disposed in the region of the corners of the containers 5 to be set down, in order to permit guidance of the containers 5 in, and transversely with respect to, the direction of travel F. Furthermore, in the region of the transfer station 2, the guide elements 9 are pivoted into the vehicle frame 8 of the vehicle 1.

When the vehicle 1 has achieved its desired entry depth into the transfer station 2, the load surface 7 jointly with the vehicle frame 8 is lowered into its transport position and the container 5 is set down with its corner fittings on the support surfaces 3c. The vehicle 1 can then leave the transfer station 2 with the load surface 7 lowered or the vehicle frame 8 lowered, leaving the container 5 behind on the support frame 3.

Figure 2 shows a perspective view of a vehicle 1 in accordance with figure 1, in which, in order to illustrate the lifting function of the load surface 7, the vehicle frame 8 and the load surface 7 are shown in the raised lifting position.

In order to facilitate the setting down of the container 5 on the load surface 7 which is located for this purpose in the lower transport position, the above-described hopper-like guide elements 9 are provided on the vehicle frame 8 of the vehicle 1. These guide elements 9 have a guide surface 9a which is oriented inwardly towards the load surface 7 and which widen in the upwards direction starting from the vehicle frame 8.

Figures 1 and 2 also show that the vehicle 1 is not a rail vehicle but a vehicle 1 with air-filled rubber tyres 1a.

Figure 3 shows a front view of figure 1 as seen in the direction of travel F of the vehicle 1 which is positioned in the transfer station 2 between the legs 3a. The container 5 which can be seen in this figure 3 and the load surface 7 with the vehicle frame 8 are located in the raised lifting position. It is clear that the corner fittings 5a or the lower surface 5b of the container 5 are located at a vertical distance e above the

support surfaces 3c of the legs 3a. This space e can vary between 50 and 150 mm depending on the loading state of the container 5 and the filling pressure of the tyres 1a. It is also clear that two tyres 1a are provided per axle in the manner of a twin tyre arrangement.

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Figure 4 shows a view corresponding to figure 3, wherein, however, the load surface 7 with the vehicle frame 8 is located in its lowered transport position without supporting a container 5. The container 5 lies with its corner fittings 5a on the support surfaces 3c.

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Figure 5 shows a view of a height-adjustable wheel suspension 11 of the running gear 10 on the vehicle frame 8 of the vehicle 1. Each wheel suspension 11 comprises a swing axle 14 with two tyres 1a mounted thereon on the right and left – as seen in the direction of travel F – in the manner of a twin tyre arrangement. The swing axle is mounted on a first end 13a of a substantially horizontally extending rocker 13. By means of the rocker 13, which extends substantially in the direction of travel F, the swing axle 14 is attached in an articulated manner to a strut 12. The substantially horizontally extending rocker 13 is pivotably articulated on the strut 12 via a lifting spindle 13b extending substantially horizontally and transversely with respect to the direction of travel F. Between the strut 12 and the rocker 13 an approximate right angle is formed which varies depending on the lifting or lowering position of the vehicle frame 8 or the load surface 7. However, an angle is formed between the strut 12 and the rocker 13 in all positions. A lifting drive 15 in the form of a hydraulic cylinder 15 is articulated on an upper side of the rocker 13 in the region of the first end 13a adjacent to the swing axle 14 and is oppositely supported at an upper end of the strut 12. By means of the lifting drive 15, the vehicle frame 8 can be raised relative to the tyres 1a by extension of the lifting drive 15 and can be lowered by retraction of the lifting drive 15.

The lift of the lifting drive 15 is about 600 mm between the lowered and raised position of the vehicle frame 8 or the load surface 7. The lifting drive 15 thus presses e.g. the rocker 13 together with the swing axle 14 articulated thereon downwards during lifting of the support platform 7 with respect to the strut 12, whereby the strut 12 and rocker 13 move apart in the manner of a hinged joint and the vehicle frame 8 is raised accordingly.

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The strut 12 is articulated on the vehicle frame 8 via a rotary bearing 16 which can rotate about an approximately vertically oriented axis, wherein the strut 12 has an externally toothed centre pivot plate 17 for rotation about the rotary bearing 16 in order to provide a steering function.

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The strut 12 is a profile part which is open on one side, has a substantially U-shaped cross-section and tapers from the vehicle frame 8 towards the rocker 13. The strut 12 and the rocker 13 are thus dimensioned and disposed with respect to one another in such a way that, when the rocker 13 is oriented approximately horizontally, the swing
 10 axle 14 is disposed approximately vertically below the fastening point (or the middle thereof) of the strut 12 on the rotary bearing 16. Therefore, the rotary axis of the tyres 1a also lies almost vertically below the rotary bearing 16 when the running gear 10 is in the normal lowered transport position.

15 If is fundamentally also possible, with suitable lifting and transport apparatus, to set down the containers 5 outside the transfer station 2 onto the load surface 7 of the vehicle 1 or to pick it up from the load surface 7. The transfer station 2 advantageously assumes a buffer function with respect to the container 5.

Reference list

	1	vehicle
	1a	tyre
5	2	transfer station
	3	support frame
	3a	leg
	3b	upper end
	3c	support surface
10	4	ground
	5	container
	5a	corner fitting
	5b	lower surface
	6	entry channel
15	7	load surface
	8	vehicle frame
	9	guide element
	9a	guide surface
	10	running gear
20	11	wheel suspension
	12	strut
	13	rocker
	13a	first end
	13b	lifting spindle
25	14	swing axle
	15	lifting drive
	16	rotary bearing
	17	centre pivot plate
30	a	space between opposing legs
	b	width of the vehicle
	c	width of the load surface
	d	space between opposing support surfaces
	e	space between support surface and lower surface
35	F	direction of travel

Claims

- 1 Ground transport vehicle (1) for the transportation of containers (5) having at
5 least one load surface (7) disposed on a vehicle frame (8) of the transport
 vehicle (1) and able to be raised from a lowered transport position by a lifting
 drive (15) to a raised transfer position or lowered reversely, wherein the lifting
 drive (15) is part of a height-adjustable wheel suspension (11) of a running gear
 (10) of the transport vehicle (1), characterised in that the wheel suspension (11)
10 is formed in the manner of a hinged joint.

- 2 Transport vehicle (1) as claimed in claim 1, characterised in that the wheel
 suspension (11) comprises a strut (12) articulated on the vehicle frame (8) and a
 rocker (13) pivotably articulated on the strut (12) via a horizontal lifting spindle
15 (13b).

- 3 Transport vehicle (1) as claimed in claim 2, characterised in that the lifting drive
 (15) is connected in an articulated manner at least to the rocker (13) and is
 preferably additionally connected to the strut (12).
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- 4 Transport vehicle (1) as claimed in any one of claims 1 to 3, characterised in
 that the running gear (10) is a multi-axle running gear and has a plurality of
 wheel suspensions (11).

- 25 5 Transport vehicle (1) as claimed in any one of claims 1 to 4, characterised in
 that each wheel suspension (11) comprises a swing axle (14) which is attached
 to a strut (12) via a respective rocker (13), wherein the lifting drive (15) is formed
 as a hydraulic cylinder (15) between the rocker (13) and the strut (12).

- 30 6 Transport vehicle (1) as claimed in claim 5, characterised in that the rocker (13)
 is articulated at one end (13a) on the swing axle (14) and at the other end on
 the strut (12) via a lifting spindle (13b).

- 35 7 Transport vehicle (1) as claimed in any one of claims 2 to 6, characterised in
 that the strut (12) is articulated on the vehicle frame (8) via a rotary bearing (16)
 which can rotate about an approximately vertically oriented axis.

- 8 Transport vehicle (1) as claimed in claim 7, characterised in that the strut (12) has an externally toothed centre pivot plate (17) for rotation about the rotary bearing (16).
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- 9 Transport vehicle (1) as claimed in any one of claims 2 to 8, characterised in that the strut (12) is a profile part which is open on one side, has a substantially U-shaped cross-section and is narrowed from the vehicle frame (8) towards the rocker (13).
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- 10 Transport vehicle (1) as claimed in any one of claims 5 to 9, characterised in that the strut (12) is inclined in the longitudinal direction of the vehicle such that the swing axle (14) is disposed approximately vertically below the fastening point of the strut (12) on the rotary bearing (16) when the rocker (13) is oriented approximately horizontally.
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- 11 Transport vehicle (1) as claimed in any one of the preceding claims 1 to 10, characterised in that the lift of the lifting drive (15) is approximately 600 mm.
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- 12 Transport vehicle (1) as claimed in any one of the preceding claims, characterised in that it is a container transport vehicle for port facilities, in particular an AGV.