

HEAVY-DUTY GROUND TRANSPORTATION VEHICLE, IN PARTICULAR AN UNMANNED HEAVY-DUTY
TRANSPORTATION VEHICLE FOR ISO CONTAINERS

The invention relates to a heavy-duty ground transport vehicle for ISO-containers, in
5 particular a heavy-duty automated guided vehicle, having a travelling drive, wherein a
battery for providing the travelling drive with power is disposed in the heavy-duty
transport vehicle.

DE 42 03 778 C2 discloses an automated ground vehicle having a manipulator
10 disposed thereon. By means of the ground vehicle the manipulator can be moved
automatically between different work stations, in order to perform assembly tasks at
these locations. The ground vehicle is driven via a replaceable nickel-cadmium
battery. The battery can be changed automatically at a changing station if it has to be
recharged. For this purpose, a vehicle frame of the ground vehicle is provided with a
15 battery space, in which there are disposed guide rails which are aligned transversely
with respect to the longitudinal direction of the ground vehicle. The underside of the
battery is provided with rollers which roll on the guide rails. In order to prevent the
battery from moving along the guide rails during operation of the ground vehicle, the
vehicle frame is provided with a pin which is pretensioned in a resilient manner in the
20 direction of the battery and engages into a recess in the battery during operation of the
ground vehicle. In order to change the battery, the pin can be lowered hydraulically.
The battery thus released can be pulled laterally out of the vehicle frame along the
guide rails by means of a changing apparatus. For the purpose of the changing
operation, the ground vehicle travels automatically to a changing station.

25 Furthermore, German patent application DE 10 2007 039 778 A1 already discloses a
heavy-duty automated guided ground vehicle for ISO-containers. The transport
vehicle comprises a vehicle frame, on which at least one lifting platform is disposed
which can be raised from a lowered transport position to a raised transfer position or
vice versa via at least one lifting drive. Typically, such transport vehicles are driven
30 by a diesel engine.

Patent specification US 4 496 274 A discloses an automated guided ground vehicle which can travel on four drive rollers, which are each pivotable about a vertical axis, and is driven via two additional drive wheels. The drive wheels are driven independently via a respective electric motor. The independent drive of the drive wheels forms a so-called tank steering system, by means of which the transport vehicle can be steered and which when used together with chainless drive wheels is typically limited to use with relative small loads. The electric motors are supplied with electrical energy by a battery. The battery can be recharged by a battery vehicle. In order to safely receive objects for transportation, the transport vehicle also comprises a loading platform which comprises two carrier rails.

International patent application WO 2009/05324 A1 describes a transport vehicle which is used for transporting containers and is operated in an automated manner. In the unloaded state, the transport vehicle can be moved via an electrical drive which is powered by a battery. For the battery which is integrated into the transport vehicle a stationary charging device is provided at the site where the containers are handled, which charging device is started up in order to charge the battery.

European patent application EP 2 017 218 A1 discloses ground conveyor vehicles for transporting containers in pairs, which each comprise two support arms pointing in a main direction of travel and having rollers. Two ground conveyor vehicles are each driven up to a container from opposite longitudinal directions thereof, in order in each case to receive one end of the container between the support arms. The ground conveyor vehicles are electrically driven.

On the basis of this prior art, the object of the present invention is to provide a heavy-duty ground transport vehicle for ISO-containers, in particular a heavy-duty automated guided vehicle, which is more environmentally friendly.

This object is achieved by means of a heavy-duty ground transport vehicle for ISO-containers, in particular a heavy-duty automated guided vehicle, having the features of claim 1. Advantageous embodiments of the invention are described in the subordinate claims 2 to 7.

In accordance with the invention, in the case of a heavy-duty ground transport vehicle for ISO-containers, in particular a heavy-duty automated guided vehicle, having a travelling drive, wherein a battery for providing the travelling drive with power is disposed in the heavy-duty transport vehicle, improved environmental friendliness is achieved by virtue of the fact that for changing purposes the battery is releasably connected to heavy-duty transport vehicle and can be moved into and out of the heavy duty transport vehicle, the battery is formed as a lead battery and weighs between 6 t and 10 t and that the heavy-duty transport vehicle has at least a permissible total weight of 40 t. A significant advantage of the heavy-duty transport vehicle operated by means of a battery in the form of a traction battery is that local emissions of pollutants can be avoided completely and sound emissions can be reduced considerably. As a consequence, the impact upon the immediate environment is considerably lower. The efficiency of the drive train can also be increased considerably. As a result, the total amount of power required to operate the vehicle can be reduced. Therefore, on the one hand, environmental compatibility is further improved and on the other hand operating costs can be reduced. The battery requires less maintenance than a diesel generator unit which has also hitherto been used for providing the electrical driving power. This makes it possible to reduce maintenance costs. Since the current for recharging the batteries can be generated from different power sources, the operation of the vehicle is independent of the availability and the costs of diesel fuel. Moreover, the reliability and disposability of the heavy-duty transport vehicle are increased, since there is extensive experience in the use of lead batteries in vehicles. The charging procedure for the battery can also be performed outside the heavy-duty transport vehicle and the heavy-duty transport vehicle can continue operation with a charged replaceable battery.

In terms of the invention, a heavy-duty transport vehicle is understood to be a vehicle which can transport a payload of at least 40 t. Loads for the heavy-duty transport vehicles include ISO-containers and swap containers. Laden swap containers can generally weigh up to about 16 t. In the laden state, ISO-containers weigh 20 t to 80 t. Transport of ISO-containers is preferred. ISO-containers are understood generally to be large standardised containers having standardised lifting points or corners for load

receiving members. A heavy-duty transport vehicle which travels empty or transports an empty ISO-container or swap container is also to be included in this category, as long as this vehicle can transport a payload of at least 15 t, preferably at least 20 t. It can also be the case that such heavy-duty transport vehicles operate in a mixed operation, i.e. can transport not only ISO-containers or swap containers but also other loads such as semitrailers, swap trailers, trailers, heavy goods vehicles or tractor trucks.

A rapid battery change is rendered possible by virtue of the fact that for changing purposes the battery can be moved in and out transversely with respect to the longitudinal direction of the heavy-duty transport vehicle.

In a preferred manner, it is provided that the heavy-duty transport vehicle comprises several front wheels and rear wheels, the front wheels can be driven by a first electric motor and the rear wheels can be driven by a second electric motor. In this case, the battery is disposed between the front and rear wheels.

In order to make it even easier to change the battery, it is provided that the heavy-duty transport vehicle comprises a vehicle frame which comprises an installation space for the battery which is open at the bottom and at the sides of the heavy-duty transport vehicle.

In constructional terms, it is provided that, as seen in the longitudinal direction of the heavy-duty transport vehicle, carrier rails are disposed at the front and rear edge of the installation space and extend transversely with respect to the longitudinal direction of the heavy-duty transport vehicle and the battery is supported on said carrier rails.

The battery is attached in a particularly convenient manner in the heavy-duty transport vehicle by virtue of the fact that the battery is substantially cuboidal, sidewalls of the battery which are at the front and rear as seen in the longitudinal direction of the heavy-duty transport vehicle have support elements disposed thereon which protrude in each case from the front and rear sidewall and the battery is supported on the carrier rails via the support elements.

In relation to the change of battery, the heavy-duty transport vehicle can be formed advantageously in a passive manner, since, in the region of the support elements and the carrier rails, centring elements are disposed which, when the battery is moved into the installation space and is lowered onto the carrier rails, align the support elements with the carrier rails. It is also provided that electrical contact elements are disposed on the battery and in the region of the carrier rails electrical counter-contact elements are disposed which can be connected automatically by lowering the battery onto the carrier rails.

The invention will be explained in greater detail hereinafter with reference to an exemplified embodiment illustrated in a drawing, in which:

Figure 1 shows a perspective view from above of a heavy-duty automated guided ground vehicle for ISO-containers,

Figure 2 shows a perspective view from below of the heavy-duty transport vehicle in accordance with Figure 1, and

Figure 3 shows a side view of the heavy-duty transport vehicle of Figure 1.

Figure 1 illustrates a perspective view from above of a heavy-duty automated guided ground vehicle 1 for ISO-containers 5. The heavy-duty transport vehicle 1 has an empty weight of about 35 tonnes. Added to this is the weight of the ISO-container 5 to be transported, so that in the laden state a total weight of about 85 tonnes is achieved. The transport vehicle 1 which is formed as a four-wheel vehicle consists substantially of a vehicle frame 2, on which two front wheels 4a are mounted on a common front axle 3a and two rear wheels 4b are mounted on a common rear axle 3b. The four wheels 4a, 4b are provided with tyres. The vehicle frame 2 supports a planar platform 4 which serves to receive the ISO-containers 5 which are to be transported.

It is evident that the vehicle frame 2 comprises an installation space 6 for a battery 7. The installation space 6 begins below the platform 5 of the vehicle frame 2 and is open at the bottom in the direction of the ground 8 and on the sides 1a of the heavy-duty transport vehicle 1. Moreover, the installation space 6 is disposed between the

front and rear wheels 4a, 4b of the heavy-duty transport vehicle 1. Since the installation space 6 is open towards the right and left side 1a as seen in the longitudinal direction L of the heavy-duty transport vehicle 1, in order to recharge the battery 7 outside the heavy-duty transport vehicle 1 the battery 7 can be changed in a convenient manner by means of a movement transverse to the longitudinal direction L of the heavy-duty transport vehicle 1 in a loading and unloading direction E.

Moreover, the installation space 6 is open at the bottom which means that the battery 7 can be loaded and unloaded by forklift truck-like handling equipment. The battery 7 is formed as a lead battery and has a weight of about 8 to 9 tonnes. This battery 7 can be used to operate the heavy-duty transport vehicle 1 for about 6 to 8 hours.

Figure 2 illustrates a perspective view from below of the heavy-duty transport vehicle 1 in accordance with Figure 1. In addition to the elements already described with respect to Figure 1, Figure 2 additionally shows a travelling drive of the heavy-duty transport vehicle 1 which consists substantially of a front electric motor 9a, a front transfer gearbox 10a, a rear electric motor 9b and a rear transfer gearbox 10b. The front electric motor 9a is attached in the region of the front axle 3a under the vehicle frame 2 and is attached centrally as seen in the longitudinal direction L of the heavy-duty transport vehicle 1. The rear electric motor 9b is attached in the region of the rear axle 3b under the vehicle frame 2 and is attached centrally as seen in the longitudinal direction L of the heavy-duty transport vehicle 1. The front electric motor 9a drives the two front wheels 4a via the front transfer gearbox 10 and the rear electric motor 9b drives the two rear wheels 4b via the rear transfer gearbox 10b. The heavy-duty transport vehicle 1 thus has a four-wheel drive.

It is also evident that space is provided between the battery 7 and the front axle 3a for the suspension of switch cabinets 11 under the vehicle frame 2 in order to receive control components.

Figure 3 illustrates a side view of the heavy-duty transport vehicle 1. It is particularly clearly apparent in this Figure that the battery 1 is suspended on the vehicle frame 2 of the transport vehicle 2 via carrier rails 2a. The two carrier rails 2a are disposed at a mutual spaced interval, are aligned horizontally with respect to each other and are

attached at one height to the vehicle frame 2 via brackets 2b. The carrier rails 2a define the installation space 6 at the front and rear as seen in the longitudinal direction L of the vehicle. In order to be able to suspend the battery 7 on the carrier rails 2a, the cuboidal battery 1 has, on its front and rear sidewalls 7b, 7c and in the region of the corners of the battery 7, laterally projecting suspension elements 7a which in the operating state of the battery 7 are supported on the carrier rails 2a of the heavy-duty transport vehicle 1. By means of this type of suspension of the battery 7 within the vehicle frame 2 and in the upper region thereof, a forklift truck or other lifting apparatus can easily be driven underneath the battery 7 in a convenient manner.

Then, by means of a movement of the forklift truck or other lifting apparatus in a vertical lifting and lowering direction S the suspension elements 7a can be lifted off the carrier rail 2a and subsequently the battery 7 can be moved out of the transport vehicle 1 in an insertion and removal direction E. It is also provided that by means of the vertical movement in the lifting and lowering direction S the battery 7, which is aligned with the carrier rails 2a and is protected from sliding by means of centring elements (not illustrated), is unlocked by the centring elements and in addition, also provided electrical contact elements on the battery 7 and counter-contact elements in the region of the carrier rails 2a for electrically connecting the battery 7 to the travelling drive are released. The advantage of this is that in relation to unlocking and contact removal the heavy-duty transport vehicle 1 can be formed in a passive manner.

The intended fields of application for the heavy-duty transport vehicles described above and the associated battery-change systems include ISO-container handling in docklands and in intermodal traffic between road and rail.

The present invention has been described with reference to a heavy-duty ground transport vehicle for the transportation of ISO-containers. In principle, it is possible also to transport other heavy loads, such as e.g. slabs or coils, in metallurgical engineering, steel engineering and rolling mill engineering.

List of reference numerals

	1	heavy-duty transport vehicle
	1a	sides
5	2	vehicle frame
	2a	carrier rail
	2b	bracket
	3a	front axle
	3b	rear axle
10	4a	front wheels
	4b	rear wheels
	5	ISO-container
	6	installation space
	7	battery
15	7a	support elements
	7b	front sidewall
	7c	rear sidewall
	8	ground
	9a	front electric motor
20	9b	rear electric motor
	10a	front transfer gearbox
	10b	rear transfer gearbox
	11	switch cabinets
25	E	loading and unloading direction
	L	longitudinal direction
	S	lifting and lowering direction

Claims

1. Heavy-duty ground transport vehicle for ISO-containers, in particular a heavy-duty automated guided vehicle (1), having a travelling drive, wherein a battery (7) for providing power to the travelling drive is disposed in the heavy-duty transport vehicle (1), characterised in that for changing purposes in order to recharge the battery (7) outside the heavy-duty transport vehicle (1) the battery (7) is releasably connected to the heavy-duty transport vehicle (1) and can be moved into and out of the heavy-duty transport vehicle (1) transversely with respect to the longitudinal direction (L) of the heavy-duty transport vehicle (1), the battery (7) is formed as a lead battery and weighs between 6 t and 10 t and that the heavy-duty transport vehicle (1) has a permissible total weight of at least 40 t, that the heavy-duty transport vehicle (1) comprises a vehicle frame (2) which comprises an installation space (6) for the battery (7), and that as seen in the longitudinal direction (L) of the heavy-duty transport vehicle (1), carrier rails (2a) are disposed at the front and rear edge of the installation space (6) and extend transversely with respect to the longitudinal direction (L) of the heavy-duty transport vehicle (1) and the battery (7) is supported on said carrier rails.
2. Heavy-duty ground transport vehicle as claimed in claim 1, characterised in that the heavy-duty transport vehicle (1) comprises several front wheels (4a) and rear wheels (4b), the front wheels (4a) can be driven by a first electric motor (9a) and the rear wheels (4b) can be driven by a second electric motor (9b).
3. Heavy-duty ground transport vehicle as claimed in claim 2, characterised in that the battery (7) is disposed between the front and rear wheels (4a, 4b).
4. Heavy-duty ground transport vehicle as claimed in any one of claims 1 to 3, wherein the installation space is open at the bottom and at the sides (1a) of the heavy-duty transport vehicle (1).
5. Heavy-duty ground transport vehicle as claimed in claim 1, characterised in that the battery (1) is substantially cuboidal, sidewalls (7b, 7c) of the battery (7) which are at

the front and rear as seen in the longitudinal direction (L) of the heavy-duty transport vehicle (1) have support elements (7a) disposed thereon which protrude in each case from the front and rear sidewall (7b, 7c), and the battery (7) is supported on the carrier rails (2a) via the support elements (7a).

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6. Heavy-duty ground transport vehicle as claimed in claim 5, characterised in that in the region of the support elements (7a) and the carrier rails (2a), centring elements are disposed which, when the battery (7) is moved into the installation space (6) and the battery (7) is lowered onto the carrier rails (2a), align the support elements (7a) with the carrier rails (2a).

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7. Heavy-duty ground transport vehicle as claimed in claim 5 or 6, characterised in that electrical contact elements are disposed on the battery (7), and in the region of the carrier rails (2a) electrical counter-contact elements are disposed which can be connected automatically by lowering the battery (7) onto the carrier rails (2a).

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