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(54) **DOUBLE-DECK RAILWAY VEHICLE**
ZWEISTÖCKIGER EISENBAHNWAGEN
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Description

[0001] The invention relates to a double-deck railway vehicle, in particular a sleeping car and/or couchette car, with a lower deck having a plurality of lower deck compartments and an upper deck located above the lower deck and having a plurality of upper deck compartments, each compartment being accessible via an aisle, respectively. On at least one longitudinal side of the vehicle, at least one entrance door is provided in the region of a vehicle end and/or in a middle section of the vehicle.

[0002] Such a double-deck railway vehicle with upper decks and lower decks is known, for example from EP 0 384 262 B1. Two upper deck compartments and two lower deck compartments, respectively, are each accessible from an aisle at an intermediate deck level via at least one staircase or lift, respectively, per compartment pair.

[0003] This arrangement has the disadvantage that it is relatively expensive to manufacture due to its relatively high number of staircases. Furthermore, the staircases take a relatively large amount of space, such that the transport capacity of the vehicle is reduced. Furthermore, due to the staircases, at a very early point in time during manufacture of the car, a specification of the segmentation of the vehicle into compartments has to ensue, such that a later modification of the segmentation, in particular a later conversion, is only possible at rather high cost.

[0004] Further generic double-deck railway vehicles are known from US 2,312,906 and US 1,798,452, none of them being suitable for a convenient use by disabled passengers.

[0005] It is thus an object of the invention to provide a double-deck railway vehicle of the type mentioned above that, at least to some extent, avoids the above disadvantages and, in particular allows to raise the transport capacity and the flexibility of the segmentation of the car while allowing convenient use by disabled passengers.

[0006] The invention solves this problem with a double-deck railway vehicle having the features of claim 1.

[0007] The invention is based on the technical teaching that a raise in the transport capacity and in the flexibility of the segmentation of the vehicle may be achieved if a lower deck aisle and a separate upper deck aisle are provided, the lower deck compartments being accessible via the lower deck aisle and the upper deck compartments being accessible via the upper deck aisle.

[0008] Thanks to the two separate aisles the numerous staircases and lifts, respectively, become superfluous, such that, on the one hand, the effort necessary for manufacturing the vehicle is greatly reduced. On the other hand, the upper deck and the lower deck, due to the accessibility of the compartments via one separate aisle per deck, may be almost arbitrarily segmented into compartments just as with common single deck cars. Even at a later point in time, this segmentation may easily be modified.

[0009] The lower deck aisle and the upper deck aisle may be arranged immediately above each other. With

preferred variants of the invention it is however provided that the vehicle has a longitudinal axis and defines a transverse direction being arranged transverse, in particular perpendicular, to the longitudinal axis. The lower deck aisle and the upper deck aisle are mutually offset in the transverse direction of said vehicle. Despite the limited height within the vehicle which is due to standardized outer boundaries of the vehicle, it is herewith possible to achieve large transit heights, which guarantee convenient access to the compartments. Furthermore, the access to both aisles may be realized in a particularly simple and space-saving manner.

[0010] The upper deck aisle and the lower deck aisle may be accessible via any suitable access device. In particular, lifts, ramps or the like may be provided. Due to the very simple and space saving design that may be achieved herewith, the upper deck aisle is accessible at least via first stairs. Additionally or alternatively, the lower deck aisle may be accessible at least via second stairs. Preferably, at both ends, an access device, preferably stairs, is provided for each aisle.

[0011] The stairs may have any suitable orientation within the vehicle. For example, the stairs may be arranged in a conventional manner to at least mainly extend in the longitudinal direction of the vehicle such that, in other words, the passengers climb the stairs in a climbing direction that lies in a vertical plane substantially parallel to the longitudinal direction of the vehicle.

[0012] However, preferably, the first stairs towards the upper deck and/or the second stairs towards the lower deck at least predominantly extend in an extension direction that is inclined by less than 30°, preferably less than 20°, more preferably less than 10°, with respect to a plane perpendicular to the longitudinal direction of the vehicle. More preferably, the extension direction is parallel to a plane perpendicular to the longitudinal direction of the vehicle.

[0013] Thus, these stairs define a climbing direction of the passengers that is only slightly inclined, preferably parallel, to a plane perpendicular to the longitudinal axis of the vehicle over the predominant part of the stairs. In other words, over the predominant part of the stairs, the width dimension of the stairs is substantially parallel to the longitudinal axis of the vehicle.

[0014] Such a staircase design is different from conventional double-deck vehicles and allows a very compact staircase that does not waste transport capacity. In particular, it is possible to arrange the respective staircase comprising the respective stairs in between two consecutive compartments of the vehicle.

[0015] Preferably, the lower deck aisle and the upper deck aisle are arranged on different longitudinal sides of the vehicle. However, it will be appreciated that the upper deck aisle may for example also be arranged in the vehicle center while the lower deck aisle is arranged on one longitudinal side of the vehicle. This may for example be the case if upper deck compartments are arranged on both sides of the upper deck aisle and are provided with

sleeping facilities aligned along the longitudinal direction of the vehicle.

[0016] To achieve large transit heights it is preferably provided that the floor level of the upper deck aisle is lowered with respect to the floor level of at least a part of said upper deck compartments. With transversally offset aisles it may eventually be that the part of the ceiling of the lower deck compartments lying below the upper deck aisle is lowered as well. But this is only associated with a comparatively small, acceptable restriction of the space available in these compartments.

[0017] To achieve the same goal it is preferably provided that the ceiling level of the lower deck aisle is raised with respect to the ceiling level of at least a part of the lower deck compartments. With transversally offset aisles it may eventually be that the part of the floor of the upper deck compartments lying above the lower deck aisle is raised as well. But this is only associated with a comparatively small, acceptable restriction of the space available in these compartments.

[0018] The arrangement of the upper deck and the lower deck in the longitudinal direction of the vehicle may occur in an arbitrary manner. Preferably, at least one intermediate deck is provided from which said upper deck and/or said lower deck is accessible. Further preferably, such an intermediate deck is provided at both vehicle ends.

[0019] Access to the vehicle may be provided as well in an arbitrary suitable manner. According to the invention, on at least one longitudinal side of the vehicle, at least one entrance door is provided in the region of a vehicle end and/or in a middle section of the vehicle.

[0020] With preferred embodiments of the double-deck railway vehicle according to the invention a running gear is provided in the region one of the vehicle ends, and the entrance door is located above the running gear. With this design it is possible to provide, in the region of the vehicle ends, the space necessary for the devices for energy supply, the water equipment, the auxiliary equipment and the sanitary equipment according to the UIC requirements.

[0021] With further preferred embodiments of the double-deck railway vehicle according to the invention a running gear is provided in the region one of the vehicle ends, and the entrance door is offset with respect to the running gear along the longitudinal direction of the vehicle. With this design, on the one hand, it is possible to provide, in the region of the vehicle ends, the space necessary for the devices for energy supply, the water equipment, the auxiliary equipment and the sanitary equipment according to the UIC requirements. Furthermore, facilities for disabled persons may be simply integrated. In particular, a lift for disabled persons may then be arranged in the region of the entrance door, for example.

[0022] With the double-deck railway vehicle according to the invention there is provided equipment for disabled persons. Thus, preferably, there is provided at least one barrier-free access from the entrance door to at least one

compartment. Furthermore, according to the invention, there is provided at least one barrier-free access from the entrance door to the lower deck. Furthermore, there is provided at least one sanitary compartment and at least one barrier-free access from the entrance door to the sanitary compartment. Finally, preferably, there is provided a lift for disabled persons in the region of the entrance door.

[0023] The entrance door may be designed arbitrarily. For example, it may be a multi-wing door. With respect to optimum use of the available space, said entrance door preferably is a single-wing door.

[0024] The equipment of the compartments may be chosen arbitrarily. Thus, there may be compartments at least partially provided with seats, couchette or sleeping compartments or arbitrary combinations thereof. In particular they may also be conference compartments, play-ground compartments or mother-and-child compartments. Preferably, at least one compartment is designed as a sleeping car and/or couchette car compartment. This then comprises at least one sleeping facility. Preferably, at least two sleeping facilities, further preferably at least four sleeping facilities, are provided to achieve a high transport capacity.

[0025] To achieve variability of the vehicle in terms of its occupation and its intended use, preferably, at least one of the sleeping facilities is foldable in order to be able to provide free space for other fixtures such as seats or the like in case of its non-use.

[0026] Particularly high transport capacities are achieved with preferred variants of the double-deck railway vehicle according to the invention wherein, on the upper deck, at least six passenger compartments are provided, each comprising four sleeping facilities, and, additionally or alternatively, on the lower deck, at least six passenger compartments are provided, each comprising four sleeping facilities. Further preferred variants of the double-deck railway vehicle according to the invention with high transport capacities have at least at least 52 sleeping facilities, preferably at least 54 sleeping facilities.

[0027] The invention further relates to a passenger train with a double-deck railway vehicle according to the invention.

[0028] Further preferred embodiments will become apparent from the dependent claims and the following description of preferred embodiments given with reference to the appended drawings. It is shown in:

- 50 Figure 1 a schematic sectional representation of a preferred embodiment of the double-deck railway vehicle according to the invention;
- Figure 2 a schematic side view of the embodiment of Figure 1;
- 55 Figure 3 a schematic sectional representation of the embodiment of Figure 1 along line III-III;

- Figure 4 a schematic sectional representation of the embodiment of Figure 1 along line IV-IV;
- Figure 5 a schematic sectional representation of a further preferred embodiment of the double-deck railway vehicle according to the invention;
- Figure 6 a schematic side view of the embodiment of Figure 5;
- Figure 7 a schematic sectional representation of the embodiment of Figure 5 along line VII-VII;
- Figure 8 a schematic sectional representation of the embodiment of Figure 5 along line VIII-VIII;
- Figure 9 a schematic sectional representation of a further preferred embodiment of the double-deck railway vehicle according to the invention.

First embodiment

[0029] In the following a preferred embodiment of the double-deck railway vehicle 1 according to the invention will be described with reference to Figure 1 to 4.

[0030] In a schematic representation Figure 1 shows a cross-section of the double-deck railway vehicle 1 that is arranged perpendicularly to the longitudinal axis of the vehicle along line I-I of Figure 2. Figure 2 shows a schematic side view of the vehicle. Figure 3 and 4 show schematic sectional representations of the vehicle 1 along line III-III and IV-IV of Figure 1, respectively.

[0031] In its middle section between the vehicle ends 1.1 and 1.2 the vehicle 1 comprises an upper deck 2 and a lower deck 3. At both vehicle ends 1.1 and 1.2 an intermediate deck 4.1 and 4.2, respectively, is located adjacent thereto from which respective intermediate deck 4.1 and 4.2 the upper deck 2 and the lower deck 3 each are accessible via a staircase 5.1 and 5.2, respectively.

[0032] The upper deck 2 has a plurality of upper deck compartments 2.1 as well as an upper deck aisle 2.2 via which each of the upper deck compartments 2.1 is accessible. The lower deck 3 also has a plurality of lower deck compartments 3.1 as well as a lower deck aisle 3.2 via which each of the lower deck compartments 3.1 is accessible.

[0033] The upper deck aisle 2.2 is accessible from the first intermediate deck 4.1 via first stairs 5.3 of the first staircase 5.1 while it is accessible from the second intermediate deck 4.2 via first stairs 5.4 of the second staircase 5.2.

[0034] The lower deck aisle 3.2 is accessible from the first intermediate deck 4.1 via second stairs 5.5 of the first staircase 5.1 while it is accessible from the second intermediate deck 4.2 via second stairs 5.6 of the second staircase 5.2.

[0035] It will be appreciated that, instead of the stairs, other transit devices may be provided between the respective intermediate deck and the upper deck and lower deck, respectively. For example, a lift or the like may be provided instead of at least one of the stairs towards the upper deck. Thus an access suitable for disabled persons would be available to the upper deck. Furthermore, instead of at least one of the stairs towards the lower deck, a ramp may be provided as it is indicated in Figure 2 by the dashed contour 6. Herewith, a barrier-free access suitable for disabled persons would be available to the lower deck as well.

[0036] Due to the separate aisles 2.2 and 3.2 for the upper deck 2 and the lower deck 3, in an advantageous manner, the numerous stairs as known from EP 0 384 262 B1 become superfluous. Herewith, on the one hand, the effort necessary for manufacturing the vehicle 1 is greatly reduced. On the other hand, due to the easy accessibility of the compartments 2.1 and 3.1, respectively, via an associated aisle 2.3 and 3.2, respectively, the upper deck 2 and the lower deck 3, similar to common single-deck vehicles, may almost arbitrarily be segmented into compartments 2.1 and 3.1, respectively. Even at a later point in time this segmentation may be modified comparatively easily.

[0037] As may be taken from Figure 1 and, in particular, from Figure 3 and 4, the upper deck compartments 2.1 and the lower deck compartments 3.1 each comprise two couchette pairs each comprising two couchettes 7.1 and 7.2 arranged one above the other. In a conventional manner, each upper couchette 7.1 may be folded downwards in order to form, in this position, a backrest of a seat device that it forms together with the lower couchette 7.2.

[0038] The first stairs 5.3 of the first staircase 5.1 and the first stairs 5.4 of the second staircase 5.2 both predominantly extend in an extension direction E that lies in a plane parallel to the transverse direction 1.3 of the vehicle 1 and perpendicular to the longitudinal axis of the vehicle 1. Thus, the stairs 5.3 and 5.4, respectively, define a climbing direction of the passengers that lies in a plane parallel to the transverse direction 1.3 of the vehicle 1 and, thus, is perpendicular to the longitudinal axis of the vehicle 1 over the predominant part of the stairs 5.3 and 5.4, respectively. In other words, over the predominant part of the first stairs 5.3 and 5.4, respectively, the width dimension of the stairs 5.3 and 5.4, respectively, is substantially parallel to the longitudinal axis of the vehicle 1. Only by the last two steps at the upper end of the first stairs 5.3 and 5.4, respectively, there is provided a turn by 90° in order to enter the upper deck aisle 2.2 in a direction that lies in a vertical plane parallel to the longitudinal axis of the vehicle 1.

[0039] Such a staircase design is different from conventional double-deck vehicles where the stairs towards the upper and lower deck typically are arranged to predominantly extend in the longitudinal direction of the vehicle and, thus, conventionally define a climbing direction of the passengers that lies in a vertical plane substantially

parallel to the longitudinal axis of the vehicle.

[0040] With the design according to the invention a very compact staircase is possible that does not waste transport capacity. In particular, it is possible to arrange the respective staircase 5.1 and 5.2 in between two consecutive compartments of the vehicle 1. Thus, other than with conventional double-deck vehicles, for example, further intermediate deck compartments 4.3 and 4.4 may be arranged at the intermediate deck 4.1 and 4.2, respectively, as can be seen from Figure 4. These intermediate deck compartments 4.3 and 4.4 add to the transport capacity of the vehicle 1.

[0041] It will be appreciated that, with other embodiments of the invention, similar to the turn provided by the two uppermost steps, the stairs towards the upper deck may also have a few steps at the lower end providing some turn in the climbing direction. However, it is also possible that completely straight stairs are provided to the upper deck aisle (then eventually being somewhat steeper).

[0042] Furthermore, it will be appreciated that, with other embodiments of the invention, depending on the floor level of the intermediate deck and of the respective upper deck and lower deck aisle, instead of or in addition to the first stairs towards the upper deck aisle, the second stairs towards the lower deck aisle may as well at least predominantly extend in the extension direction E as outlined above (i.e. in a plane parallel to the transverse direction of the vehicle and perpendicular to the longitudinal axis of the vehicle).

[0043] It will be further appreciated that, with other embodiments of the invention, the extension direction E may also be slightly inclined with respect to a plane perpendicular to the longitudinal axis of the vehicle. Preferably the inclination with respect to the plane perpendicular to the longitudinal axis of the vehicle is less than 30°, preferably less than 20°, more preferably less than 10°. Here as well a compact and space saving design may be achieved.

[0044] In the embodiment shown, the upper deck 2 and the lower deck 3 each comprises seven compartments 2.1 and 3.1, respectively. Furthermore, the first intermediate deck 4.1 comprises an intermediate deck compartment 4.4 for train attendant staff with one couchette, and the second intermediate deck 4.2 comprises an intermediate deck compartment 4.3 with two couchette pairs 7.1 and 7.2. Altogether, a capacity of 60 passenger sleeping facilities and one sleeping facility for a train attendant is provided.

[0045] As may be seen from Figure 1, the upper deck aisle 2.2 and the lower deck aisle 3.2 are offset in the transverse direction 1.3 of the vehicle 1 and arranged on different lateral sides of the vehicle 1. Despite the limited height within the vehicle 1 which is due to standardized outer boundaries of the vehicle 1, it is herewith possible to achieve large transit heights of the aisles 2.2 and 3.2, which allow convenient access to the compartments 2.1 and 3.1, respectively. Furthermore, the access to both

aisles 2.2 and 3.2 may be realized in a convenient and space-saving manner, for example via the staircases 5.1 and 5.2 described above.

[0046] In order to achieve large transit heights, the floor 2.4 of the upper deck aisle 2.2 is lowered with respect to the floor 2.3 of the upper deck compartments 2.1. Thus, due to the thickness of the floor (that is required for reasons of strength) the part of the ceiling of the lower deck compartments 3.1 lying below the upper deck aisle 2.2 is also lowered. However, this is only associated with a comparatively low and acceptable restriction of the space available in the lower deck compartments 3.1.

[0047] For the same purpose, the ceiling 3.4 of the lower deck aisle 3.2 is raised with respect to the ceiling of the lower deck compartments 3.1. Thus, the part of the floor of the upper deck compartments located above the lower deck aisle 3.2 is raised as well. However, here as well, this is only associated with a comparatively low and acceptable restriction of the space available in the upper deck compartments 2.1.

[0048] As may be taken from Figure 2, the vehicle 1, at each one of its both ends 1.1. and 1.2, has a running gear in the form of a bogie 8.1 and 8.2, respectively. At the first vehicle end 1.1, above the bogie 8.1, a single-wing entrance door 9 is provided on each longitudinal side of the vehicle 1.

[0049] Due to this arrangement of the entrance doors 9 it is possible to provide, in the region of the vehicle ends 1.1 and 1.2, the space necessary for the devices for energy supply, the water equipment, the auxiliary equipment and the sanitary equipment according to the UIC requirements. Thus, sanitary compartments 10.1 and 10.2 are provided in the region of the vehicle ends 1.1 and 1.2. Furthermore, operational compartments 10.3 to 10.7 are arranged in the region of the vehicle ends 1.1 and 1.2.

Second embodiment

[0050] In the following a further preferred embodiment of the double-deck railway vehicle, 101 according to the invention will be described with reference to Figure 5 to 8.

[0051] In a schematic representation Figure 5 shows a cross-section of the double-deck railway vehicle 101 that is arranged perpendicularly to the longitudinal axis of the vehicle along line V-V of Figure 6. Figure 6 shows a schematic side view of the vehicle. Figure 7 and 8 show schematic sectional representations of the vehicle 101 along line VII-VII and VIII-VIII of Figure 5, respectively.

[0052] The vehicle 101, in its basic design and functionality, corresponds to the vehicle 1 of Figure 1 to 4. In particular, in Figure 5 to 8, similar components are designated by reference numerals only raised by the amount 100. Due to the wide accordance of the embodiment of Figure 1 to 4 and of Figure 5 to 8 it is here mainly referred to the differences.

[0053] As may be taken from Figure 5, one difference relates to the equipment of the upper deck compartments

102.1 of the upper deck 102 and of the lower deck compartments 103.1 of the lower deck 103 that are accessible via an upper deck aisle 102.2 and a lower deck aisle 103.2, respectively, that are offset in the transverse direction 101.3 of the vehicle 101.

[0054] The difference mainly lies within the design of the couchettes 107.1 and 107.2. The upper couchette 107.1 may be folded in its middle section and may be pivoted from its couchette position shown in Figure 5 in the upper deck compartment 102.1 into the position, shown in Figure 5 in the lower deck compartment 103.1. Furthermore, the lower couchette 107.2 may be pivoted from its couchette position shown in Figure 5 in the upper deck compartment 102.1 into the position shown in Figure 5 in the lower deck compartment 103.1.

[0055] Herewith it is possible to provide free space within the respective compartment for seating facilities 111 without having to remove the couchettes 107.1 and 107.2. Thus, the upper deck compartments 102.1 and the lower deck compartments 103.1, respectively, may be easily equipped for different purposes. As may be seen in particular from Figure 7 and 8, compartments equipped with couchettes 107.1 and 107.2 exclusively may be provided as well as compartments equipped with seating facilities 111 as well as compartments equipped with seating facilities 111 exclusively.

[0056] A further difference with respect to the vehicle of Figure 1 to 4 lies within the arrangement of the entrance doors 109 which are located in the region of the first vehicle end 101.1 and offset along the longitudinal direction of the vehicle 101 with respect to the bogie 108.1. Herewith it is, on the one hand, possible to provide, in the region of the vehicle ends 1.1 and 1.2, the space necessary for the devices for energy supply, the water equipment, the auxiliary equipment and the sanitary equipment according to the UIC requirements. Thus, operational compartments 110.3, 110.6 and 110.7 are arranged in the region of the vehicle ends 1.1 and 1.2.

[0057] Furthermore, due to this design, facilities accessible by disabled passengers may simply be integrated. Thus, on the first intermediate deck 104.1, an intermediate deck compartment 104.3 accessible by disabled passengers is provided that comprises a couchette pair. This intermediate deck compartment 104.3 has a barrier-free access to the entrance doors 109. Furthermore, in the region of the vehicle ends 1.1 and 1.2, sanitary compartments 110.1 and 110.2 are provided, the first sanitary compartment 110.1 of which being as well designed to be accessible by disabled passengers. The first sanitary compartment 110.1 as well has a barrier-free access to the intermediate deck compartment 104.3 and the entrance doors 109. Finally, in the region of the entrance doors 109, a lift for disabled passengers may be provided.

[0058] It will be appreciated in this context that, with other embodiments of the double-deck rail vehicle according to the invention, the entrance door or entrance doors, respectively, may also be arranged at a different

location. For example, at least one entrance door may be provided as well in a middle section of the vehicle. This door may be located at the level of a lower deck or of a central intermediate deck. Of course, combinations of the embodiments described above are possible as well.

[0059] In the present embodiment, the equipment of which is intended for a first class vehicle, the upper deck 102 and the lower deck 103 each comprises seven compartments 102.1 and 103.1, respectively, six of which are equipped with two couchette pairs 107.1, 107.2 and one with one couchette pair 107.1, 107.2. Furthermore, on the first intermediate deck 104.1 an intermediate deck compartment 104.3 is provided that is accessible to disabled passengers and equipped with one couchette pair 107.1, 107.2, and, on the second intermediate deck 104.2, an intermediate deck compartment 104.4 having one couchette is provided for train attendant staff. Altogether, depending on the number of installed seating facilities, a maximum capacity of 54 passenger sleeping facilities and one sleeping facility for a train attendant is provided.

Third embodiment

[0060] In the following a further preferred embodiment of the double-deck railway vehicle 201 according to the invention will be described with reference to Figure 9. In a schematic representation Figure 9 shows a cross-section of the double-deck railway vehicle 1 that is arranged perpendicularly to the longitudinal axis of the vehicle 201.

[0061] The vehicle 201, in its basic design and functionality, corresponds to the vehicle 1 of Figure 1 to 4. In particular, in Figure 9, similar components are designated by reference numerals only raised by the amount 200. Due to the wide accordance of the embodiment of Figure 1 to 4 and of Figure 9 it is here mainly referred to the differences.

[0062] The essential difference lies within the design of the upper deck 202 that has a central upper deck aisle 202.2 while the lower deck 203 has a lower deck aisle 203.2 that is offset with respect to the former in the transverse direction 201.3 of the vehicle 201 and arranged on one longitudinal side of the vehicle 201.

[0063] While the lower deck 203 is designed like the lower deck 3 of Figure 1, the upper deck has upper deck compartments 202.1 that are located on both sides of the upper deck aisle 202.2 and comprise couchettes 207.1 and 207.2 aligned in the longitudinal direction of the vehicle 201.

[0064] It will be appreciated in this context that, with other variants of the double-deck rail vehicle according to the invention, instead of or in addition to such a central upper deck aisle, a central lower deck aisle may be provided with such lower deck compartments located on both sides thereof.

Claims

1. Double-deck railway vehicle, in particular a sleeping car and/or couchette car, with a lower deck (3; 103; 203) having a plurality of lower deck compartments (3.1; 103.1; 203.1) and an upper deck (2; 102; 202) located above said lower deck (3; 103; 203) and having a plurality of upper deck compartments (2.1; 102.1; 202.1), each compartment being accessible via an aisle (2.2, 3.2; 102.2, 103.2; 202.2, 203.2), respectively, wherein a lower deck aisle (3.2; 103.2; 203.2) and a separate upper deck aisle (2.2; 102.2; 202.2) are provided, said lower deck compartments (3.1; 103.1; 203.1) being accessible via said lower deck aisle (3.2; 103.2; 203.2) and said upper deck compartments (2.1; 102.1; 202.1) being accessible via said upper deck aisle (2.2; 102.2; 202.2), and on at least one longitudinal side of said vehicle, at least one entrance door (9; 109) is provided in the region of a vehicle end (1.1; 101.1) and/or in a middle section of said vehicle,
characterized in that
 there is provided at least one barrier-free access from said entrance door (9; 109) to said lower deck (3).
2. Double-deck railway vehicle according to claim 1, **characterized in that**
- it has a longitudinal axis and defines a transverse direction (1.3; 101.3; 201.3), said transverse direction (1.3; 101.3; 201.3) being arranged transverse, in particular perpendicular, to said longitudinal axis, and
 - said lower deck aisle (3.2; 103.2; 203.2) and said upper deck aisle (2.2; 102.2; 202.2) are mutually offset in said transverse direction (1.3; 101.3; 201.3) of said vehicle.
3. Double-deck railway vehicle according to claim 1 or 2, **characterized in that**
- said upper deck aisle (2.2; 102.2) is accessible at least via first stairs (5.3, 5.4; 105.3, 105.4) and/or
 - said lower deck aisle (3.2; 103.2) is accessible at least via second stairs (5.5, 5.6; 105.5, 105.6).
4. Double-deck railway vehicle according to claim 3, **characterized in that**
- it has a longitudinal axis, and
 - said first stairs (5.3, 5.4; 105.3, 105.4) and/or said second stairs (5.5, 5.6; 105.5, 105.6) at least predominantly extend in an extension direction (E) that is inclined by less than 30° with respect to a plane perpendicular to said longitudinal axis, preferably is parallel to said plane per-
- pendicular to said longitudinal axis.
5. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that** said lower deck aisle (3.2; 103.2) and said upper deck aisle (2.2; 102.2) are arranged on different longitudinal sides of said vehicle.
6. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that** the floor level of said upper deck aisle (2.2; 102.2) is lowered with respect to the floor level of at least a part of said upper deck compartments (2.1; 102.1).
7. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that** the ceiling level of said lower deck aisle (3.2) is raised with respect to the ceiling level of at least a part of said lower deck compartments (3.1).
8. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that** at least one intermediate deck (4.1, 4.2; 104.1, 104.2) is provided from which said upper deck (2; 102) and/or said lower deck (3; 103) is accessible.
9. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that**
- a running gear (8.1) is provided in the region of one of said vehicle ends (1.1), and
 - said entrance door (9) is located above said running gear (8.1).
10. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that**
- a running gear (108.1) is provided in the region of one of said vehicle ends (101.1), and
 - said entrance door (109) is offset with respect to said running gear (108.1) along the longitudinal direction of said vehicle.
11. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that** there is provided at least one barrier-free access from said entrance door (109) to at least one compartment (104.3).
12. Double-deck railway vehicle according to any one of the preceding claims, **characterized in that**
- at least one sanitary compartment (110.1) is provided, and
 - there is provided at least one barrier-free access from said entrance door (109) to said san-

- itary compartment (110.1).
13. Double-deck railway vehicle according to any one of the preceding claims,
characterized in that there is provided a lift for disabled passengers in the region of said entrance door (109).
14. Double-deck railway vehicle according to any one of the preceding claims,
characterized in that said entrance door (9; 109) is a single-wing door.
15. Double-deck railway vehicle according to any one of the preceding claims,
characterized in that at least one compartment (2.1, 3.1, 4.3; 102.1, 103.1, 104.3; 202.1, 203.1) is arranged as a sleeping and/or couchette compartment, wherein it comprises at least one sleeping facility (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), preferably at least two sleeping facilities (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), further preferably at least four sleeping facilities (7.1, 7.2; 107.1, 107.2; 207.1, 207.2).
16. Double-deck railway vehicle according to claim 15,
characterized in that at least one of said sleeping facilities (7.1, 7.2; 107.1, 107.2) is foldable.
17. Double-deck railway vehicle according to any one of the preceding claims,
characterized in that,
- on the upper deck (2; 102), at least six passenger compartments (2.1; 102.1) are provided, each comprising four sleeping facilities (7.1, 7.2; 107.1, 107.2),
 - and/or
 - on the lower deck (3; 103), at least six passenger compartments (3.1; 103.1) are provided, each comprising four sleeping facilities (7.1, 7.2; 107.1, 107.2).
18. Double-deck railway vehicle according to any one of the preceding claims,
characterized in that at least 52 sleeping facilities (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), preferably at least 54 sleeping facilities (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), are provided.
19. Passenger train with a double-deck railway vehicle (1; 101; 201) according to any one of the preceding claims.

Patentansprüche

1. Doppelstock-Eisenbahnwagen, insbesondere Schlaf- und/oder Liegewagen, mit einem Unterdeck

(3; 103; 203), das eine Mehrzahl von Unterdeckabteilen (3.1; 103.1; 203.1) aufweist, und einem Oberdeck (2; 102; 202), das über dem Unterdeck (3; 103; 203) angeordnet ist und eine Mehrzahl von Oberdeckabteilen (2.1; 102.1; 202.1) aufweist, wobei jedes Abteil jeweils von einem Gang (2.2, 3.2; 102.2, 103.2; 202.2, 203.2) aus zugänglich ist, wobei ein Unterdeckgang (3.2; 103.2; 203.2) und ein separater Oberdeckgang (2.2; 102.2; 202.2) vorgesehen sind, wobei die Unterdeckabteile (3.1; 103.1; 203.1) von dem Unterdeckgang (3.2; 103.2; 203.2) aus zugänglich sind und die Oberdeckabteile (2.1; 102.1; 202.1) von dem Oberdeckgang (2.2; 102.2; 202.2) aus zugänglich sind, und an wenigstens einer Wagenlängsseite im Bereich eines Wagenendes (1.1; 101.1) und/oder in einer Mittensektion des Wagens eine Einstiegstür (9; 109) vorgesehen ist,
dadurch gekennzeichnet, dass ausgehend von der Einstiegstür (9; 109) wenigstens ein barrierefreier Zugang (6) zu dem Unterdeckgang (3) vorgesehen ist.

2. Doppelstock-Eisenbahnwagen nach Anspruch 1,
dadurch gekennzeichnet, dass

- er eine Längsachse aufweist und eine Querrichtung (1.3; 101.3; 201.3) definiert, wobei die Querrichtung (1.3; 101.3; 201.3) quer, insbesondere senkrecht, zu der Längsachse angeordnet ist, und
- der Unterdeckgang (3.2; 103.2; 203.2) und der Oberdeckgang (2.2; 102.2; 202.2) in der Querrichtung des Wagens zueinander versetzt angeordnet sind.

3. Doppelstock-Eisenbahnwagen nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**

- der Oberdeckgang (2.2; 102.2) wenigstens über eine erste Treppe (5.3, 5.4; 105.3, 105.4) zugänglich ist
- und/oder
- der Unterdeckgang (3.2; 103.2) wenigstens über eine zweite Treppe (5.5, 5.6; 105.5, 105.6) zugänglich ist.

4. Doppelstock-Eisenbahnwagen nach Anspruch 3,
dadurch gekennzeichnet, dass

- er eine Längsachse aufweist und
- die erste Treppe (5.3, 5.4; 105.3, 105.4) und/oder die zweite Treppe (5.5, 5.6; 105.5, 105.6) sich zumindest überwiegend in einer Erstreckungsrichtung (E) erstreckt, die um weniger als 30° zu einer senkrecht zu der Längsachse verlaufenden Ebene geneigt ist, vorzugsweise parallel zu der senkrecht zu der Längsachse verlaufenden Ebene ist.

5. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der Unterdeckgang (3.2; 103.2) und der Oberdeckgang (2.2; 102.2) an verschiedenen Längsseiten des Wagens angeordnet sind.
6. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Bodenniveau des Oberdeckganges (2.2; 102.2) gegenüber dem Bodenniveau wenigstens eines Teils der Oberdeckabteile (2.1; 102.1) abgesenkt ist.
7. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Deckenniveau des Unterdeckganges (3.2) gegenüber dem Deckenniveau wenigstens eines Teils der Unterdeckabteile (3.1) angehoben ist.
8. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** wenigstens ein Zwischendeck (4.1, 4.2; 104.1, 104.2) vorgesehen ist, von dem aus das Oberdeck (2; 102) und/oder das Unterdeck (3; 103) zugänglich ist.
9. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**
- im Bereich eines der Wagenenden (1.1) ein Fahrwerk (3.1) vorgesehen ist und
 - die Einstiegstür (9) über dem Fahrwerk (3.1) angeordnet ist.
10. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**
- im Bereich eines der Wagenenden (101.1) ein Fahrwerk (108.1) vorgesehen ist und
 - die Einstiegstür (109) in der Längsrichtung des Wagens zu dem Fahrwerk (108.1) versetzt angeordnet ist.
11. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** ausgehend von der Einstiegstür (109) wenigstens ein barrierefreier Zugang zu wenigstens einem Abteil (104.3) vorgesehen ist.
12. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**
- wenigstens ein Sanitärabteil (110.1) vorgesehen ist und
 - ausgehend von der Einstiegstür (109) wenigstens ein barrierefreier Zugang zu dem Sanitärabteil (110.1) vorgesehen ist.
13. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** im Bereich der Einstiegstür (109) ein Lift für behinderte Passagiere vorgesehen ist.
14. Doppelstock-Eisenbahnwagen nach einem der Ansprüche 8 bis 14, **dadurch gekennzeichnet, dass** die Einstiegstür (9; 109) einflügelig ausgebildet ist.
15. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** wenigstens ein Abteil (2.1, 3.1, 4.3; 102.1, 103.1, 104.3; 202.1, 203.1) als Schlaf- und/oder Liegewagenabteil ausgebildet ist, wobei es wenigstens eine Liegeeinheit (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), vorzugsweise zwei Liegeeinheiten (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), weiter vorzugsweise vier Liegeeinheiten (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), umfasst.
16. Doppelstock-Eisenbahnwagen nach Anspruch 15, **dadurch gekennzeichnet, dass** wenigstens eine der Liegeeinheiten (7.1, 7.2; 107.1, 107.2) klappbar ausgebildet ist.
17. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**
- auf dem Oberdeck (2; 102) wenigstens sechs Passagierabteile (2.1; 102.1) mit jeweils vier Liegeeinheiten (7.1, 7.2; 107.1, 107.2) vorgesehen sind
 - und/oder
 - auf dem Unterdeck (3; 103) wenigstens sechs Passagierabteile (3.1; 103.1; 203.1) mit jeweils vier Liegeeinheiten (7.1, 7.2; 107.1, 107.2) vorgesehen sind.
18. Doppelstock-Eisenbahnwagen nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** wenigstens 52 Liegeeinheiten (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), vorzugsweise wenigstens 54 Liegeeinheiten (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), vorgesehen sind.
19. Reisezug mit einem Doppelstock-Eisenbahnwagen (1; 101; 201) nach einem der vorhergehenden Ansprüche.
- 55 **Revendications**
1. Véhicule de chemin de fer à deux étages, en particulier wagon-lit et/ou couchettes, ayant un étage in-

- férieur (3; 103; 203) comprenant une pluralité de compartiments d'étage inférieur (3.1; 103.1; 203.1) et un étage supérieur (2; 102; 202) se trouvant audessus dudit étage inférieur (3; 103; 203) et comprenant une pluralité de compartiments d'étage supérieur (2.1; 102.1; 202.1), chaque compartiment étant accessible par un couloir (2.2, 3.2; 102.2, 103.2; 202.2, 203.2), respectivement, dans lequel un couloir d'étage inférieur (3.2; 103.2; 203.2) et un couloir d'étage supérieur distinct (2.2; 102.2; 202.2) sont prévus, lesdits compartiments d'étage inférieur (3.1; 103.1; 203.1) étant accessibles par ledit couloir d'étage inférieur (3.2; 103.2; 203.2) et lesdits compartiments d'étage supérieur (2.1; 102.1; 202.1) étant accessibles par ledit couloir d'étage supérieur (2.2; 102.2; 202.2), et, sur au moins un côté longitudinal dudit véhicule, au moins une porte d'entrée (9; 109) est prévue dans la zone d'une extrémité de véhicule (1.1; 101.1) et/ou dans une section centrale dudit véhicule,
- caractérisé en ce que**
au moins un accès sans barrière est prévu entre ladite porte d'entrée (9; 109) et ledit étage inférieur (3).
2. Véhicule de chemin de fer à deux étages selon la revendication 1, **caractérisé en ce que**
- il a un axe longitudinal et définit une direction transversale (1.3; 101.3; 201.3), ladite direction transversale (1.3; 101.3; 201.3) étant transversale, en particulier perpendiculaire, par rapport audit axe longitudinal, et
 - ledit couloir d'étage inférieur (3.2; 103.2; 203.2) et ledit couloir d'étage supérieur (2.2; 102.2; 202.2) sont décalés l'un par rapport à l'autre dans ladite direction transversale (1.3; 101.3; 201.3) dudit véhicule.
3. Véhicule de chemin de fer à deux étages selon la revendication 1 ou 2, **caractérisé en ce que**
- ledit couloir d'étage supérieur (2.2; 102.2) est accessible au moins par des premiers escaliers (5.3, 5.4; 105.3, 105.4), et/ou
 - ledit couloir d'étage inférieur (3.2; 103.2) est accessible au moins par des deuxièmes escaliers (5.5, 5.6; 105.5, 105.6).
4. Véhicule de chemin de fer à deux étages selon la revendication 3, **caractérisé en ce que**
- il dispose d'un axe longitudinal, et
 - lesdits premiers escaliers (5.3, 5.4; 105.3, 105.4) et/ou lesdits deuxièmes escaliers (5.5, 5.6; 105.5, 105.6) s'étendent au moins principalement dans une direction d'extension (E) qui est inclinée de moins de 30° par rapport à un
- plan perpendiculaire audit axe longitudinal, et est, de préférence, parallèle audit plan perpendiculaire par rapport audit axe longitudinal.
5. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit couloir d'étage inférieur (3.2; 103.2) et ledit couloir d'étage supérieur (2.2; 102.2) sont disposées sur des côtés longitudinaux différents dudit véhicule.
6. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le niveau du sol dudit couloir d'étage supérieur (2.2; 102.2) est abaissé par rapport au niveau du sol d'au moins une partie desdits compartiments d'étage supérieur (2.1; 102.1).
7. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le niveau du plafond dudit couloir d'étage inférieur (3.2) est surélevé par rapport au niveau du plafond d'au moins une partie desdits compartiments d'étage inférieur (3.1).
8. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**au moins un étage intermédiaire (4.1, 4.2; 104.1, 104.2) est prévu, à partir duquel ledit étage supérieur (2; 102) et/ou ledit étage inférieur (3; 103) est accessible.
9. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que**
- un train de roulement (8.1) est prévu dans la zone d'une desdites extrémités de véhicule (1.1), et
 - ladite porte d'entrée (9) se trouve au-dessus dudit train de roulement (8.1).
10. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que**
- un train de roulement (108.1) est prévu dans la zone d'une desdites extrémités de véhicule (101.1), et
 - ladite porte d'entrée (109) est décalée par rapport audit train de roulement (108.1) le long de la direction longitudinale dudit véhicule.
11. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**au moins un accès sans barrière est prévu entre ladite porte d'entrée (109) et au moins un compartiment (104.3).

12. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que**
- au moins un compartiment d'installations sanitaires (110.1) est prévu, et 5
 - au moins un accès sans barrière est prévu entre ladite porte d'entrée (109) et ledit compartiment d'installations sanitaires (110.1). 10
13. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un appareil élévateur pour voyageurs handicapés est prévu dans la région de ladite porte d'entrée (109). 15
14. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite porte d'entrée (9; 109) est une porte à un seul battant. 20
15. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**au moins un compartiment (2.1, 3.1, 4.3; 102.1, 103.1, 104.3; 202.1, 203.1) est conçu comme un compartiment de wagon-lit et/ou couchettes, et comprend au moins un couchage (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), de préférence au moins deux couchages (7.1, 7.2; 107.1, 107.2; 207.1, 207.2), et plus préférablement au moins quatre couchages (7.1, 7.2; 107.1, 107.2; 207.1, 207.2). 25
30
16. Véhicule de chemin de fer à deux étages selon la revendication 15, **caractérisé en ce qu'**au moins un desdits couchages (7.1, 7.2; 107.1, 107.2) est pliable. 35
17. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce que**
- au moins six compartiments voyageurs (2.1; 102.1) sont prévus sur l'étage supérieur (2; 102), chacun comprenant quatre couchages (7.1, 7.2; 107.1, 107.2), 45
 - et/ou
 - au moins six compartiments voyageurs (3.1; 103.1) sont prévus sur l'étage inférieur (3; 103), chacun comprenant quatre couchages (7.1, 7.2; 107.1, 107.2). 50
18. Véhicule de chemin de fer à deux étages selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**au moins 52 couchages (7.1, 7.2; 107.1, 107.2; 207.1, 207.2) sont prévus, de préférence, au moins 54 couchages (7.1, 7.2; 107.1, 107.2; 207.1, 207.2). 55
19. Train de voyageurs avec véhicule de chemin de fer à deux étages (1; 101; 201) selon l'une quelconque des revendications précédentes.

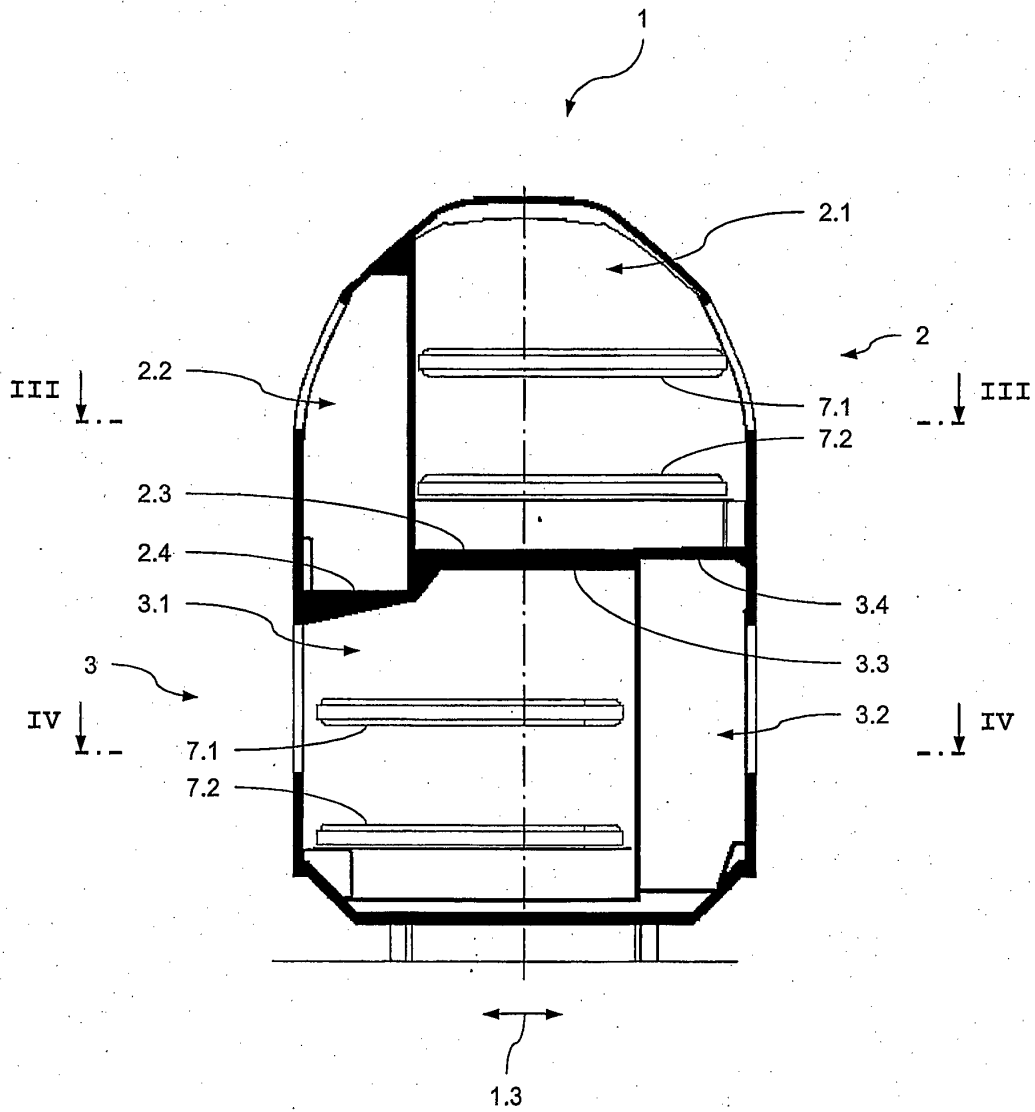


Fig. 1

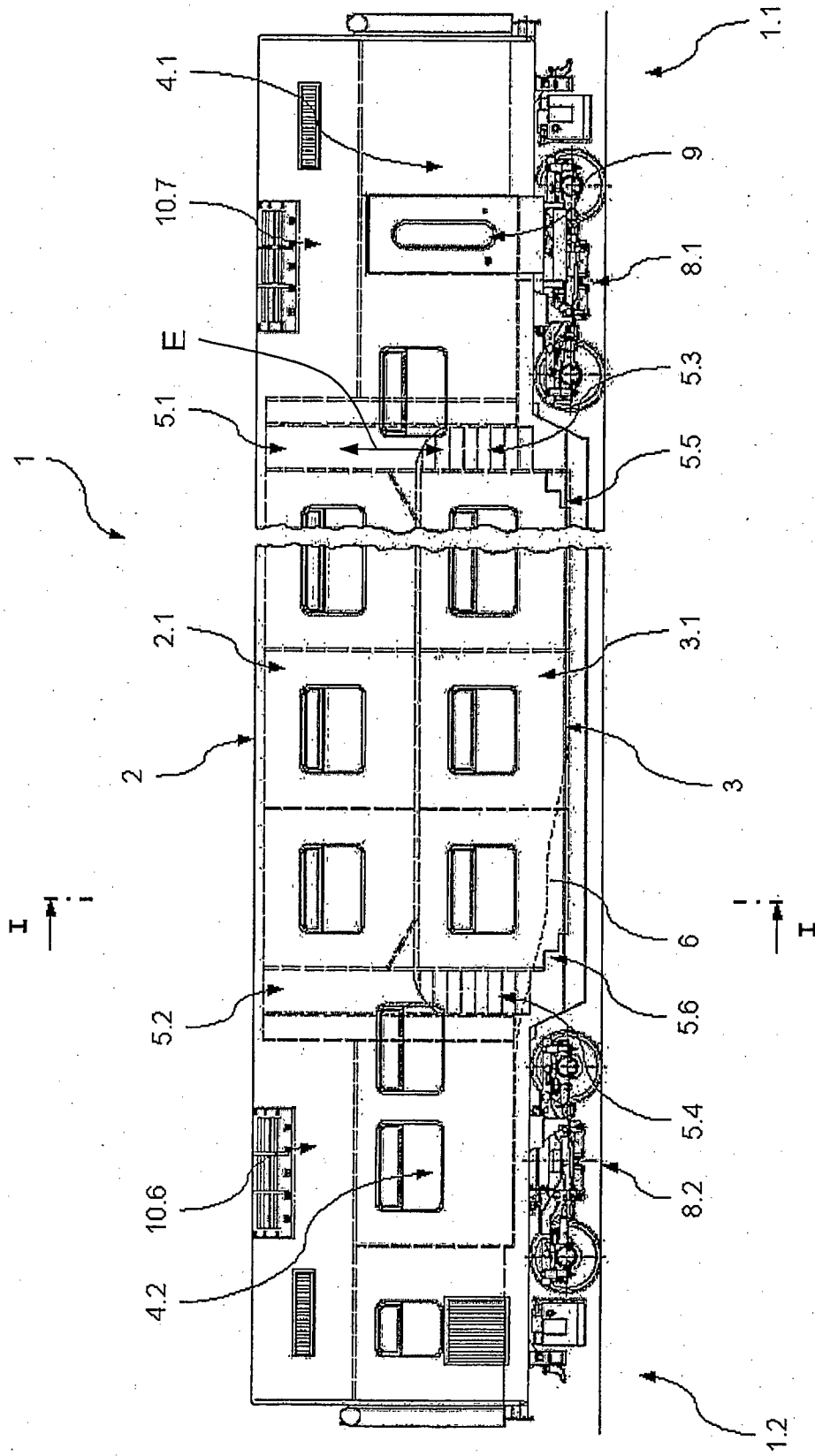


Fig. 2

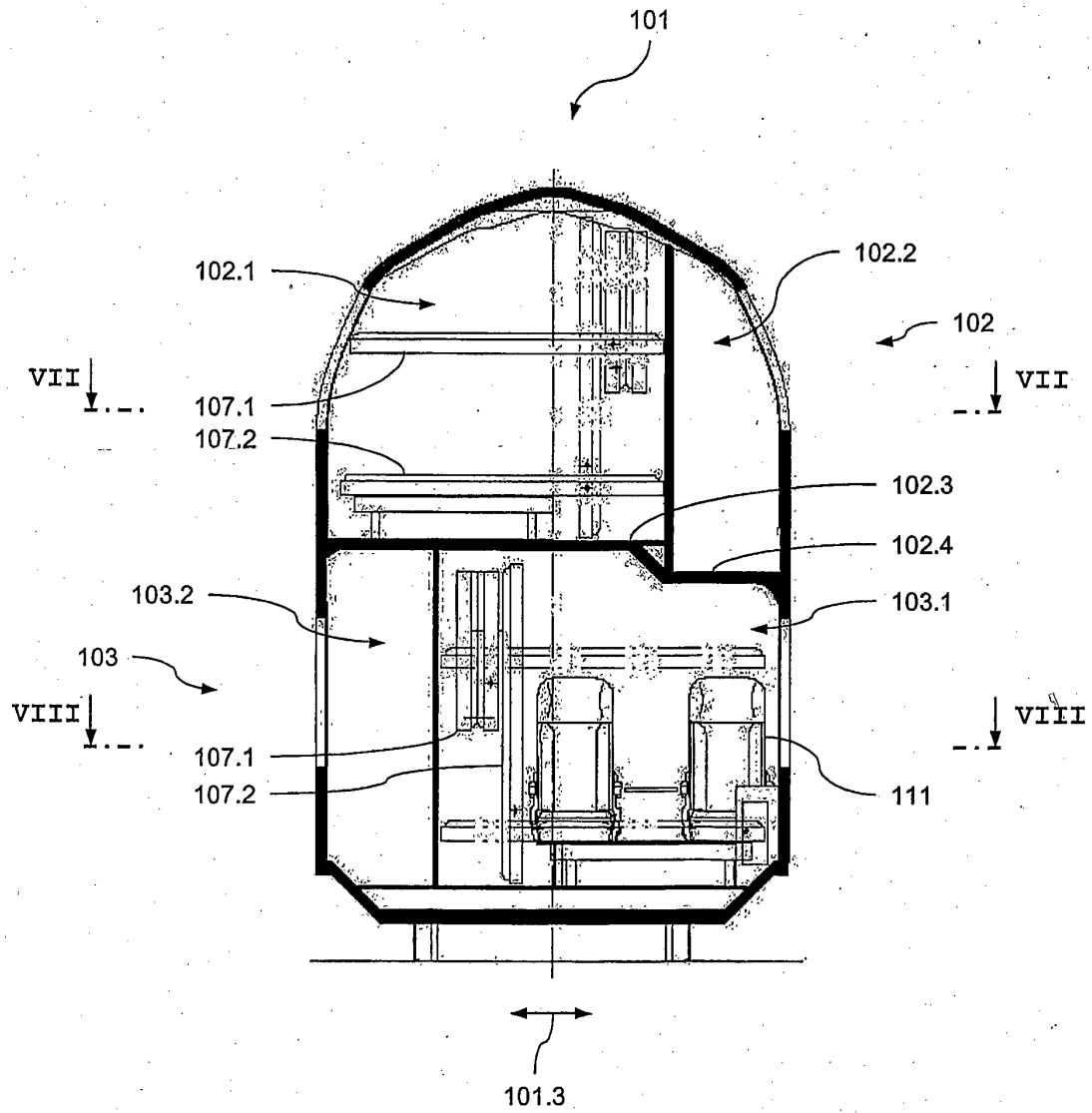


Fig. 5

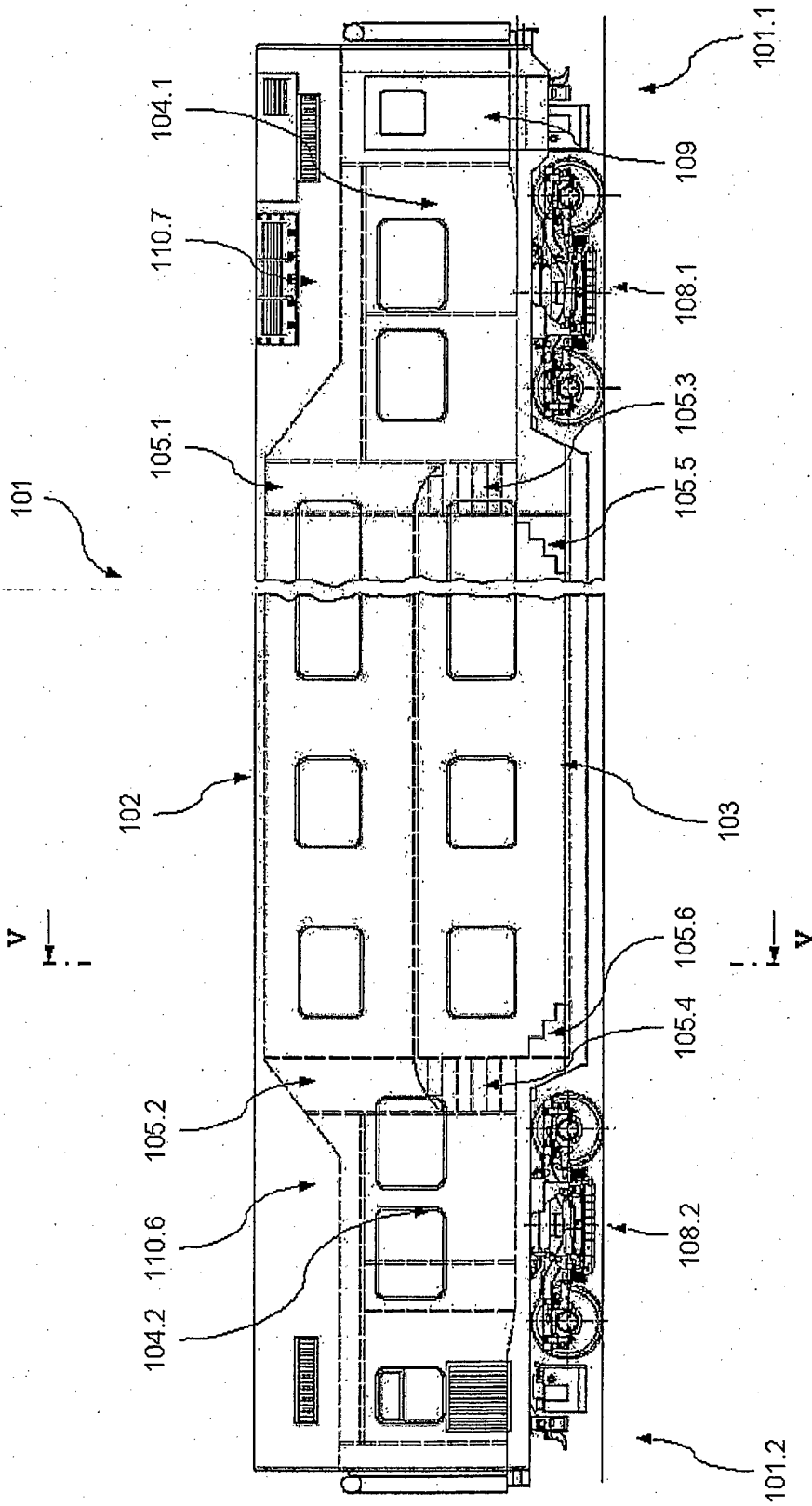


Fig. 6

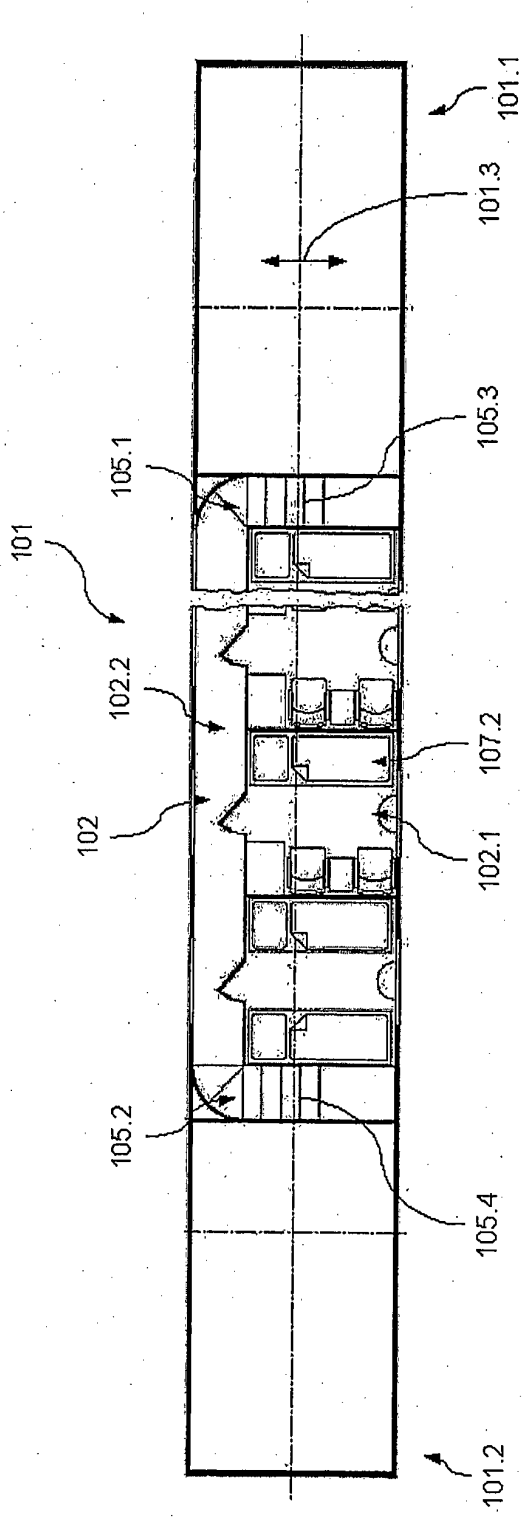


Fig. 7

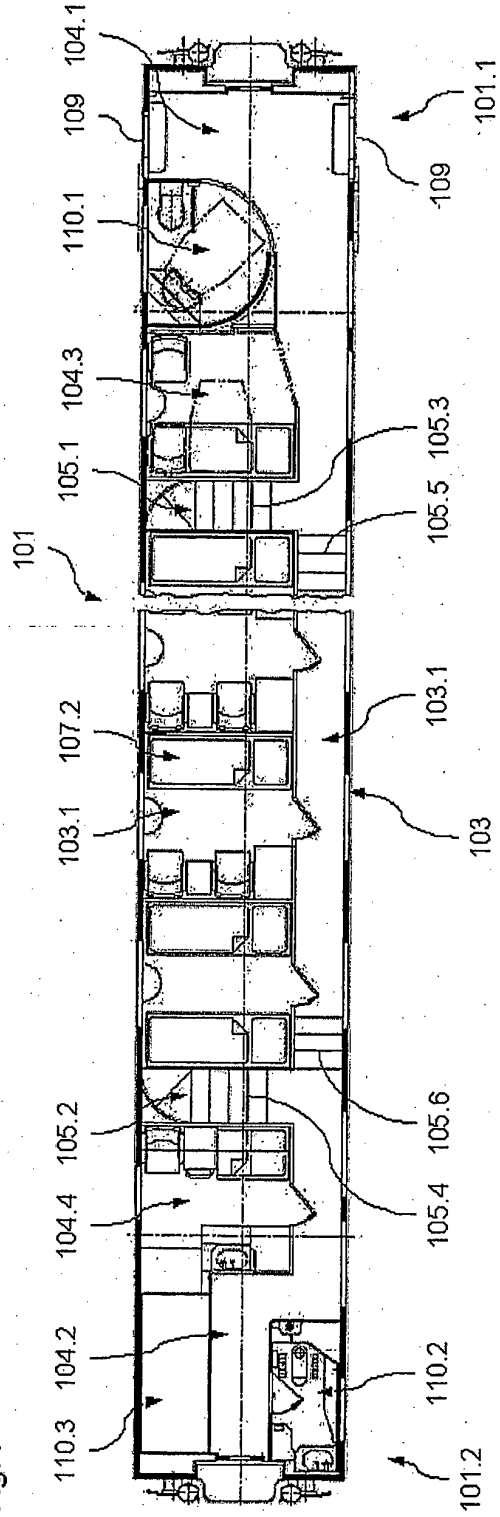


Fig. 8

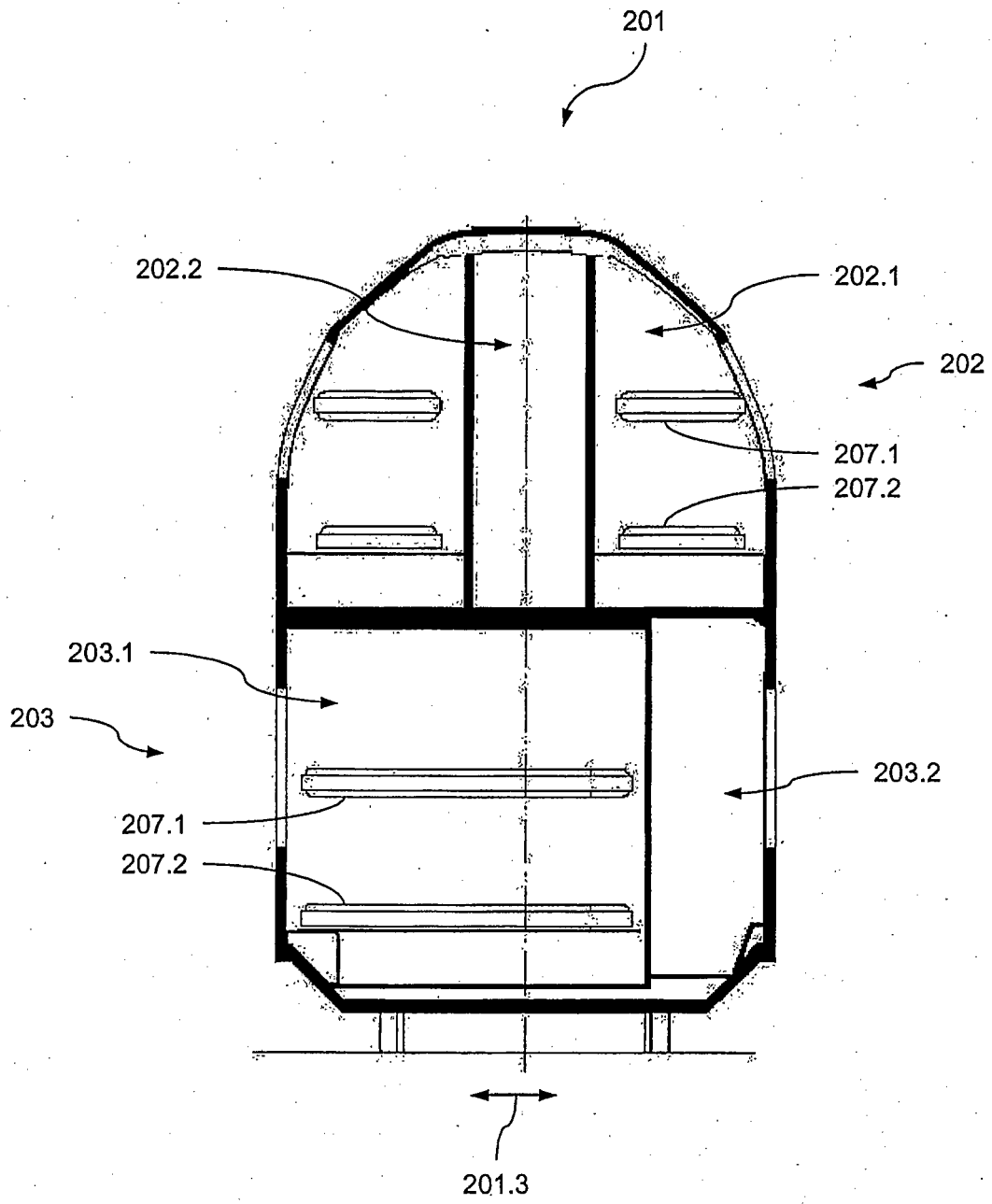


Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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