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(54) **RAILWAY VEHICLE WITH ADJUSTABLE FLOOR HEIGHT**

(57) A railway vehicle (100) comprising a car body (1), a floor (2), and one or more boarding areas (3) each associated with at least one door (4), wherein a floor supporting assembly (10) is operatively connected to and support the floor (2), the floor supporting assembly (10) being arranged to reversibly adjust the height of the floor (2) at least at the one or more boarding areas (3) from at least a first level (H1) to a second level (H2).

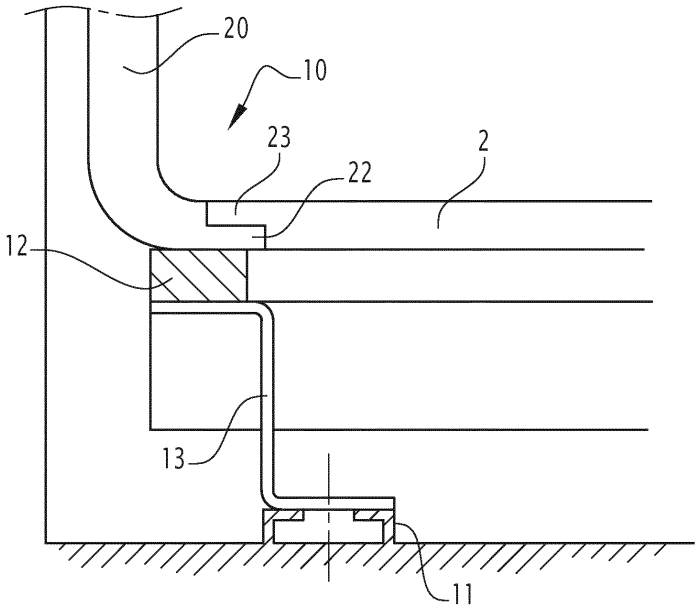

FIG.3

EP 3 712 030 A1

Description

[0001] The present invention concerns a railway vehicle with adjustable floor height, and more in particular, a railway vehicle having a floor whose height can be reversibly adjusted from a first level to a second level.

[0002] As known, railway vehicles, such as trams or train wagons, are fitted with a floor which has, at least at boarding entrance areas, at least a given height with respect to the eight of on/off boarding platforms in order to allow barrier-free entrance or exit of passengers.

[0003] A part of a floor at a second different height might be provided inside the railway vehicle, in particular inside train wagons, and can be accessible by means of one additional step in accordance with the relevant Technical Specification for Interoperability or "TSI".

[0004] These configurations with portions of floors at multiple and different levels, although admitted, have some shortcomings since they might create difficulties to passengers, for example when carrying heavy luggage, and in any case they hinder full free circulation and movement inside the vehicle, for instance to wheelchairs.

[0005] In order to minimize such issues, some solutions have been devised, for example by using some inclined sections or ramps, which connect adjacent parts of the floor of a railway vehicle at different levels.

[0006] Although these solutions mitigate on one side the problem of easily accessing parts of a vehicle floor which are at different levels, on the other side they render very difficult, or even impossible, to change the height of the floor of a railway vehicle with respect to the level of the on/off boarding platform, when such needs arise during the operative lifetime of a railway vehicle.

[0007] For example, it is possible that during the long lifetime of a rail vehicle, new regulations are introduced by authorities changing, for whatever reasons, the level of existing or on/off boarding platforms.

[0008] For instance, some countries may have historically used some platforms having heights which do not exactly correspond to those common with or admitted by international standards, and therefore such platforms need to be modified sooner or later.

[0009] Accordingly, some railway vehicles may have a level of the floor relative to the platform level, in particular at the entrance area, which might not be suitable anymore for guaranteeing barrier-free entrance inside the vehicle itself.

[0010] Further, during the quite long operating lifetime of railway vehicles, it is also possible that train operators may request, for various reasons and more than once, for a change of the floor height.

[0011] Hence, it is quite evident the need of having railway vehicles further improved in order to satisfy such technical requirements and solve at least partially, some of the above indicated drawbacks and operational issues.

[0012] Therefore, it is a main aim of the present invention to provide a railway vehicle offering substantial improvements over known solutions, in particular as regard to the capability of adapting the height of the floor at different levels while ensuring free access at the boarding area.

[0013] Within the scope of this aim, an object of the present invention is to provide a railway vehicle where the adaptation of the height of the floor at different levels, while ensuring free access at the boarding area, would facilitate at the same time and as much as possible free movement inside the railway vehicle itself in areas other than the boarding area.

[0014] Yet a further object of the present invention is to provide a railway vehicle which is highly reliable, easy to realize and at competitive costs.

[0015] This aim, these objects and others which will become apparent hereinafter are achieved by a railway vehicle comprising a car body, a floor, and one or more boarding areas each associated with at least one door, characterized in that it comprises a floor supporting assembly which is operatively connected to and support said floor, said floor supporting assembly being arranged to reversibly adjust the height of said floor at least at said one or more boarding areas from at least a first level to a second level.

[0016] Some peculiar aspects and features of the railway according to the present invention are defined in particular in the appended relevant claims.

[0017] Further characteristics and advantages will become apparent from the description of some preferred but not exclusive exemplary embodiments of a railway vehicle according to the present disclosure, illustrated only by way of non-limitative examples with the accompanying drawings, wherein:

Figure 1 is side view schematically representing a part of a rail vehicle provided with an exemplary floor supporting assembly for positioning and holding at least part of the floor of the vehicle at a first height;
Figure 2 is a side view showing a railway vehicle with its floor positioned at said first height by using the floor supporting assembly depicted in figure 1;
Figure 3 is side view schematically representing a part of a rail vehicle provided with an exemplary floor supporting assembly for positioning and holding at least part of the floor of the vehicle at a second height higher than the first height depicted in figure 1;
Figure 4 is a side view showing a railway vehicle with its floor positioned at said second height by using the floor supporting assembly depicted in figure 3;
Figure 5 is a schematic view illustrating in more details some components of the floor supporting assembly depicted in figures 1 and 3;
Figure 6 schematically shows an alternative embodiment of a floor supporting assembly which can be used in a railway vehicle according to the present invention.

[0018] It should be noted that in the detailed description that follows, identical or similar components, either from

a structural and/or functional point of view, have the same reference numerals, regardless of whether they are shown in different embodiments of the present disclosure; it should also be noted that in order to clearly and concisely describe the present disclosure, the drawings may not necessarily be to scale and certain features of the disclosure may be shown in somewhat schematic form.

[0019] Further, when the term "adapted" or "arranged" or "configured" or "shaped", is used herein while referring to any component as a whole, or to any part of a component, or to a combination of components, it has to be understood that it means and encompasses correspondingly either the structure, and/or configuration and/or form and/or positioning.

[0020] A railway vehicle according to the present invention, indicated in figures 2 and 4 by the overall reference number 100, comprises a car body 1, a floor 2 inside the car body 1, and one or more boarding areas 3 each associated with a corresponding door 4.

[0021] The floor 2 can be formed, for example, by one or more floor panels which are assembled each other according to solutions well known or readily available to those skilled in the art, and therefore herein not described in details.

[0022] In the example illustrated in figures 2 and 4, the railway vehicle 100 comprises, for example, two removable doors 4 on each side of the car body 1.

[0023] Between the illustrated boarding areas 3, there is a central resident area 5 for passengers, e.g. a sitting area, usually provided with windows 6.

[0024] In addition, the railway vehicle comprises a plurality of bogies 7, e.g. in the exemplary embodiments illustrated two bogies 7, which are positioned, along the car body 1, at opposite sides with respect to the one or more boarding areas 3.

[0025] Above the bogies 7, inside the car body 1, there are provided corresponding lateral resident areas 8 for passengers, e.g. sitting areas, which can be also provided with associated windows 6.

[0026] Accordingly, the floor 2 inside the vehicle, as a whole, comprises the floor areas or parts at the one or more boarding areas 3, at the central or main resident area 5, and at the one or more lateral areas 8.

[0027] The opposite longitudinal side of the railway vehicle 100 is substantially identical to the side visible in figures 2 and 4.

[0028] The rail vehicle 100 according to the present invention comprises a floor supporting assembly, indicated in figures 1, 3 and 5 by the overall reference number 10, which is operatively connected to the floor 2 and supports it structurally above the bottom part of the car body 1.

[0029] In particular, the floor supporting assembly 10 is arranged to reversibly adjust the height of at least part of the floor 2, e.g. at the one or more boarding areas 3, from a first level H1 to a second level H2.

[0030] The height of the floor at the first level H1 or at the second level H2 for instance can be referred to the upper surface of a rail, as for example indicated in figures 2 and 4.

[0031] According to an embodiment, the floor supporting assembly 10 comprises a plurality of structurally separate components which are configured and mutually arranged, i.e. shaped, positioned and connected, so that the height of at least part of the floor 2 at the boarding area 3 can be reversibly adjusted from the first level H1 to the second level H2, wherein at least the adjusted part of the floor 2 is held, at the first level H1 or at said second level H2, by the components of the floor supporting assembly 10 itself.

[0032] According to an embodiment, the floor supporting assembly 10 comprises at least one multifunctional profile 20, made for example of aluminum or aluminum alloy, which is positioned at a corresponding inner side of the car body 1.

[0033] For example, with reference to the railway vehicles 100 illustrated in figure 2 or in figure 4, the at least one multifunctional profile 20, is positioned at and covers the internal wall of the car body 1 in the area between the two doors 4 and around the windows 6 of the central resident area 5.

[0034] As schematically illustrated in figure 5, the multifunctional profile 20 comprises one or more fastening points 21 for attaching therewith one or more corresponding internal functional components of the railway vehicle 100, such as seats 25, tables 26, air ducts, et cetera..., e.g. by means or rivets, nails or the like, and it is further adapted to mechanically connect to and contribute to support an associated part of the floor 2.

[0035] In the schematic example illustrated, the multifunctional profile 20 comprises, for instance, a bottom step-shaped profile 22 which mates with a correspondingly shaped profile 23 of a side of a floor panel 2.

[0036] For example, the two parts can be mutually coupled via a reversible forced form-coupling, or by means of a plug-in coupling, or else, and once coupled, the multifunctional profile 20 extends, inside the car body 1, from the coupling side of and above the floor 2.

[0037] According to an embodiment, the vehicle 100 preferably comprises at least two multifunctional profiles of which, a first multifunctional profile 20 corresponds to the multifunctional profile 20 above described, and a second multifunctional profile 20, functionally substantially similar to the first one, which is positioned at and covers the internal wall of the car body 1, opposite to that where the first multifunctional profile 20 is positioned according to a longitudinal plane.

[0038] Also the second multifunctional profile 20 comprises one or more fastening points 21 for attaching therewith one or more corresponding internal functional components of the railway vehicle 100, such seats, tables, air ducts, et cetera..., and it is further adapted to mechanically connect to and contribute to support an associated part of the floor 2.

[0039] In particular, also the second multifunctional

profile 20 comprises, for instance, a bottom step-shaped profile 22 which mates with a correspondingly shaped profile 23 of another side of a floor panel 2.

[0040] Also in this case the two parts can be mutually connected via a reversible forced form-coupling, or by means of a plug-in coupling, or else, and once coupled, also the second multifunctional profile 20 extends, inside the car body 1, from the associated coupling side of and above the floor 2.

[0041] As illustrated in the exemplary embodiment of figures 1 and 3, the floor supporting assembly 10 further comprises a multi-member mechanical supporting structure which is positioned, within the car body 1, beneath the floor 2, and comprises at least an anchoring frame 11.

[0042] In the embodiments illustrated, the anchoring frame 11, for example C-shaped, is made integral with the bottom part of the frame of the car body 1.

[0043] Alternatively, the anchoring frame 11 can be stably mechanically connected to the frame of the car body 1, e.g. by soldering, or nailing, or bolting, or in any other suitable way.

[0044] As illustrated in the embodiments of figure 1 and 3, the multi-member mechanical supporting structure comprises a structure decoupling member 12 in order to limit the transmission of sound and heat between the floor 2 and the side walls of the vehicle.

[0045] The structure decoupling member 12 can be realized by one or more layers of suitable material, e.g. a dampening material, such as rubber, or by elastic springs, or else, and according to any shape and size suitable for the specific application.

[0046] In the embodiment illustrated in figure 1, the decoupling member 12 is interconnected between the bottom of the car body 1 and the floor 2, and in particular, it is preferably placed beneath and connected to the first or second multi-functional profile 20 at the coupling area between its step-shaped profile 22 and the correspondingly step-shaped profile 23 of the floor panel 2 connected therewith.

[0047] Alternatively, the decoupling member 12 could be sandwiched between the anchoring member 11 and the floor 2, and in particular positioned preferably at or close to the coupling area between the step-shaped profile 22 of the first or second multifunctional profile 20 and the correspondingly step-shaped profile 23 of the floor panel 2 connected therewith.

[0048] In this way, the floor 2 is supported and held by the floor supporting assembly 10 at a height H1 with reference to the upper surface of the rail 200 as illustrated in figure 2.

[0049] Alternatively, the structure decoupling material 12 could be sandwiched between the anchoring member 11 and the floor 2, in particular positioned preferably at or close to the coupling area between the step-shaped profile 22 of the first or second multifunctional profile 20 and the correspondingly step-shaped profile 23 of the floor panel 2 connected therewith.

[0050] In this case, the size of the decoupling material should be suitably reduced in order to respect the desired total height H1.

[0051] As illustrated in the embodiment of figure 3, the multi-member mechanical supporting structure of the assembly 10 further comprises a detachable support frame 13 which is removably connected on one side to the anchoring member 11 and on the other side to the decoupling member 12 which in turn is preferably placed beneath and connected to the first or second multi-functional profile 20 at the coupling area between its step-shaped profile 22 and the correspondingly step-shaped profile 23 of the floor panel 2 connected therewith.

[0052] In this way, the floor 2 is supported and held by the floor supporting assembly 10 at a height H2 with reference to the upper surface of the rail 200 as indicated in figure 4.

[0053] According to a particularly preferred embodiment of the railway vehicle 100 according to the invention, the floor 2 at the floor areas 8 above corresponding bogies 7 is designed to be at the height of the second level H2.

[0054] In turn, the floor supporting assembly 10 is arranged so that the parts of the floor 2 at the one or more boarding areas 3, as well as the parts of the floor 2 at the central resident area 5, are placed at the height corresponding to the second level H2.

[0055] Hence, the floor 2 at the second higher level H2 is substantially uniform and leveled throughout the entire extension of the railway vehicle 100.

[0056] In an alternative embodiment schematically illustrated in figure 6, the floor supporting assembly 10 comprises an actuator 30 which is positioned, inside the car body 1, beneath the floor 2, and is adapted to raise or lower at least the portion of the floor 2 at the boarding area 3, between the first level at height H1 and the second level at eight H2, respectively.

[0057] For example, the actuator 30 can be selected from the group comprising an electromechanical actuator, a pneumatic actuator, a hydraulic actuator, an oleopneumatic actuator, or a robotized actuator.

[0058] The actuator 30 can be operatively connected to the inferior side of the floor panel 2, e. g. at or close to the area of coupling between the floor panel 2 and the associated first or second multi-functional profile 20, with the decoupling member 12 interposed there between.

[0059] It is also possible that the decoupling member 12 can be formed as an integral part of the actuator 30 itself.

[0060] For example, such actuator may resemble the structure used for raising or lowering platforms, e. g with a pantograph system, and its actuation can be commanded even remotely, e.g. from a control unit inside a driver cabin.

[0061] Finally, in the rail vehicle 100 there is provided also an adapter, schematically indicated in figures 2 and 4 by the reference number 40.

[0062] The adapter 40 is for instance removably connected to and is mounted above an associated door 4

when the floor 2, at least at the corresponding boarding area 3, is placed at the height H1 of the first level, as represented in figure 2, or below the associated door 4, when the floor 2, at least at the corresponding boarding area 3, is placed at the height H2 of the second level as illustrated in figure 4.

[0063] In this way, any space which might be created above or below the door 4 is covered and fitted.

[0064] Further, the adapter 40 can be shaped so that it integrates in its structure fasteners, e.g. for an operating unit of an associated door 4.

[0065] Hence, it is evident from the foregoing description that the railway vehicle 100 according to the present invention allows to achieve the intended aim and objects since it offers the possibility of adapting the height of the floor 2, at least in some parts of its surface, according to the operative needs.

[0066] Indeed, the railway vehicle 100 can be put in operation for example with the parts of the floor 2 at the one or board boarding areas 3 and at the main central area 5 which are leveled at the height H1 of the first level, while the parts of the floor 2 at the floor areas 8 above the bogies 7 are at the height H2 of the second higher level.

[0067] When, for whatever reason, it is necessary to modify the height of the floor 2 at the one or more boarding areas 3 and at the main floor areas 9 as well, then with quite simple refurbishing operations, and in a reasonable amount of time, it is possible to adjust the height of the floor 2 at the newly desired height H2 thanks to the above described floor supporting assembly 10 and related components.

[0068] Clearly, when needed, it is also possible to perform adjustment in the reverse direction, i.e. from the higher level at height H2 to the lower level at height H1.

[0069] In both cases, corresponding adaptation of the interior part of the vehicle 100 can be performed by removing cover profiles 50, illustrated in figure 5, and replacing them with equivalent profiles of different size, in order to match with the new position of the multifunctional profiles 20, which are raised or lowered together with the associated floor panels 2.

[0070] These results are achieved according to a solution very simple that can be applied in building new railway vehicles 100 or refurbishing existing ones, making minor modifications and using quite simple and numerically reduced components.

[0071] The railway vehicle 100 thus conceived is susceptible of modifications and variations, all of which are within the scope of the inventive concept as defined in particular by the appended claims; for example, the shape of the detachable support frame 13 or of the anchoring member 11 can be realized differently with respect to those illustrated in the exemplary embodiments of figures 1 and 3, in relation to the specific application, as those skilled in the art would appreciate.

[0072] Further, the described floor supporting assembly may be replicated as many times as necessary in different positions of the floor 2.

[0073] All the details may furthermore be replaced with technically equivalent elements.

Claims

1. A railway vehicle (100) comprising a car body (1), a floor (2), and one or more boarding areas (3) each associated with at least one door (4), **characterized in that** it comprises a floor supporting assembly (10) which is operatively connected to and support said floor (2), said floor supporting assembly (10) being arranged to reversibly adjust the height of said floor (2) at least at said one or more boarding areas (3) from at least a first level (H1) to a second level (H2).

2. A railway vehicle (100), according to claim 1, wherein said floor supporting assembly (10) comprises a plurality of structurally separate components which are configured and mutually arranged so that to reversibly adjust the height of said floor (2) at least at said one or more boarding areas (3) from a first level (H1) to a second level (H2) and hold at least the adjusted part of said floor (2) at said first level (H1) or at said second level (H2).

3. A railway vehicle (100), according to claim 2, wherein said floor supporting assembly (10) comprises at least one multifunctional profile (20) which is positioned at a corresponding inner side of the car body (1) and extends, inside the car body (1), from a side of and above the floor (2), said multifunctional profile (20) comprising one or more fastening points (21) for attaching therewith one or more corresponding internal functional components of the railway vehicle (100), and wherein said multifunctional profile (20) is further adapted to mechanically connect to an associated part of and support said floor (2).

4. A railway vehicle (100), according to claim 3, wherein floor supporting assembly (10) comprises a first multifunctional profile (20) and a second multifunctional profile (20) which are positioned at corresponding inner sides of the car body (1) and extend, inside the car body (1), from corresponding sides of and above the floor (2), said first and second multifunctional profiles (20) comprising each one or more fastening points (21) for attaching therewith one or more corresponding internal functional components of the railway vehicle (100), and wherein said first and second multifunctional profiles (20) are adapted to mechanically connect to a first side of said floor (2) and to a second side of said floor (2), respectively, and to support said floor (2).

5. A railway vehicle (100), according to one or more of the previous claims, wherein said floor supporting

assembly (10) comprises a multi-member mechanical supporting structure which is positioned, within said car body (1), below the floor (2), and comprises at least an anchoring frame (11) which is made integrally with or is stably mechanically connected to the structure of the car body (1),

6. A railway vehicle (100), according to claim 5, wherein said multi-member mechanical supporting structure comprises a structurally decoupling member (12) which is interconnected between said floor (2) and said mechanical supporting structure or said structure of the car body (1).

7. A railway vehicle (100), according to claim 6, wherein said multi-member mechanical supporting structure further comprises a detachable support frame (13) which is removably connected on one side to said anchoring member (11) and on the other side to said decoupling member (12).

8. A railway vehicle (100), according to claim 1, wherein said floor supporting assembly (10) comprises an actuator (30) which is positioned, inside said car body (1), beneath the floor (2), and is adapted to raise or lower said floor (2) between said first level (H1) and said second level (H2), respectively.

9. A railway vehicle (100), according to one or more of the previous claims, further comprising a plurality of bogies (7) positioned outside the car body (1), wherein said floor (2) comprises floor areas (8) for sitting passengers which are positioned, inside the car body (1), above corresponding bogies (7), and one or more main floor areas (9) for sitting passengers which are adjacent to said one or more boarding areas (3), and wherein when said floor (2) at said one or more boarding areas (3) are placed at the height corresponding to said second level (H2), said floor areas (8) above corresponding bogies (7), said one or more main floor areas (9) and said floor (2) at said one or more boarding areas (3) are substantially leveled with each other.

10. A railway vehicle (100), according to one or more of the previous claims, wherein it comprises a space adapter (40) which is connected to and is mounted above or below said at least one door (4), when said floor (2) at the one or more boarding areas (3) is placed at the height of said first level (H1) or of said second level (H2), respectively.

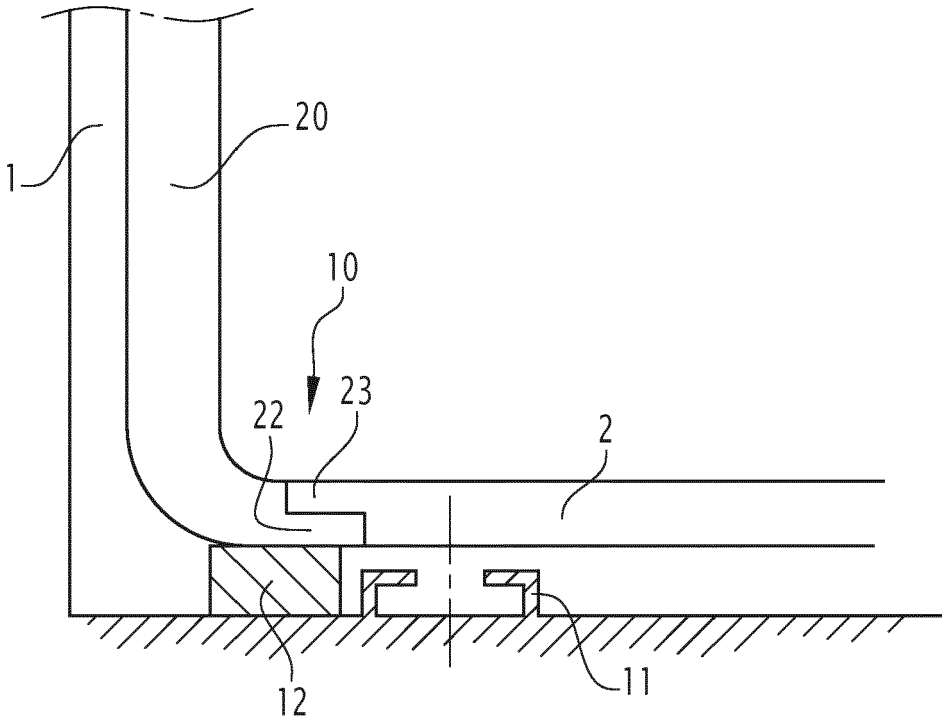

FIG.1

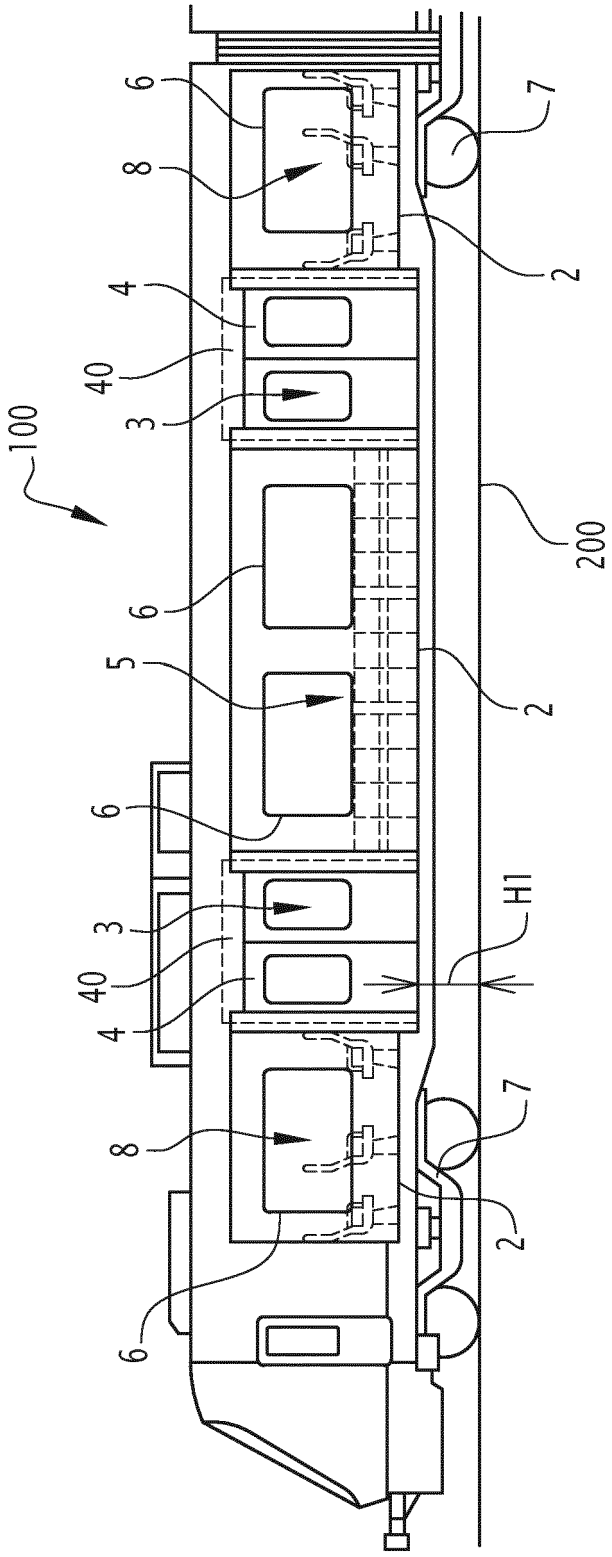

FIG.2

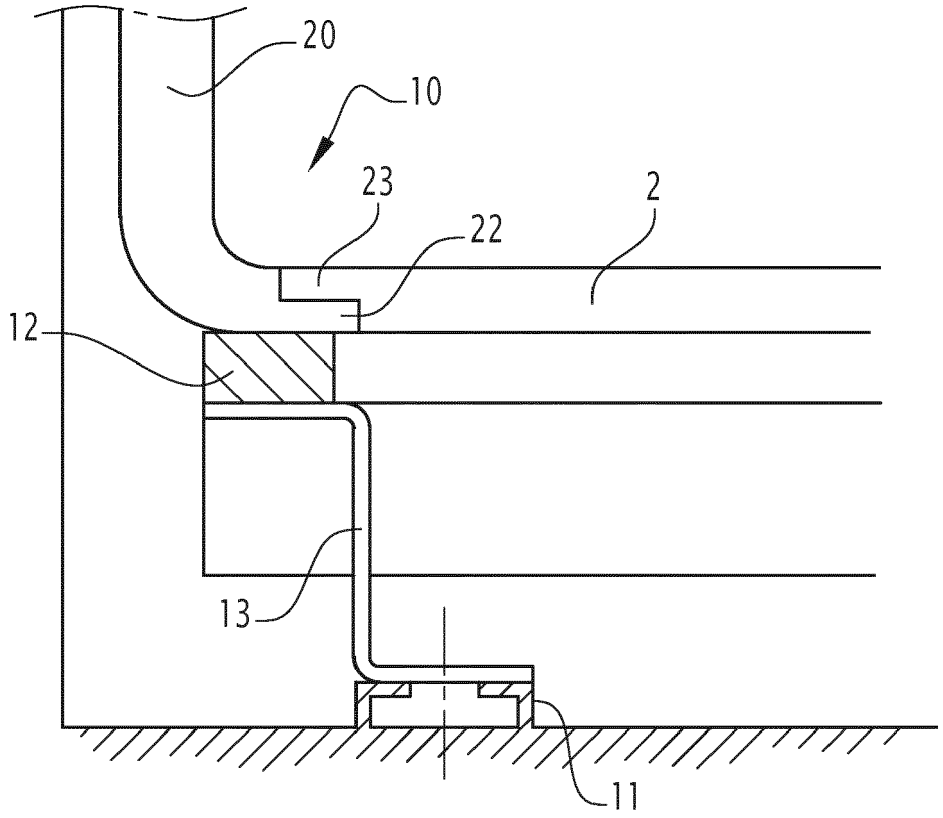

FIG.3

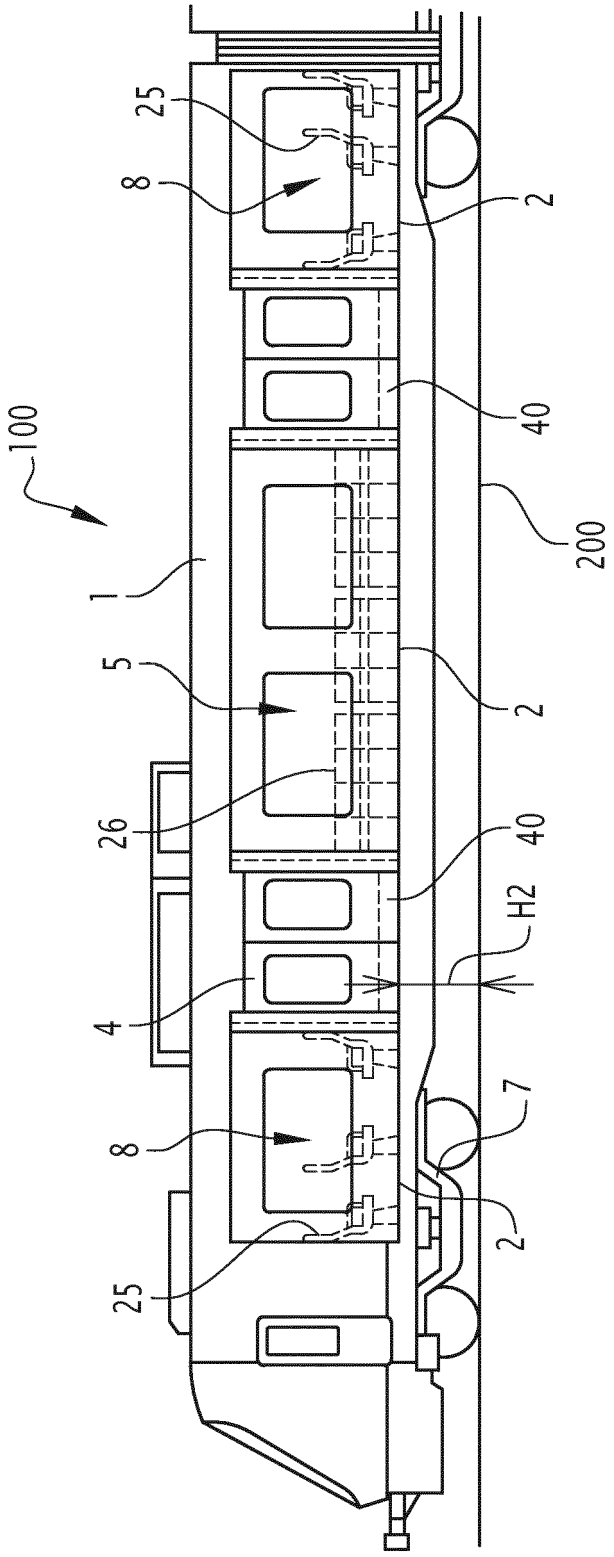

FIG.4

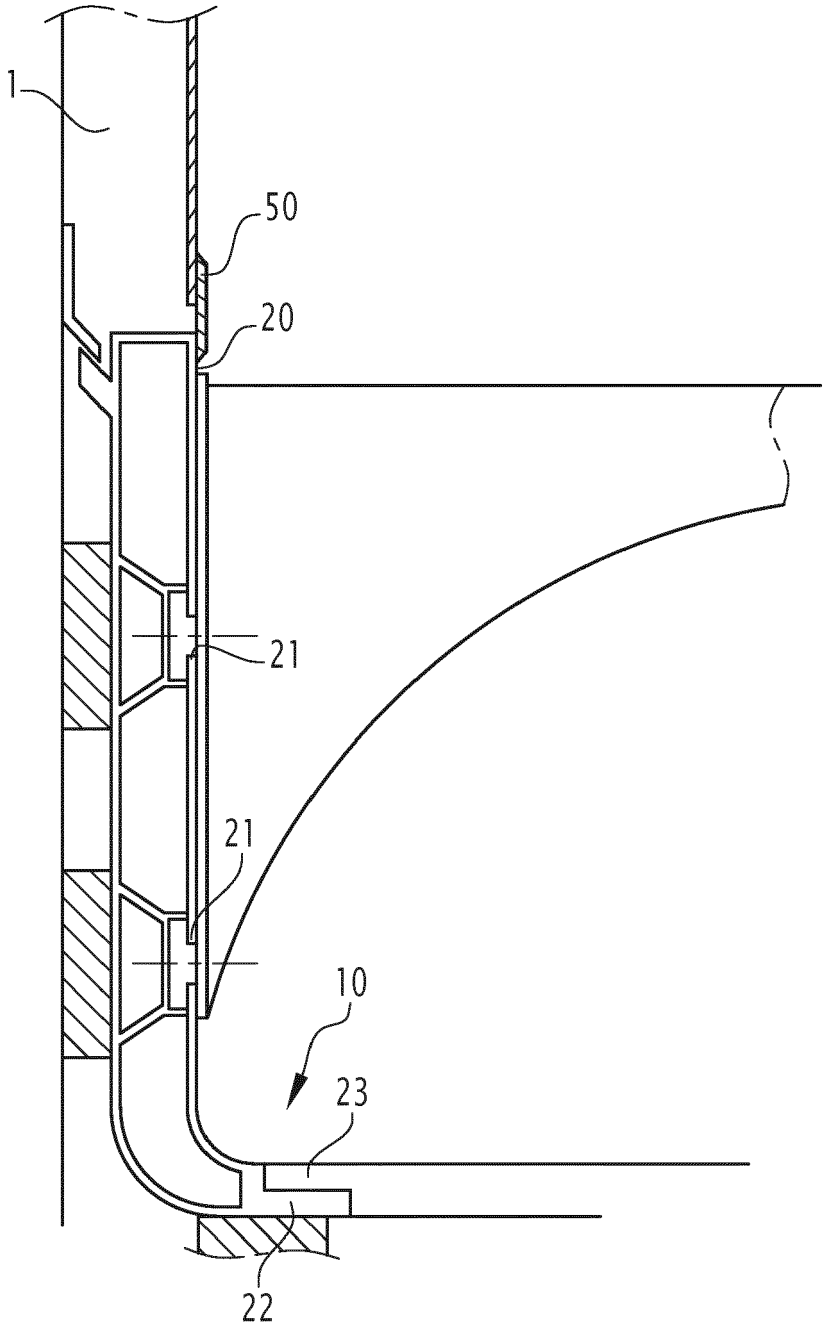

FIG.5

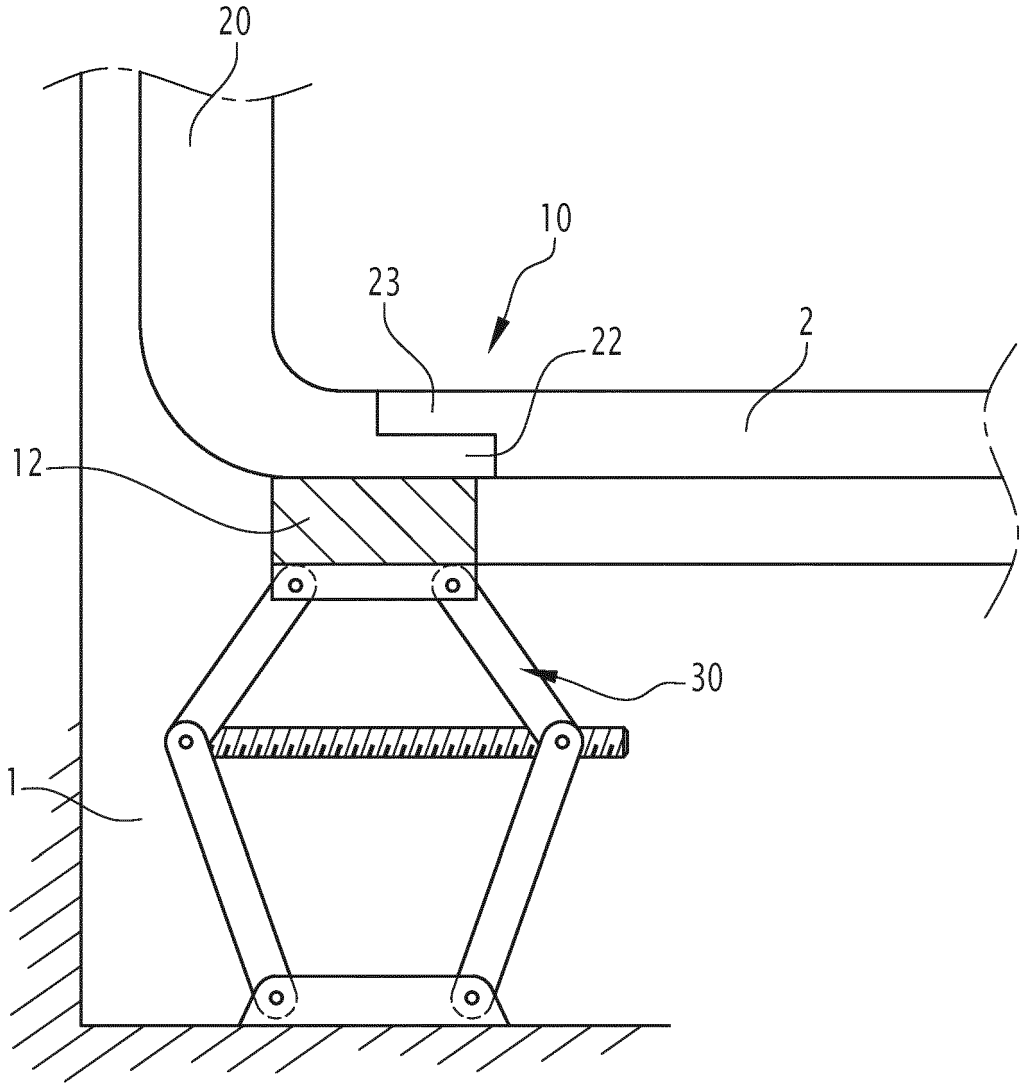

FIG.6

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EUROPEAN SEARCH REPORT

Application Number
EP 19 30 5325

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B61D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 June 2019	Denis, Marco

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 30 5325

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