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(54) **RAILWAY VEHICLE BODY**

(57) A rail vehicle body (110) extends in a longitudinal direction (LD) and has, when seen perpendicular to the longitudinal direction (LD), a substantially constant main cross-sectional profile along the longitudinal direction (LD). The rail vehicle body (110) includes at least one

local widening structure (120) projecting beyond the main cross-sectional profile in a given region of rail vehicle body (110) to provide more interior space for a piece of equipment such as a passenger toilet compartment (160).

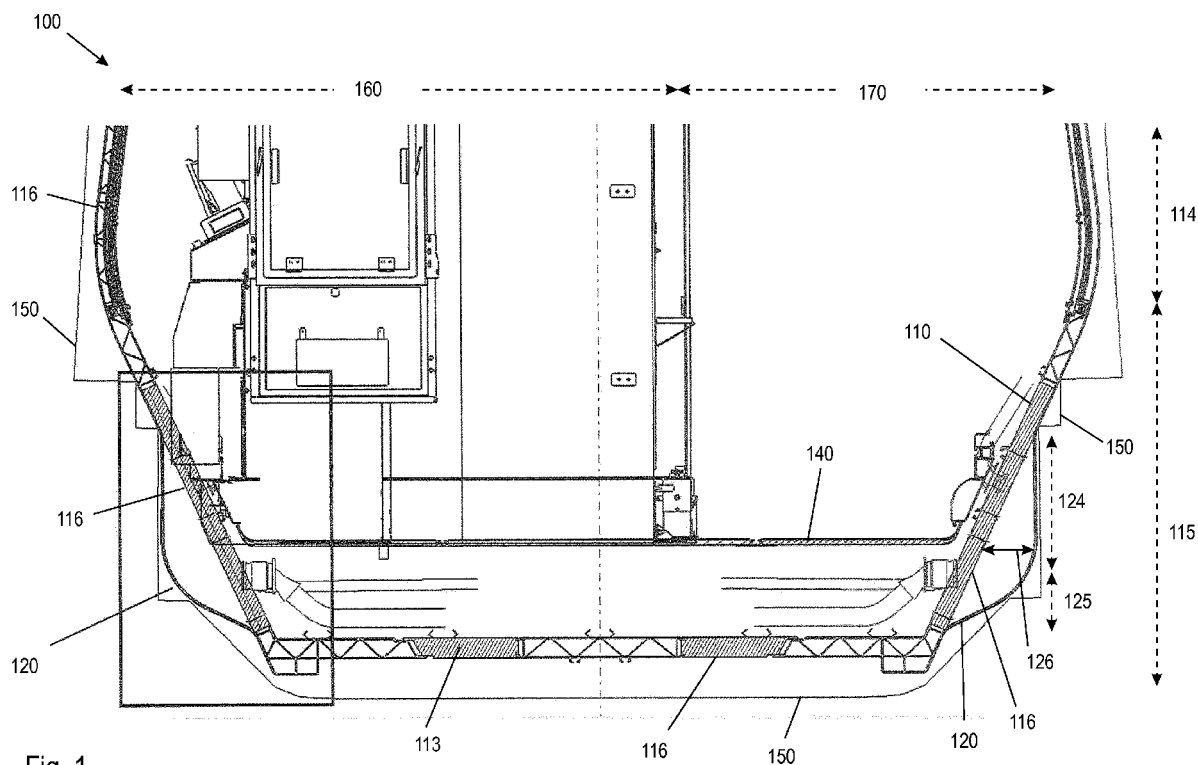


Fig. 1

## Description

**[0001]** The present invention pertains to a rail vehicle body providing increased space for a piece of equipment such as a passenger toilet and other huge space equipment. The invention also pertains to a rail vehicle including a rail vehicle body providing increased space for a piece of equipment.

**[0002]** Modern railway standards demand for more comfort for the passengers including disabled persons with wheelchairs. To allow a disabled person with a wheelchair to move freely within a train, the passageways have to have a certain width. Furthermore, disabled persons require more space in a toilet compartment to allow moving in and manoeuvring within the toilet compartment. Both requirements are difficult to meet as the allowed clearance gauge for the rail vehicle body is limited by regulatory authorities. Hence, the width of a rail vehicle body cannot be expanded beyond the maximal allowed clearance gauge.

**[0003]** Toilet compartments which meet the needs of disabled persons are referred to as universal toilets (UWC). Universal toilets are larger than non-standard toilets which cannot be used by disabled persons requiring a wheelchair.

**[0004]** The above problem is exacerbated due to the demand of the railway operators for longer rail vehicles to have more space for passengers. Using longer rail vehicles also reduces the numbers of bogies per train when the total length of the train is maintained. EP 2 223 841 B1 describes a rail vehicle body of an extended rail vehicle. The rail vehicle body has a curved outer shape with reduced width in the low floor area of the cars. The low floor area is typically in the centre region of the car, between the bogies.

**[0005]** Hitherto, rail vehicle manufacturers tried to solve the above problem by either providing non-standard toilets to keep the required width for the passageway, or by providing a universal toilet next to a passenger compartment specifically designed for the needs of disabled persons. However, the latter solution limits the freedom of movement of the disabled persons since the passageway next to the universal toilet may be too small for a wheel chair. Hence, the disabled person cannot pass the universal toilet to reach other passenger compartments.

**[0006]** In view of the above there is need for an improvement.

## Summary of the Invention

**[0007]** In view of the above, a rail vehicle body according to claim 1 and a vehicle rail according to claim 15 are provided.

**[0008]** According to an embodiment, a rail vehicle body extends in a longitudinal direction and has, when seen perpendicular to the longitudinal direction, a substantially constant main cross-sectional profile along the longitudinal direction. The rail vehicle body includes at least one

local widening structure projecting beyond the main cross-sectional profile in a given region of rail vehicle body to provide more interior space for a piece of equipment which can be, for example, a passenger toilet compartment.

**[0009]** The main cross-sectional profile is substantially constant along the longitudinal extension of the rail vehicle body, at least between adjacent bogies carrying the rail vehicle body. The at least one local widening structure is only arranged in a given region where provisions are made for accommodating equipment such as a toilet compartment or other equipment that requires large space. By providing the local widening structure, which can also be referred to as local lateral extension, more space is available for accommodating equipment needed for, for example, the toilet compartment. For example, the toilet, a washbasin or a tank can be arranged to be partially within the extra space defined by the local widening structure. Hence, more space is available within the main cross-sectional profile for the available open space within the toilet compartment to meet the needs of disabled persons.

**[0010]** Typically, the local widening structure is not arranged in a region where a door is provided or immediately next to the door to avoid that additional measures are required to adapt the shape of the door, the closing and opening mechanism of the door, or the sealing for the door. According to an embodiment which can be combined with any other embodiment described herein, the region where the door is arranged as well as a region next to the door having at least the same longitudinal extension as the door, follows the main cross-sectional profile. Thus, the local widening structure is spaced from the door at least by a distance that is needed to open the door without interfering with the local widening structure.

**[0011]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure is only provided on one side of the rail vehicle body as only one toilet compartment is arranged at a given position in the longitudinal direction. Alternatively, the rail vehicle body includes a local widening structure on each side of the rail vehicle body. In this case, the local widening structures can be arranged at different ends of the rail vehicle body. According to an alternative embodiment which can be combined with any other embodiment described herein, the rail vehicle body includes at least two local widening structures, which can be arranged on opposite lateral sides of the rail vehicle body either at the same longitudinal position when seen in longitudinal direction or longitudinally displaced relative to each other. For example, when the local widening structure is used to provide extra space for one toilet compartment, one local widening structure adds space for, for example, a freshwater tank or a fresh water connection box while the opposite local widening structure for, for example, a waste water tank or a waste water connection box. Alternatively, both tanks are arranged at least partially in one of the local widening structures

while the other widening structure provides extra space for the interior of the toilet increasing the available interior space for passengers.

**[0012]** According to an embodiment which can be combined with any other embodiment described herein, the rail vehicle body further includes an upper part and a lower part. The lower part tapers towards the bottom of the rail vehicle body. The upper part of the rail vehicle body may also have a tapered shape with a taper less than the taper of the lower part. The rail vehicle body may have its maximum width at the transition between the upper part and the lower part. The lower part can tapering more than the upper part.

**[0013]** The local widening structure of the rail vehicle body is provided in the lower part of the rail vehicle body. A tapered lower part of the rail vehicle body is often used to meet the step-wise reduction of the maximal allowed clearance gauge towards the grounds. While it would be possible to shape the rail vehicle body such that it also has a step-wise cross-section to follow closely the maximal allowed clearance gauge, such a step-wise shape increases the costs and complexity of the rail vehicle body, and in particular the costs for the passenger doors as a complicate shape of the doors requires additional effort for door guiding and sealing.

**[0014]** The embodiments described herein take advantage of this situation and provide the local widening structure at those positions where space is left between the tapered shape of the rail vehicle body and the allowed clearance gauge. This reduces costs without changing the overall constant main cross-sectional profile. The rail vehicle body can be manufactured to have its main cross-sectional profile substantially along the longitudinal extension while only at a given position, or at given positions, where a toilet compartment or other bulky equipment is to be integrated the one or more local widening structures are provided. Only at this position the local widening structure exceeds the main cross-sectional profile within the maximal allowed clearance gauge.

**[0015]** For example, the rail vehicle body can be designed to have the main cross-sectional profile that provides a cost efficient compromise between functionality, mechanical stability and constructional demands on one hand and utilisation of the available space allowed by the maximal allowed clearance gauge on the other hand. More specifically, the shell of the rail vehicle body can be designed to have the main cross-sectional profile. In local regions of the rail vehicle body where extra space is needed, the local widening structures can be selectively provided at the exterior of the shell to expand locally the available internal space.

**[0016]** According to an embodiment which can be combined with any other embodiment described herein, the rail vehicle body further includes two pivot bearings for supporting the rail vehicle body on respective bogies. The two pivot bearings are spaced from each other in the longitudinal direction, wherein the local widening structure is arranged between the two pivot bearings.

The toilet compartment can be arranged between the bogies while, for example, the doors can be provided between the bogies and the respective end of the rail vehicle body to provide sufficient space between the local widening structure and the next door.

**[0017]** According to an embodiment which can be combined with any other embodiment described herein, the at least one local widening structure is arranged eccentric to the centre of the rail vehicle body in the longitudinal direction. Typically, the part of the rail vehicle body, which swings laterally to the maximum when the rail vehicle body moves along a curve, is the centre of a rail vehicle body in the longitudinal extension of the rail vehicle body. To avoid that portions of this part may pass the maximal allowed clearance gauge, the local widening structure is arranged in other parts of the rail vehicle body, for example closer to the pivot bearings. According to an alternative embodiment which can be combined with any other embodiment described herein, the at least one local widening structure is arranged at the centre of the rail vehicle body in the longitudinal direction.

**[0018]** According to an embodiment which can be combined with any other embodiment described herein, the rail vehicle body is a high-floor vehicle including an internal floor which is arranged to be above the pivot bearings and to remain at the same level throughout the whole longitudinal extension of the rail vehicle body.

**[0019]** According to an embodiment which can be combined with any other embodiment described herein, the rail vehicle body is a low-floor vehicle including an internal floor which is arranged at a first level above the pivot bearings and which lowers to extend at a second level lower than the first level between the pivot bearings. Specifically for rail vehicle bodies having a low-floor section the local widening structure is beneficial as the space left between the internal floor and the bottom of the rail vehicle body is limited.

**[0020]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure, when seen in a cross-section perpendicular to the longitudinal direction comprises an upper wall part which extends substantially in a vertical direction and an inclined lower wall part. This shape provides for maximum additional space.

**[0021]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure has a length, in the longitudinal direction (defined as x-direction), of less than 7 m, particularly less than 4 or less than 3 m such as less than about 2 m, without being limited thereto. In further embodiments which can be combined with any other embodiment described herein, the rail vehicle body includes at least two local widening structures displaced relative to each other in longitudinal direction on the same side of the rail vehicle body. In a region between the two local widening structures the rail vehicle body does not exceed the main cross-sectional profile. The shape and length of the two local widening structures can be identical or

can be different, such as one local widening structure is longer than the other one. The overall length of the region in which the at least two local widening structures are arranged can be, for example, up to 7 m with a length of an individual local widening structure being about 1.5 m to 3 m without being limited thereto.

**[0022]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure has, in a lateral direction (defined as y-direction), a maximum lateral (horizontal) projection beyond the outline of the main cross-sectional profile of at least 0.01 m and less than approximately 0.25 m, particularly of about 0.1 m to about 0.2 m, without being limited thereto.

**[0023]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure has, in a vertical direction (defined as z-direction), a maximum vertical extension between about 0.2 m to about 0.5 m, without being limited thereto.

**[0024]** According to an embodiment which can be combined with any other embodiment described herein, the rail vehicle body is a self-supporting structure, wherein the local widening structure is a structural part of the self-supporting structure of the rail vehicle body. The local widening structure contributes to the structural integrity and strength of the railway vehicle body. For example, the local widening structure can be formed to be a self-supporting structure that provide integral stability to the local widening structure without requiring additional structural means such as stiffeners.

**[0025]** According to an embodiment which can be combined with any other embodiment described herein, the rail vehicle body is a self-supporting structure forming the shell of the rail vehicle body, wherein the local widening structure is a cover mounted to the self-supporting structure (shell) of the rail vehicle body and covering an opening formed in the self-supporting structure (shell) of the rail vehicle body. The local widening structure does not need to be an integral part of the rail vehicle body and thus can be formed with less material usage and by a different material than the rail vehicle body. For example, the local widening structure can be formed by a comparatively thin sheet material covering an internal framework of the local widening structure which gives stability to the local widening structure. Hence, a removed local widening structure would not jeopardize the structural stability and strength of the rail vehicle body. Furthermore, the size of the opening formed in the rail vehicle body, i.e. in the shell of the rail vehicle body, may be limited to such extent that the structural stability of the rail vehicle body as a whole is preserved. If needed, an additional local reinforcement element around the periphery of the opening may be provided.

**[0026]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure (cover) can be attached to the outer skin of the rail vehicle body by suitable fastening

means such as glue, bolts or screws. In case of a rail vehicle body having a self-supporting structure, the outer skin is defined and formed by the most outer plate-shaped material sections that are part of and contribute to the self-supporting structure (shell) of the rail vehicle body. The self-supporting structure typically additional includes stiffening elements at the respective interior side of the outer skin and an inner skin attached to the stiffening elements. The outer skin, the inner skin and the stiffening elements can be at least partially or at least in sections integral which each other and form together the shell of the rail vehicle body. Typical examples are hollow extruded aluminium profiles. For illustration purposes, the width of the self-supporting structure (shell) in a cross-section perpendicular to the longitudinal direction can be between 0.4 m to 0.6 m.

**[0027]** According to an embodiment which can be combined with any other embodiment described herein, the local widening structure (cover) is attached to the outer skin only and not to the stiffening elements of the rail vehicle body's shell. Furthermore, the local widening structure is typically attached along its outer periphery facing the outer skin of the rail vehicle body. If the local widening structure includes a frame extending along the periphery of the local widening structure and providing added stability to the local widening structure, the frame can also be fastened to the rail vehicle body a clamping means.

**[0028]** Furthermore, the shape of the local widening structure can be such that there is a smooth transition between the outer skin of the rail vehicle body as defined by the main cross-sectional profile and the local widening structure. The transition can be particularly step-less as this is beneficial for high speed trains to reduce generation of additional aerial noise.

**[0029]** According to an embodiment which can be combined with any other embodiment described herein, the cover is an openable flap. This facilitates inspection and maintenance of equipment installed directly behind the cover and within the space defined by the local widening structure. In this case, the cover (local widening structure) includes a self-supporting structure which ensures the stability and rigidity of the cover when opened. Suitable hinges and detachable fastening means such as screw connection provides for the attachment of the cover.

**[0030]** According to an embodiment which can be combined with any other embodiment described herein, a rail vehicle includes a rail vehicle body as described herein.

#### Brief Description of the Drawings

**[0031]** In the following, various embodiments are described without being limited thereto.

Figure 1 shows a cross-sectional profile of a rail vehicle body according to an embodiment.

Figure 2 shows a 3-dimensional view of a rail vehicle body.

Figure 3 shows a detail of the rail vehicle body with an opening according to an embodiment.

Figure 4 shows a detail of the rail vehicle body with a local widening structure formed as integral part of the rail vehicle body according to an embodiment.

Figure 5 shows a rail vehicle with a rail vehicle body having a local widening structure.

#### Detailed Description

**[0032]** As used herein, the term main cross-sectional profile intends to describe a cross-sectional profile of a rail vehicle body which is substantially identical when taken at different locations along the longitudinal direction of the rail vehicle body. With substantially identical it is meant that only technically unavoidable variations occur and that it does not increase or decrease when considering different positions along the longitudinal extension of the rail vehicle body. The outer shape of the rail vehicle body is not curved when seen in longitudinal direction, i.e. the cross-section does not enlarge or shrink along the length of the rail vehicle body. More specifically, the main cross-sectional profile remains constant within a region between pivot bearings of the respective bogie while deviations between the pivot bearings to each respective end of the rail vehicle body may occur.

**[0033]** With reference to Figure 1 an embodiment showing a cross-sectional profile of the rail vehicle body 110 is described. The rail vehicle body 110 is formed to include a self-supporting structure forming the shell of the rail vehicle body 110 and can be made of, for example, extruded profiles such as extruded aluminium profiles. A self-supporting structure does not need an additional frame carrying the rail vehicle body. When using extruded profiles, the rail vehicle body 110 can be formed as integral structure which provides both integral stability and structural strength as well as an outer cover (outer skin) for the rail vehicle. Alternatively, the rail vehicle body 110 can be made of a skeleton such as an aluminium or steel skeleton to provide integral stability and structural strength, and separate covering sheets attached to the skeleton for forming and defining the outer skin and appearance of the rail vehicle body 110. The covering sheets can be made of metal such as aluminium or steel, composite materials such as fibre-reinforced laminates, or of one of both for selected parts while other parts are made of the respective other material. The embodiment shown in Figure 1 uses extruded profiles without being limited thereto.

**[0034]** The outline of the rail vehicle body 110 defined by the extruded profiles is denoted by 116. The outline 116 is within the maximal allowed clearance gauge 150. The maximal allowed clearance gauge 150 is defined by

regulation, which may be different from country to country and from region to region even within the same country, and by additional safety margins taking into account roll of the rail vehicle body 110 during movement, and the proximity of infrastructure such as size and shape of tunnels and bridges. As shown in Figure 1, the maximum allowed clearance gauge 150 includes several steps which narrow the allowed space for the rail vehicle body 110 towards the ground. In principle, it would be possible to shape the rail vehicle body 110 to follow closely the stepwise shape of the maximum allowed clearance gauge 150. However, this would require to form the rail vehicle body 110 with an outer stepwise shape which would not only complicate the overall structure of the rail vehicle body 110 but also increase the costs. For that reason, the rail vehicle body 110 has a tapered shape in a lower part 115 of the rail vehicle body 110 to simplify the overall structure of the rail vehicle body 110. The upper part 114 of the rail vehicle body 110 may also have a slightly tapered shape, however the tapering is less pronounced in the upper part 114 than in the lower part 115. This double tapered shape has been turned out to provide sufficient strength and stability to support the whole rail vehicle. The region where the upper part 114, which widens towards the lower part, and the lower part 115, which widens towards the upper part 114, meet has the maximum width of the rail vehicle body 110. As seen in Figure 1, the lower part 115 tapers more than the upper part 114.

**[0035]** The bottom 113 of the rail vehicle body 110 is formed to be flat. An advantage of the integral structure of the rail vehicle body 110 formed by extruded profiles is that cut-outs (openings) may be formed at selected positions without significantly weakening of the integral structure of the whole rail vehicle body 110. If needed, these cut-outs can be reinforced by additional extruded profiles. An example of a cut-out 137 is shown in Figure 2 for a bogie 130 (see Figure 5).

**[0036]** According to an embodiment, at a position where a toilet compartment 160 is to be integrated into the rail vehicle body 110 a local widening structure 120 is formed to expand locally the cross-sectional profile of the rail vehicle body 110. Figure 1 illustrates an embodiment where local widening structures 120 are formed on both sides of the rail vehicle body 110. It would also be possible to provide only one single local widening structure 120 at that side of the rail vehicle body 110 where the toilet compartment 160 is arranged.

**[0037]** As shown in Figure 1, providing a local extension of the cross-sectional profile adds additional space to the rail vehicle body 110 to install equipment needed for the toilet compartment 160. In a cross-sectional view, the installed equipment seems to partially pass the main cross-sectional profile defined by the extruded profiles of the rail vehicle body 110. Thus, the installed equipment for the toilet compartment 160 may be arranged laterally outside of the main cross-sectional profile. This, however, is possible since the tapered shape of the rail vehicle

body 110 does not closely follow the maximal allowed clearance gauge 150 so that "unused" space between the outline 116 of the rail vehicle body 110 and the maximal allowed clearance gauge 150 can be used for locally installing equipment for the toilet compartment 160.

**[0038]** Figure 1 shows a rail vehicle body 110 for a so-called low-floor vehicle where the internal floor 140 is arranged at a second level (low-floor level) lower than an internal floor section at a first level (high-floor level - not shown in Figure 1) above the bogies and the bogie cut-out 137 to facilitate boarding of disabled persons using a wheelchair. See, for example, Figure 5. Alternatively, the rail vehicle body 110 can include an internal floor at the first level (high-floor level) to allow that the internal floor 140 remains flat and at the same level throughout the whole longitudinal extension of the rail vehicle body 110. This might be of particular advantage for disabled persons requiring a wheelchair to move within the rail vehicle. An elevated internal floor 140 additionally allows to have a floor with greater width since the internal floor 140 is arranged at a position where the lower part 115 of the rail vehicle body 110 provides more lateral space due to its tapered shape. In addition to that, an elevated internal floor 140 provides additional space below the floor for rail vehicle equipment.

**[0039]** On the other hand, when including an internal floor 140 at the low-floor level, the space below the internal floor 140 is limited. This is particularly pronounced for rail vehicle bodies 110 having a cross-sectional profile that tapers towards the bottom 113 of the rail vehicle body 110 as, for example, illustrated in Figure 1. The lower the internal floor 140, the smaller is the available lateral width of the internal floor 140. Thus, using the local widening structure 120 is particularly beneficial for low-floor vehicles.

**[0040]** According to the technical specification for interoperability (TSI) drafted by the European Railway agency, a passageway 170 suitable for disabled people requiring a wheel chair must have a width (in y-direction) of at least 800 mm so that disabled persons using a wheelchair can move along the passageway 170. Canadian standard association (CSA) B651-12 requires a width of at least 810 mm (31,8897 in) and the Americans with Disabilities Act (ADA) standard requires a width of 32 in (812,8 mm). Therefore, the width of the passageway 170, taken at the narrowest portion of the passageway 170, which is in the embodiment shown in Figure 1 at internal floor level, must be at least 800 mm. Due to the tapered shape of the lower part 115 of the rail vehicle body 110 the total available space in width direction of the rail vehicle body 110, at internal floor level, is limited to also include a universal toilet, which is described herein as toilet compartment 160, meeting the minimum required dimensions defined by the TSI. For most rail vehicle bodies, either a toilet compartment 160 meeting the applicable norm and a passageway 170 that does not meet the norm or a passageway 170 meeting the norm and a toilet compartment 160 that does not meet the norm

can be arranged at the same position.

**[0041]** The local widening structure 120 solves this problem by allowing to at least partially install equipment "outside" of the rail vehicle body 110, i.e. outside of the main cross-sectional profile, to provide more internal space within the toilet compartment so that the wall between the toilet compartment 160 and the passageway 170 can be arranged such that at internal floor level both the toilet compartment 160 and the passageway 170 meet the dimensional requirements of the TSI.

**[0042]** As seen in Figure 1 the local widening structure 120 is arranged to extend from a level above the internal floor 140 to a level below the internal floor 140, particularly above and below the lower internal floor level (second level). This allows, for example, to arrange manifolds such as pipes partially "outside" of the rail vehicle body 110 so that these pipes do not consume space within the toilet compartment 160 particularly not at internal floor level.

**[0043]** A practical outer shape of the local widening structure can be described to be "bubble-like" which means that local widening structure 120 has an overall gently curved shape to reduce drag. In a cross-sectional view, as illustrated in Figure 1, the local widening structure 120 may include an upper wall part 124, which extend substantially straight in a vertical direction, and a lower wall part 125, which is inclined relative to the upper wall part 124 to come in contact with the outline 116 of the rail vehicle body 110 at the bottom 113 of the rail vehicle body 110. The transition between the upper wall part 124 and the lower wall part 125 is gently curved.

**[0044]** The maximum lateral projection 126 (width direction or y-direction) of the widening structure "beyond" the outline defined by the main cross-sectional profile can be, for example between 0.1 m and 0.2 m, depending on product cross section and country norms.

**[0045]** As illustrated in Figure 1, the local widening structure 120 can be formed by a comparable thin material such as a metal sheet or glass-reinforced plastics (GRP) to cover an opening 117 as for example shown in Figure 3. A local widening structure 120 made of GRP can be freely shaped and may have a material thickness less than the thickness of the shell. An alternative arrangement is shown in Figure 2 where the local widening structure 120 is formed by a structural part of the rail vehicle body 110. In this embodiment, the local widening structure 120 may also be formed of extruded profiles, at least in portions, to add additional strength to the rail vehicle body 110. Another option is to provide a cover that can be removed to provide access to the opening 117. An example is a flap which is hinged to the external side of the structural part of the rail vehicle body 110 so that the cover can be easily opened for maintenance purposes.

**[0046]** The thickness of the shell of the local widening structure 120, for example the thickness of the material used to form the local widening structure 120, can be less than the thickness of the shell of the rail vehicle body

110. The shell of the rail vehicle body 110 may have a thickness between 0.4 m cm to 0.6 m while the shell of the local widening structure 120 may have a thickness between 5 cm to 30 cm.

**[0047]** In a typical application, the main cross-section profile is designed such that the rail vehicle body 110 is structurally self-supporting without requiring additional structural elements. When designing the rail vehicle body 110, the regions where cut-outs or openings are formed are taken into account when designing the shell of the rail vehicle body 110 to meet the required structural stability. The local widening structure 120 is an element that is typically not needed for the structural stability to the rail vehicle body 110. Therefore, the shell of the local widening structure 120 can be designed independently from stability considerations for the shell of the rail vehicle body 110. For example, the shell of the local widening structure 120 can be structurally thinner than the shell of the rail vehicle body which reduces the weight of the local widening structure 120. This is particularly beneficial for local widening structures 120 forming an openable cover.

**[0048]** Dimensionally, the opening 117 can have a length of about 2 m to 4 m and a height of about 0.4 m to 0.5 m without being limited thereto.

**[0049]** An advantage of the rail vehicle body 110 as described herein is the cost efficient integration of the local extension of the cross-sectional profile of the rail vehicle body without requiring an overall constructional change of the rail vehicle body 110. This also facilitates adaptations of the interior design according to customer's demand, for example when the toilet shall be arranged at another position. For illustration purposes, a principal alternative approach would be to form the rail vehicle body such that the cross-sectional shape gradually expands from the centre, when seen in longitudinal extension of the rail vehicle body, towards the regions of the bogies. Such shaped rail vehicle bodies can be described to have an S-shape or double S-shape. However, the gradual expansion of the cross-sectional profile significantly increases the complexity of the rail vehicle body and also of its manufacturing. In addition to that, the reliable sealing of doors on those cross-sectional profiles may even be impossible or at least significantly increases the costs.

**[0050]** Different thereto, using a widening structure 120 to expand only locally the cross-sectional profile allows to keep the cross-sectional profile of the rail vehicle body 110 constant along the longitudinal extension of the rail vehicle body 110 so that the manufacturing costs can be reduced.

**[0051]** An additional advantage is that unlike for S-shaped rail vehicle bodies, door opening and closing mechanisms can be kept simple. If the cross-sectional profile of the rail vehicle body would gradually expand, the complexity of the door opening and closing mechanisms increases as well as demands for sealing the doors during use of the rail vehicle. For the reason, the local widening structure 120 can be arranged spaced relative

to any door so that an open door does not interfere with the local widening structure 120. Figures 2 and 4 show embodiments with door openings 111 which are spaced from the adjacent local widening structure 120 in the longitudinal direction LD of the rail vehicle body 110.

**[0052]** Figure 5 illustrates a rail vehicle 100 with a rail vehicle body 110 as described above. The rail vehicle body 110 includes a plurality of windows 112 and at least one door at each side of the rail vehicle body 110. The local widening structure 120, illustrated in Figure 5 by the dashed line, is arranged in the lower part 115 of the rail vehicle body to arrange from below an upper end of a bogie cut-out 137 to above the upper end of the bogie cut-out 137.

**[0053]** The bogie cut-outs 137 are spaced from each other in the longitudinal direction LD, illustrated by the dashed double-arrow. The rail vehicle body 110 is supported by the two bogies 130 by means of pivot bearings 135.

**[0054]** The present invention is not limited to the above described embodiments, but is defined by the appending claims.

#### Reference list

#### [0055]

100	rail vehicle
110	rail vehicle body
111	door opening
112	window
113	bottom of the rail vehicle body
114	upper part of the rail vehicle body
115	lower part of the rail vehicle body
116	outline of the rail vehicle body
117	opening
120	local widening structure / cover / flap
124	upper wall part
125	lower wall part
126	maximum lateral projection
130	bogie
135	pivot bearing
137	bogie cut-out
140	internal floor
150	maximal allowed clearance gauge
160	toilet compartment
170	passageway
LD	longitudinal direction

#### Claims

1. A rail vehicle body (110) extending in a longitudinal direction (LD) and having, when seen perpendicular to the longitudinal direction (LD), a substantially constant main cross-sectional profile along the longitudinal direction (LD), the rail vehicle body (110) comprising at least one local widening structure (120)

projecting beyond the main cross-sectional profile in a given region of rail vehicle body (110) to provide more interior space for a piece of equipment (160), particularly for a passenger toilet compartment (160).

2. A rail vehicle body of claim 1, wherein the local widening structure (120) is only provided on one side of the rail vehicle body (110). 5
3. A rail vehicle body of claim 1, wherein the rail vehicle body (110) comprises at least two local widening structures (120), which can be arranged on opposite sides of the rail vehicle body (110) either at the same longitudinal position when seen in longitudinal direction or longitudinally displaced relative to each other. 10
4. A rail vehicle body of any of the previous claims, further comprising an upper part (114) and a lower part (115), the lower part (115) tapering towards the bottom (113) of the rail vehicle body (110), wherein the local widening structure (120) of the rail vehicle body (110) is provided in the lower part (115) of the of the rail vehicle body (110). 20
5. A rail vehicle body of any of the previous claims, further comprising two pivot bearings (135) for supporting the rail vehicle body (110) on respective bogies (130), the two pivot bearings (135) being spaced from each other in the longitudinal direction, wherein the local widening structure (120) is arranged between the two pivot bearings (135). 25
6. A rail vehicle body of any of the previous claims, wherein the local widening structure (120) is arranged eccentric to the centre of the rail vehicle body (110) in the longitudinal direction (LD). 30
7. A rail vehicle body of any of the previous claims, wherein the local widening structure (120) is arranged at the centre of the rail vehicle body (110) in the longitudinal direction (LD). 35
8. A rail vehicle body of any of the previous claims, wherein the local widening structure (120), when seen in a cross-section perpendicular to the longitudinal direction (LD) comprises an upper wall part (124) which extends substantially in a vertical direction and an inclined lower wall part (125). 40
9. A rail vehicle body of any of the previous claims, wherein the local widening structure (120) has a length, in the longitudinal direction, of less than 7 m, particularly less than 4 m. 45
10. A rail vehicle body of any of the previous claims, wherein the local widening structure (120) has, in a lateral direction, a maximum lateral projection (126) 50

beyond the outline (116) of the main cross-sectional profile of less than about 0.25 m, particularly of at least 0.01 cm and less than about 0.25 m, and more particularly of at least 0.1 m and less than about 0.25 m.

11. A rail vehicle body of any of the previous claims, wherein the rail vehicle body (110) comprises a self-supporting structure forming the shell of the rail vehicle body (110), and wherein the local widening structure (120) is a structural part of the self-supporting structure of the rail vehicle body (110). 55
12. A rail vehicle body of any of the previous claims 1 to 10, wherein the rail vehicle body (110) comprises a self-supporting structure forming the shell of the rail vehicle body (110), and wherein the local widening structure (120) is a cover mounted to the self-supporting structure of the rail vehicle body (110) and covering an opening (117) formed in the self-supporting structure of the rail vehicle body (110). 60
13. A rail vehicle body of claim 12, wherein the shell of the rail vehicle body (110) is thicker than the shell of the local widening structure (120) and/or wherein the material used for the shell of the rail vehicle body (110) is different than the material used for the shell of the local widening structure (120). 65
14. A rail vehicle body of claim 12 or 13, wherein the cover is an openable flap. 70
15. A rail vehicle (100) comprising a rail vehicle body (110) according to any of the previous claims, and a toilet compartment (160) comprising equipment which is partially or completely arranged in the space defined by the local widening structure (120) of the rail vehicle body (110). 75



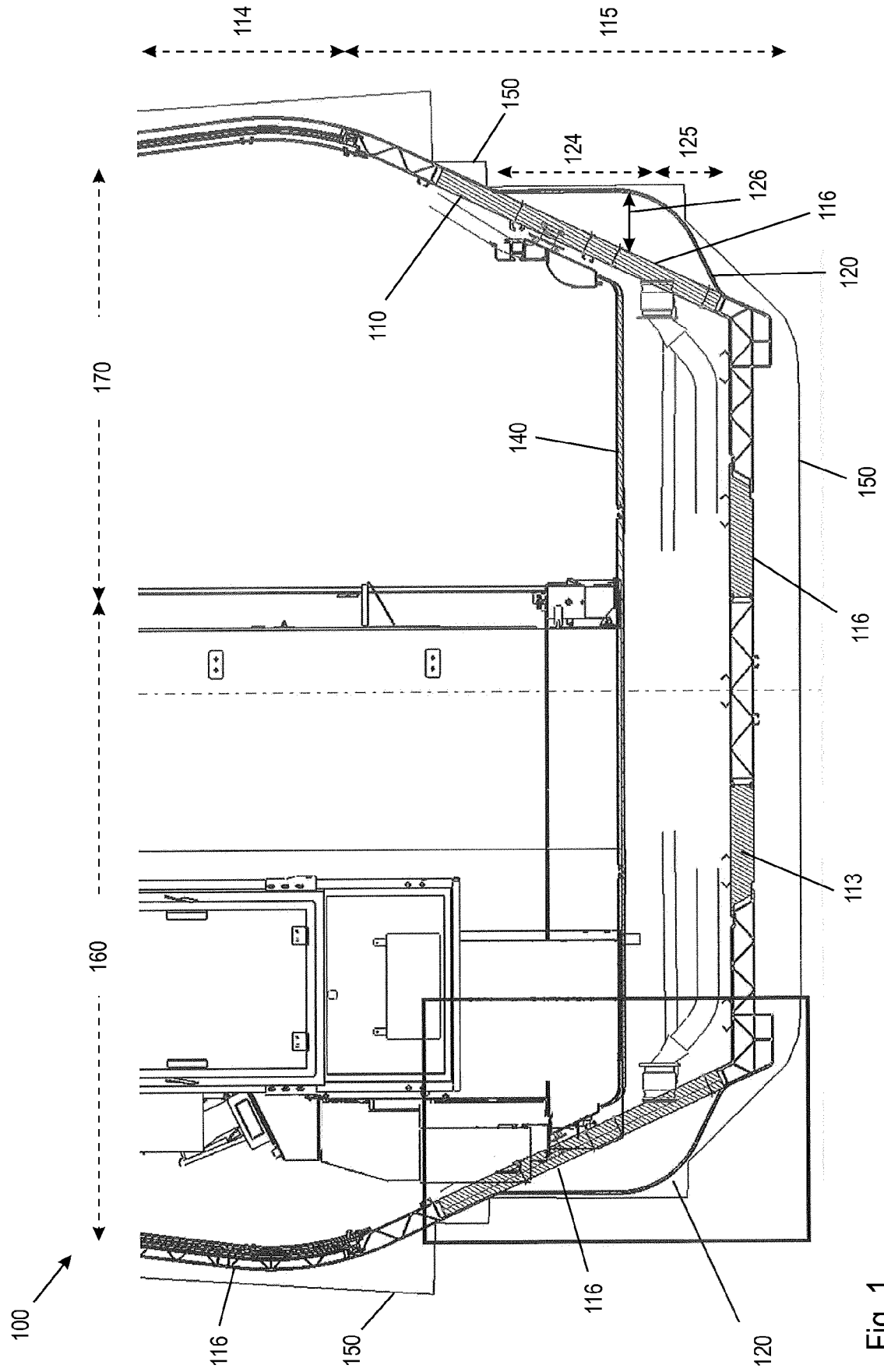


Fig. 1

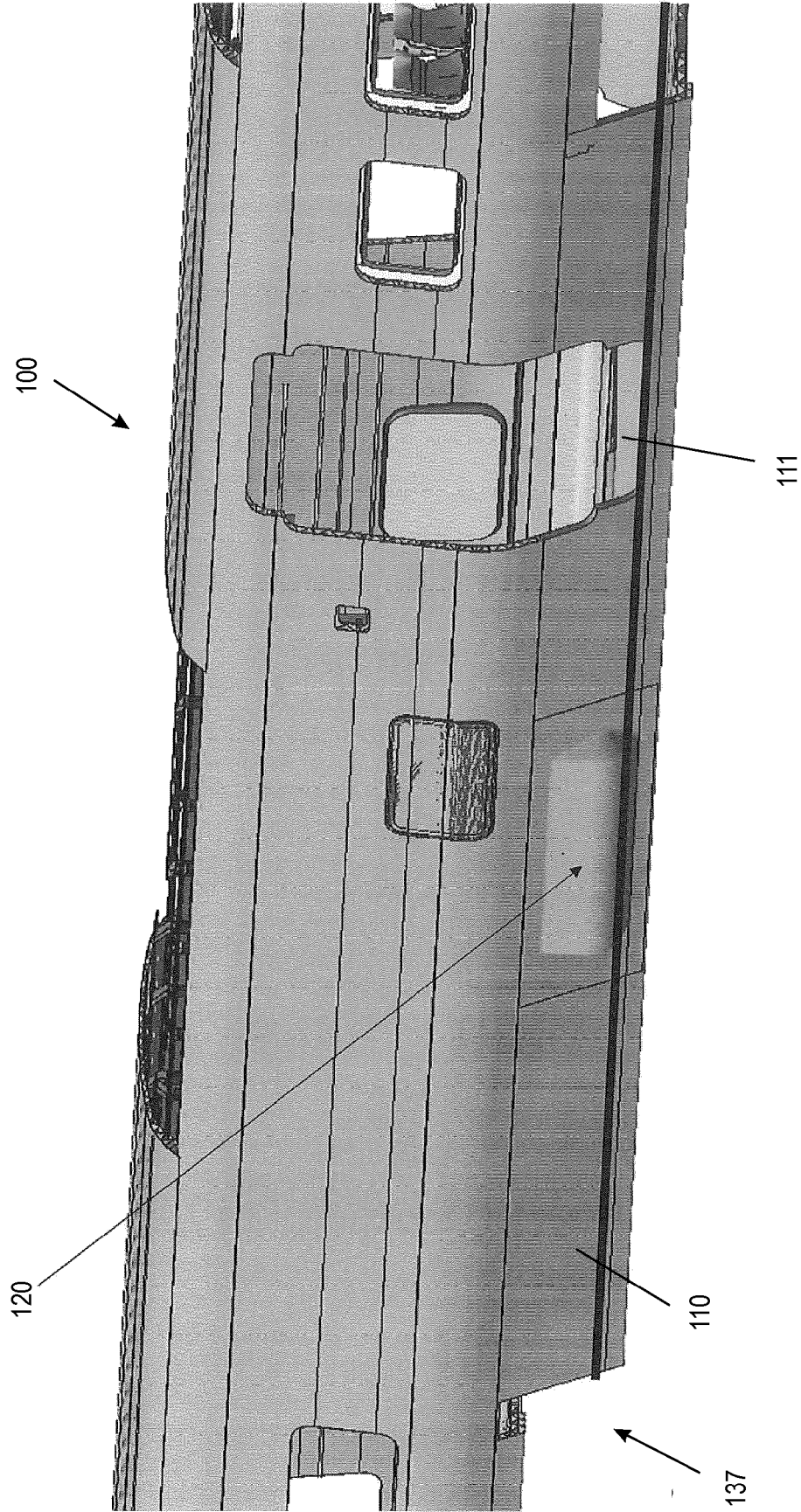


Fig. 2

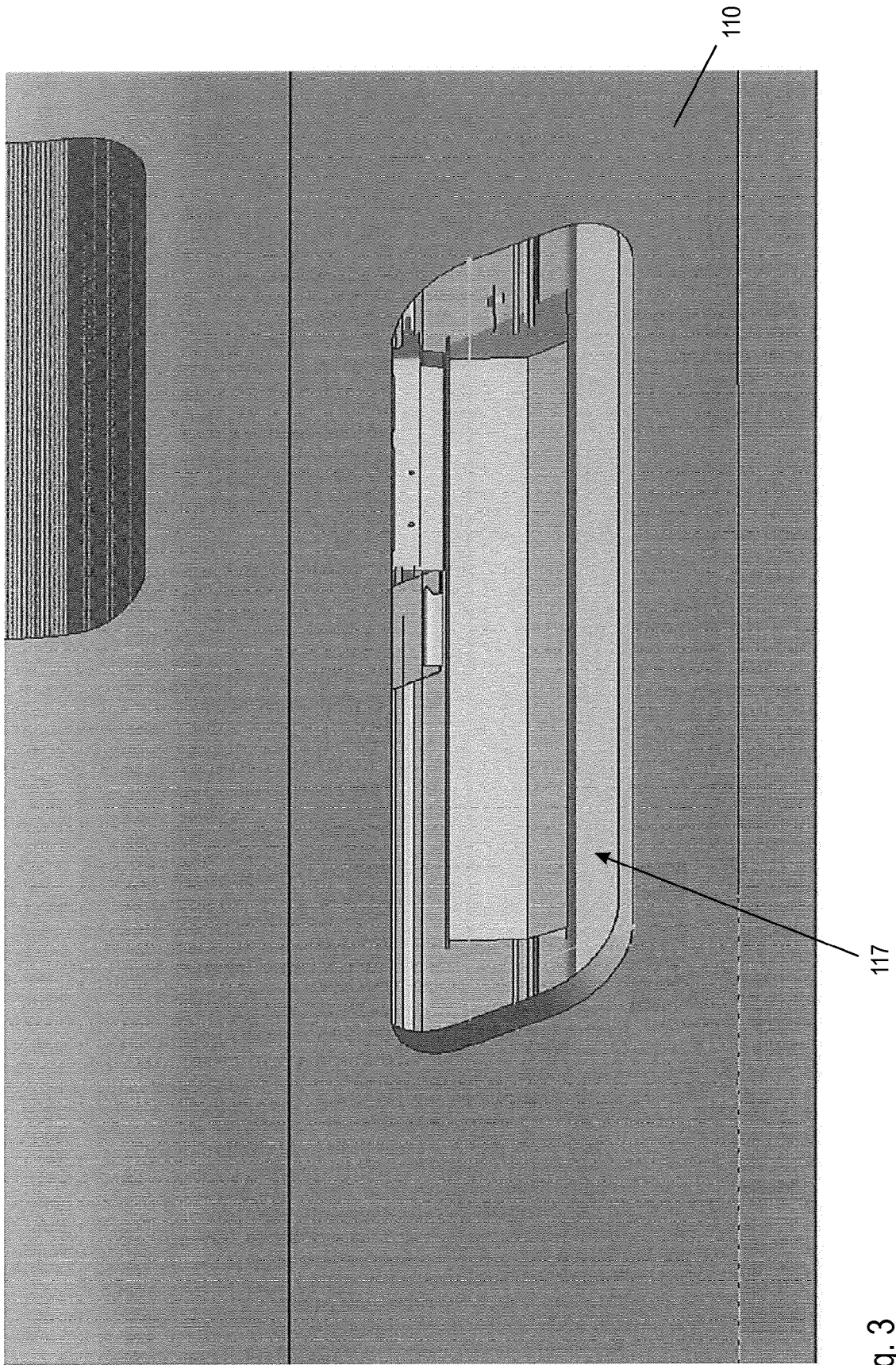


Fig. 3

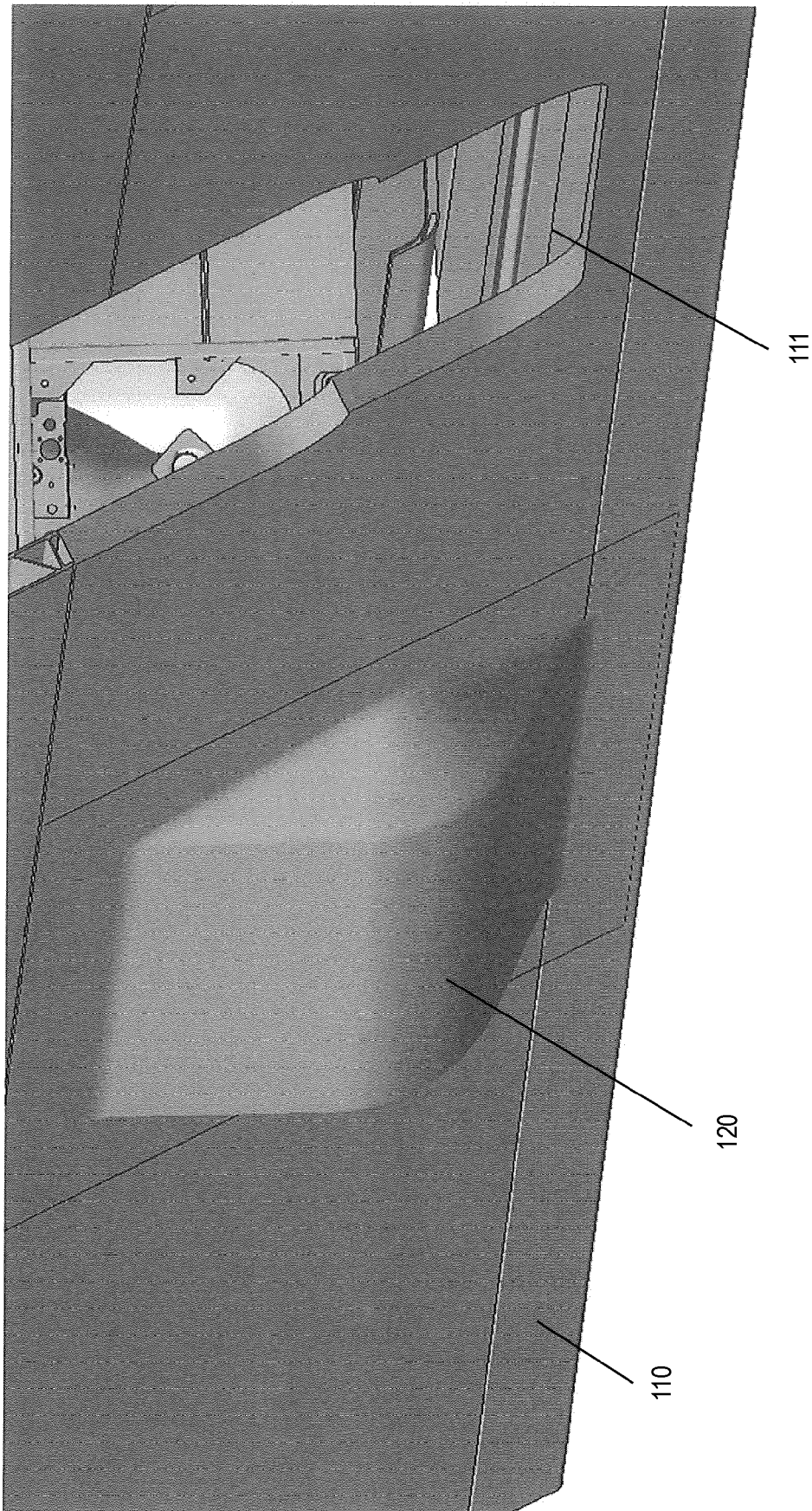


Fig. 4

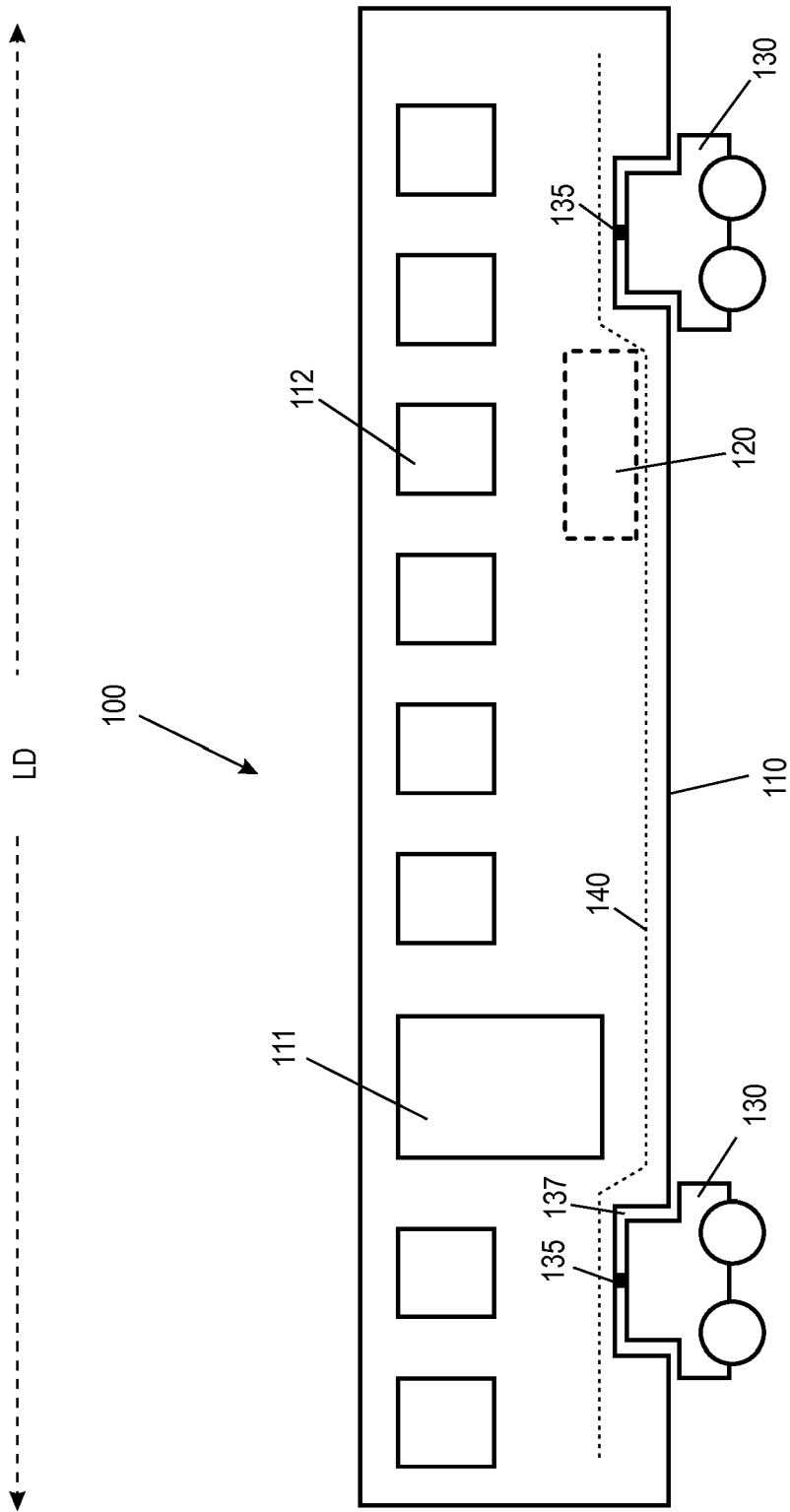


Fig. 5



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Application Number  
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			B61D
The present search report has been drawn up for all claims			
Place of search <b>Munich</b>		Date of completion of the search <b>17 April 2020</b>	Examiner <b>Denis, Marco</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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