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(54) Rail vehicle unit with a rolling support

(57) The present invention relates to a rail vehicle unit comprising a first vehicle component (104), a second vehicle component (111) and a rolling support device (112), the rolling support device (112) counteracting rolling motion between said first vehicle component (104) and said second vehicle component (111) about a rolling axis. The rolling support device (112) comprises a torsion bar (112.1), a first torsion arm (112.2) and a second torsion arm (112.3). The first torsion arm (112.2) is rotationally rigidly connected to a first end section of the torsion bar (112.1) and is articulated to the first vehicle component (104), while the second torsion arm (112.3) is rotationally rigidly connected to a second end section of the torsion bar (112.1) and is also articulated to the first vehicle component (104). The torsion bar (112.1) is pivotably mounted to the second vehicle component (111) via a first support element (113.1) and a second support element (113.2), the first support element (113.1) and the second support element (113.2) being mutually spaced by a support distance along a longitudinal torsion bar axis (112.6) of the torsion bar (112.1). Furthermore, at least one intermediate element (114.1, 114.2) is provided, the intermediate element (114.1, 114.2) being connected to the second vehicle component (111) and cooperating with the torsion bar (112.1). The intermediate element (114.1, 114.2) is located between the first support element (113.1) and the second support element (113.2).

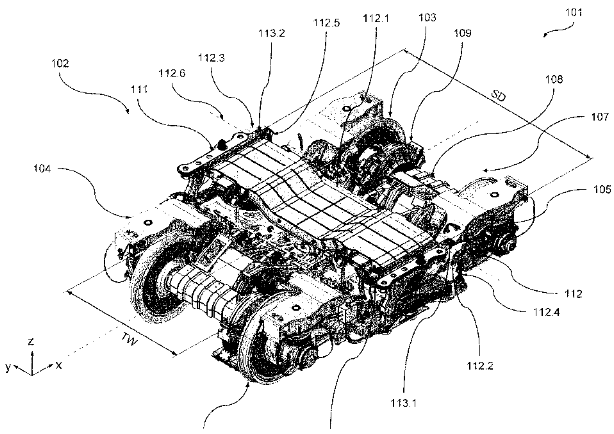

Fig. 1

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a rail vehicle unit, comprising a first vehicle component, a second vehicle component and a rolling support device counteracting rolling motion between the first vehicle component and the second vehicle component about a rolling axis. The rolling support device comprises a torsion bar, a first torsion arm and a second torsion arm. The first torsion arm is rotationally rigidly connected to a first end section of the torsion bar and is articulated to the first vehicle component, while the second torsion arm is rotationally rigidly connected to a second end section the torsion bar and is articulated to the first vehicle component as well. Furthermore, the torsion bar is pivotably mounted to the second vehicle component via a first support element and a second support element, the first support element and the second support element being mutually spaced by a support distance along a longitudinal torsion bar axis of the torsion bar. The present invention further relates to a rail vehicle comprising such a running gear.

[0002] In modern rail vehicles such rolling support devices are used to improve running stability of the rail vehicle by preventing excessive rolling motion about a rolling axis (typically extending substantially parallel to the longitudinal axis of the vehicle) between components of the running gear (for example, between the wheelsets and the running gear frame supported thereon) or between the running gear and the wagon body supported thereon, as it is known e.g. from EP 1 075 407 B1 (Klopfer et al.), EP 1 915 283 A1 (Brundisch et al.) and EP 0388 999 A2 (Harsy), the entire disclosure of which is incorporated herein by reference.

[0003] In modern rail vehicles, in particular, modern high-speed rail vehicles (adapted for operation at nominal operating speeds above 200 km/h and more), with the ongoing need to improve running stability and passenger comfort the vibrational behavior is becoming more and more important. In this context, the comparatively long torsion bars of the known rolling support devices may be the source of considerable vibration resulting from specific bending modes of the torsion bar at specific excitations during operation of the rail vehicle. Furthermore, space requirements, in particular, within the running gear become more and more strict due to the increasing number of components to be placed in the area of modern running gears leading to increased problems in placing the components and, in particular, providing a sufficient amount of free space for the motion of the torsion arms of the rolling support device.

SUMMARY OF THE INVENTION

[0004] It is thus an object of the present invention to provide a rail vehicle unit as outlined above that, at least to some extent, overcomes the above disadvantages. It is a further object of the present invention to provide a rail vehicle unit that provides improved dynamic properties at an overall space-saving configuration.

[0005] The above objects are achieved starting from a rail vehicle unit according to the preamble of claim 1 by the features of the characterizing part of claim 1.

[0006] The present invention is based on the technical teaching that improvement of the dynamic behavior of the running gear, in particular, at high speeds, maybe achieved with an overall space-saving configuration if the at least one intermediate element located in between the support elements is co-operating with the torsion bar. This intermediate element, for example, may serve as further support or as a damper that modifies the bending vibrational modes of the torsion bar. This allows increasing the length of the torsion bar while at the same time nevertheless improving its vibrational behavior, in particular, at high speeds. An increased length of the torsion bar on the other hand provides the opportunity to place the torsion arms (in the transverse direction of the vehicle) further to the outer side of the running gear where the necessary free space for their motion is more readily available than in a more central area of the running gear.

[0007] Hence, according to one aspect, the present invention relates to a rail vehicle unit comprising a first vehicle component, a second vehicle component and a rolling support device, the rolling support device counteracting rolling motion between the first vehicle component and the second vehicle component about a rolling axis. The rolling support device comprises a torsion bar, a first torsion arm and a second torsion arm, the first torsion arm being rotationally rigidly connected to a first end section of the torsion bar and being articulated to the first vehicle component, the second torsion arm being rotationally rigidly connected to a second end section the torsion bar and being articulated to the first vehicle component. The torsion bar is pivotably mounted to the second vehicle component via a first support element and a second support element, the first support element and the second support element being mutually spaced by a support distance along a longitudinal torsion bar axis of the torsion bar. Furthermore, at least one intermediate element is provided, the intermediate element being connected to the second vehicle component and cooperating with the torsion bar, the intermediate element further being located between the first support element and the second support element.

[0008] The intermediate element may be a further support element substantially rigidly supporting and, in particular, guiding the torsion bar in a substantially rigid manner in a direction transverse to the torsion bar axis. With preferred embodiments of the invention, the intermediate support element comprises a damping element, the damping element cooperating with the torsion bar to damp bending vibrations of the torsion bar about a bending axis running transverse to the torsion bar axis. This solution has the beneficial effect that not only the bending vibrational modes of the torsion bar modified in a favorable way, but also damping of the vibrations is achieved in a very simple manner.

[0009] The damping element may, in principle, be of any suitable design providing the desired damping properties. Preferably, the damping element comprises a polymeric element, thereby providing good damping properties while at the same time achieving sufficient lifetime. Generally, any suitable polymers providing the appropriate damping and lifetime properties may be used. Preferably, the polymeric element is made of a readily compressible polymer, thereby providing good vibration energy absorption properties.

[0010] With preferred embodiments of the invention the compressible polymer, upon compression in a direction of compression, shows a relative elongation in a direction transverse to the direction of compression of less than 10%, preferably less than 5%, more preferably substantially 0%. Such a material has the advantage that the damping element during operation largely keeps its outer shape interfacing with its holder such that, if at all, only very moderate stresses and/or motion occurs at the outer interface area of the damping element and its holder. This is highly beneficial in terms of the lifetime of the intermediate element.

[0011] An example for such a material is a cellular polyurethane elastomer material sold under the trade name Vulcocell® by P+S Polyurethan-Elastomere GmbH & Co. KG, 49356 Diepholz, DE.

[0012] It will be appreciated that the damping properties of the damping element may be constantly available irrespective of the frequency of the vibration. However, with certain embodiments of the invention, the damping effect may vary as a function of the frequency of the vibration. With certain preferred embodiments of the invention, the damping element is adapted to be effective at a frequency of the bending vibrations above 1 Hz, preferably from 1 Hz to 15 Hz, more preferably from 3 Hz to 10 Hz, these frequencies being particularly relevant in terms of the running stability of high-speed rail vehicles.

[0013] The intermediate element may, in principle, be of any suitable design providing the desired support and/or damping functionality as outlined above. Preferably, with variants providing a very simple and reliable design, the intermediate element comprises a holding element and a bush element, the holding element being connected to the second vehicle component and the bush element surrounding the torsion bar and being held, at its outer circumference, in a receptacle of the holding element.

[0014] Preferably, the bush element is under compressive pre-stress in an unloaded state of the rolling support device (as is the case, for example, at a standstill of the vehicle on a straight level track). Such a pre-stress has the advantage that the damping properties of the bush element may already become effective at very low bending deflections of the torsion bar.

[0015] It will be appreciated that, in particular, depending on the available space for the interface with the second vehicle component, the intermediate elements may be placed at any suitable and available location in between the first and second support element. Preferably, the intermediate element is in an area where, otherwise (i.e. in a configuration without such an intermediate element) maximum deflection of the torsion bar is to be expected during operation of the rail vehicle. By this means, maximum effectiveness of the intermediate element may be achieved.

[0016] Hence, with preferred embodiments of the invention, the torsion bar, in a reference configuration during an operational state of the rail vehicle unit, has a mode of bending vibration showing at least one relative maximum of bending deflection at a bending maximum location. The intermediate element is located, along the torsion bar axis, at a distance from the bending maximum location which is less than 10% of the support distance, preferably less than 5% of the support distance, more preferably 3% to 0% of the support distance. In this case, as already indicated above, the reference state configuration is a configuration wherein, under omission of the at least one intermediate element, the torsion bar is exclusively connected to the second vehicle component via the first support element and the second support element.

[0017] It will be appreciated that the operational state of the rail vehicle may be any operational state where a correspondingly intense bending vibration of the torsion bar is to be expected. For example, this may be an operational state wherein the frequency of the excitation of torsion bar lies in the range of a natural bending frequency of the torsion bar. With certain embodiments of the invention, the operational state of the rail vehicle unit, may be a state wherein the rail vehicle unit is operated at its nominal operating speed.

[0018] It will be further appreciated that the damping effect of the intermediate element may be chosen as a function of the negative impact of the bending vibration of the torsion bar on either one of the running stability and the passenger comfort level achieved in the respective rail vehicle. Preferably, the intermediate element is adapted to provide, compared to the reference configuration, a reduction of a maximum amplitude of the bending vibrations by at least 80%, preferably by at least 90%, more preferably by at least 95%. Hereby, particularly beneficial improvements of running stability and/or passenger comfort may be achieved.

[0019] In principle, any desired number of intermediate elements may be provided. These intermediate elements may, at least partially, vary in their design and/or their dynamic properties, in particular, their damping properties. However, particularly simple configurations show substantially identical intermediate elements.

[0020] With certain preferred embodiments of the invention showing good dynamic properties, in particular good damping properties, at comparatively low expense, two intermediate elements are provided, each of the intermediate elements being located, along the torsion bar axis, at an intermediate element distance from the respective closer one of the first support element and the second support element. The intermediate element distance is 25% to 45% of the support distance, preferably 30% to 40% of the support distance, more preferably 33% to 37% of the support distance. It will be appreciated that the two intermediate elements may be the sole intermediate elements present in the rail vehicle unit. However, with other embodiments of the invention, further intermediate elements located at different locations may be added.

[0021] The first and second vehicle component, in principle, may be any components of the rail vehicle which are prone to execute an undesired mutual rolling motion. These may be, for example, a wheel unit (such as a wheel set or a wheel pair) and a running gear frame supported thereon via a primary spring device (one of both forming the first vehicle component and the other one forming the second vehicle component). Furthermore, one of a running gear and a wagon body (typically supported thereon via a secondary spring device) may form the first vehicle component while the other one forms the second vehicle component.

[0022] Certain preferred embodiments of the rail vehicle unit according to the invention comprise a running gear, the first vehicle component being a running gear frame of the running gear and the second vehicle component a bolster or a wagon body supported on the running gear frame via a secondary spring device. Such configurations, typically, providing the advantage that the bolster or the wagon body allows simpler integration of the torsion bar (extending in the transverse direction of the rail vehicle and spanning a major fraction of the total width of the running gear in this transverse direction) provide a more readily available interface space for the mounting of the torsion bar.

[0023] Preferably, the second vehicle component is a bolster extending in a transverse direction of the rail vehicle unit, the first support element and the second support element being located in the region of transversally opposite ends of the bolster. Such a configuration has the advantage that the ends of the torsion bar with the torsion arms mounted thereon are located comparatively far laterally outside from the center of the running gear where free building space for integrating the linkage to the first vehicle component is more readily available.

[0024] It will be appreciated that the lateral position of the support elements (in the transverse direction of the rail vehicle) may be selected as a function of the free building space available for integration of the rolling support device. Preferably, the rail vehicle unit comprises a wheel unit defining a track width and the support distance is at least 120% of the track width, preferably at least 150% of the track width, more preferably 160% to 180% of the track width. Such a configuration again has the above advantages of a configuration with torsion arms that are located comparatively far laterally outside from the center of the running gear.

[0025] It will be appreciated that the present invention may be used for any desired rail vehicle operating at any desired nominal operating speed. However, the beneficial effect of the present invention or a particularly visible in the high-speed operations. Hence, preferably, the running gear it is adapted for a nominal operating speed above 250 km/h, preferably above 300 km/h, more preferably above 350 km/h.

[0026] The present invention furthermore relates to a rail vehicle with a rail vehicle unit according to the invention as it has been outlined above.

[0027] Further embodiments of the present invention will become apparent from the dependent claims and the following description of preferred embodiments which refers to the appended figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Figure 1 is a schematic perspective top view of a preferred embodiment of a rail vehicle unit according to the present invention used in a preferred embodiment of the vehicle according to the present invention;

Figure 2 is a further schematic top view of a detail of the rail vehicle unit of Figure 1

DETAILED DESCRIPTION OF THE INVENTION

[0029] With reference to Figures 1 and 2 a preferred embodiment of a rail vehicle 101 according to the present invention comprising a preferred embodiment of a rail vehicle unit in the form of a running gear 102 according to the invention will now be described in greater detail. In order to simplify the explanations given below, an xyz-coordinate system has been introduced into the Figures, wherein (on a straight, level track) the x-axis designates the longitudinal direction of the running gear 102, the y-axis designates the transverse direction of the running gear 102 and the z-axis designates the height direction of the running gear 102.

[0030] The vehicle 101 is a high-speed rail vehicle with a nominal operating speed above 250 km/h, more precisely above 300 km/h to 380 km/h. The vehicle 101 comprises a wagon body (not shown) supported by a suspension system on the running gear 102. The running gear 102 comprises two wheel units in the form of wheel sets 103 supporting a running gear frame unit 104 via a primary spring unit 105. The running gear frame unit 104 supports the wagon body via a secondary spring unit 106.

[0031] Each wheel set 103 and is driven by a drive unit 107. The drive unit 107 comprises a motor unit 108 (suspended to the running gear frame unit 104) and a gearing 109 (sitting on the shaft of the wheel set 103) connected via a motor shaft 110. Both drive units 107 are of substantially identical design and arranged substantially symmetrically with respect to the center of the running gear frame unit 104.

[0032] The running gear frame unit 104 is of generally H-shaped design with a middle section in the form of a transverse beam 104.1 located between the wheel sets 103. The interface of the running gear 102 to the wagon body (not shown) is formed by a bolster 111 rigidly connected to the wagon body and supported on the running gear frame unit 104 via the secondary spring unit 106.

[0033] To counteract undesired rolling motion between the wagon body and the running gear frame unit 104 about a rolling axis which is generally parallel to the vehicle longitudinal axis (x-direction) a rolling support device 112 is provided. The rolling support device 112 acts between the running gear frame unit 104 (forming a first vehicle component in the sense of the present invention) and the bolster 111 (forming a second vehicle component in the sense of the present invention).

[0034] The rolling support device 112 comprises a torsion bar 112.1, a first torsion arm 112.2 and a second torsion arm 112.3. One end of the first torsion arm 112.2 is rotationally rigidly connected to a first end section of the torsion bar 112.1. The other end of the first torsion arm 112.2 is articulated to the running gear frame unit 104 via a first linkage element 112.4. Furthermore, the second torsion arm 112.3 is rotationally rigidly connected to a second end section the torsion bar 112.1. The other end of the second torsion 112.3 is articulated to the running gear frame unit 104 via a second linkage element 112.5.

[0035] The torsion bar 112.1 is mounted to the bolster 111 via a first support element 113.1 and a second support element 113.2, the first support element 113.1 and the second support element 113.2 being mutually spaced by a support distance SD along the longitudinal torsion bar axis 112.6 of the torsion bar 112.1. The first support element 113.1 and the second support element 113.2 hold the torsion bar 112.1 such that it is pivotable about the torsion bar axis 112.6.

[0036] The rolling support device 112, in a generally known manner (which, consequently, will not be described in further detail), counteracts an undesired rolling motion between the running gear frame unit 104 and the bolster 111 (and, hence, the wagon body) by an elastic torsion of the torsion bar 112.1 generating a corresponding counteracting moment about the rolling axis.

[0037] As can be seen from Figure 2, in addition to and in between the first and second support element 113.1, 113.2, a first intermediate element 114.1 and a second intermediate element 114.2 are mounted to the bolster 111. The first intermediate element 114.1 is located closer to the first support element 113.1 at an intermediate element distance IED (along the torsion bar axis 112.6), while the second intermediate element 114.2 is located closer to the second support element 113.2 at substantially the same intermediate element distance IED (along the torsion bar axis 112.6).

[0038] The first and second intermediate element 114.1 and 114.2 are formed as damping units co-operating with the torsion bar 112.1 to damp and reduce bending vibrations of the torsion bar 112.1 about a bending axis running transverse to the torsion bar axis 112.6. By this means an improvement of the dynamic behavior of the running gear 102, in particular, at high speeds, is achieved with an overall space-saving configuration.

[0039] This improvement is achieved since the intermediate elements 114.1, 114.2, on the one hand, modify the bending vibrational modes of the torsion bar 112.1 and, on the other hand, absorb vibration energy. Compared to conventional rolling supports, this allows increasing the length of the torsion bar 112.1 (along its torsion bar axis 112.6) while at the same time nevertheless improving its vibrational behavior, in particular, at high speeds. This increased length of the torsion bar 112.6, on the other hand, provides the opportunity to place the torsion arms 112.2, 112.3 (in the transverse direction of the vehicle) further to the outer side of the running gear 102 where the necessary free space for their motion is more readily available than in a more central area of the running gear 102.

[0040] Consequently, the lateral position of the support elements 113.1, 113.2 (in the transverse direction of the rail vehicle) is selected to be comparatively far laterally outside, namely in the region of opposite ends of the transversally extending bolster 111. More precisely, in the present example, the support distance SD is about 170% of the track width TW defined by the wheel sets 103.

[0041] In the present example, the intermediate element distance IED is about 35% of the support distance SD. By this means, as will be outlined in further detail below, a highly beneficial damping effect is achieved.

[0042] To achieve the damping effect, each of the intermediate elements 114.1, 114.2 comprises a polymeric bush element 114.3 received and held in a receptacle of a holding element 114.4. The holding element 114.4, in turn, is rigidly mounted to the bolster 111.

[0043] The bush element 114.3 surrounds the torsion bar 112.1 and is under compressive pre-stress in an unloaded state of the rolling support device 112 (as is the case, for example, at a standstill of the vehicle on a straight level track). Such a pre-stress has the advantage that the damping properties of the bush element 114.3 may already become effective at very low bending deflections of the torsion bar 112.1. It will be appreciated that, with certain other embodiments of the invention, a certain (eventually only very slight) radial play may be provided between the bush element 114.3 and the torsion bar 112.1.

[0044] For the bush element 114.3, generally, any suitable polymers providing the appropriate damping and lifetime properties may be used. In the present example, the polymeric element forming the bush element 114.3 is made of a readily compressible polymer, thereby providing good vibration energy absorption properties.

[0045] Furthermore, in the present example, the compressible polymer, upon compression in a direction of compression, shows a relative elongation in a direction transverse to the direction of compression which is substantially 0%. Such a material has the advantage that the damping element 114.3 during operation largely keeps its outer shape interfacing with its holder 114.4 such that, if at all, only very moderate stress and/or motion occurs at the outer interface area of the damping bush 114.3 and its holder 114.4. This is highly beneficial in terms of the lifetime of the respective intermediate element 114.1, 114.2, in particular, in terms of the lifetime of the damping bush 114.3.

[0046] In the present example the polymeric material used for the bush 114.3 is a cellular polyurethane elastomer material sold under the trade name Vulcocell® by P+S Polyurethan-Elastomere GmbH & Co. KG, 49356 Diepholz, DE, showing these properties.

[0047] It will be appreciated that the damping element does not necessarily have to be formed as one single bush made from one single material. For example, with other embodiments, damping elements comprising a plurality of layers, eventually made of different materials, may also be used. In particular, in this case, not all of the layers used need to show corresponding damping properties. More precisely, one or more carrier layers or the like may be used to provide structural stability of the damping element.

[0048] It will be appreciated that the damping properties of the damping element 114.3 may be constantly available irrespective of the frequency of the vibration. However, with certain embodiments of the invention, the damping effect may vary as a function of the frequency of the vibration. In the present example, the damping element 114.3 is adapted to be effective at a frequency of the bending vibrations above 1 Hz, preferably from 1 Hz to 15 Hz, more preferably from 3 Hz to 10 Hz, these frequencies being particularly relevant in terms of the running stability of high-speed rail vehicles.

[0049] In the present example, each of the intermediate elements 113.1, 113.2 is located in an area where, otherwise (i.e. in a reference configuration without such an intermediate element, wherein the torsion bar 112.1 is exclusively connected to the bolster 111 via the first and second support element 113.1, 113.2) a maximum deflection of the torsion bar 112.1 is to be expected during operation of the rail vehicle 101. By this means, maximum effectiveness of the intermediate elements 113.1, 113.2 is achieved.

[0050] In the example shown, the torsion bar 112.1, in the above reference configuration during a given operational state of the rail vehicle unit, has a sinusoidal mode of bending vibration showing at least two relative maxima of bending deflection, each at a relative bending maximum location. Each one of the intermediate elements 113.1 and 113.2 is located, along the torsion bar axis 112.6 in the area of one of these bending maxima, at a distance from the respective bending maximum location which is less than 10% of the support distance SD.

[0051] In the embodiment shown, this slight distance from the respective bending maximum has the advantage that the connection between respective intermediate element 114.1, 114.2 and the bolster 111 may be formed in a very simple manner due to the given shape of the bolster 111. It will be appreciated that, with other embodiments of the invention, another distance to be respective bending maximum may be chosen. Furthermore, it may also be provided that the location of the respective intermediate element may coincide with the bending maximum.

[0052] It will be appreciated that the above operational state of the rail vehicle 101 and, hence, the running year 102 (wherein the bending maximum occurs) may be any operational state where a correspondingly intense bending vibration of the torsion bar 112.1 is to be expected. For example, this may be an operational state wherein the frequency of the excitation of torsion bar 112.1 lies in the range of a natural bending frequency of the torsion bar 112.1. With certain embodiments of the invention, the operational state of the rail vehicle unit may be a state wherein the rail vehicle unit is operated at its nominal operating speed.

[0053] In the present example, the two is substantially identically designed intermediate elements 114.1, 114.2 provide (compared to the reference configuration as outlined above) a reduction of a maximum amplitude of the bending vibrations by about 95% such that particularly beneficial improvements of running stability and/or passenger comfort are achieved in a very simple manner.

[0054] It will be appreciated that the lateral position of the support elements (in the transverse direction of the rail vehicle) may be selected as a function of the free building space available for integration of the rolling support device. Preferably, the rail vehicle unit comprises a wheel unit defining a track width and the support distance is at least 120% of the track width, preferably at least 150% of the track width, more preferably 160% to 180% of the track width. Such a configuration again has the above advantages of a configuration with torsion arms that are located comparatively far laterally outside from the center of the running gear.

[0055] Although the present invention in the foregoing has only a described in the context of high-speed rail vehicles, it will be appreciated that it may also be applied to any other type of rail vehicle in order to overcome similar problems with respect to a simple solution for generally vibrational problems, such as running stability problems and acoustic problems.

Claims

1. A rail vehicle unit, comprising

- a first vehicle component (104),
- a second vehicle component (111) and
- a rolling support device (112);

- said rolling support device (112) counteracting rolling motion between said first vehicle component (104) and said second vehicle component (111) about a rolling axis;
- said rolling support device (112) comprising a torsion bar (112.1), a first torsion arm (112.2) and a second torsion arm (112.3);
- said first torsion arm (112.2) being rotationally rigidly connected to a first end section of said torsion bar (112.1) and being articulated to said first vehicle component (104);
- said second torsion arm (112.3) being rotationally rigidly connected to a second end section of said torsion bar (112.1) and being articulated to said first vehicle component (104);
- said torsion bar (112.1) being pivotably mounted to said second vehicle component (111) via a first support element (113.1) and a second support element (113.2), said first support element (113.1) and said second support element (113.2) being mutually spaced by a support distance along a longitudinal torsion bar axis (112.6) of said torsion bar (112.1);

characterized in that

- at least one intermediate element (114.1, 114.2) is provided;
- said intermediate element (114.1, 114.2) being connected to said second vehicle component (111) and cooperating with said torsion bar (112.1);
- said intermediate element (114.1, 114.2) being located between said first support element (113.1) and said second support element (113.2).

2. The rail vehicle unit according to claim 1, wherein

- said intermediate element (114.1, 114.2) comprises a damping element (114.3);
- said damping element (114.3) cooperating with said torsion bar (112.1) to damp bending vibrations of said torsion bar (112.1) about a bending axis running transverse to said torsion bar axis (112.6).

3. The rail vehicle unit according to claim 2, wherein

- said damping element (114.3) comprises a polymeric element;
- said polymeric element, in particular, being made of a compressible polymer, in particular a cellular polyurethane elastomer,
- said compressible polymer, in particular, upon compression in a direction of compression, showing a relative elongation in a direction transverse to said direction of compression of less than 10%, preferably less than 5%, more preferably substantially 0%.

4. The rail vehicle unit according to one of claims 2 or 3, wherein said damping element (114.3) is adapted to be effective at a frequency of said bending vibrations above 1 Hz, preferably from 1 Hz to 15 Hz, more preferably from 3 Hz to 10 Hz.

5. The rail vehicle unit according to any one of claims 1 to 4, wherein

- said intermediate element (114.1, 114.2) comprises a holding element (114.4) and a bush element (114.3);
- said holding element (114.4) being connected to said second vehicle component (111);
- said bush element (114.3) surrounding said torsion bar (112.1) and being held, at its outer circumference, in a receptacle of said holding element (114.4);
- said bush element (114.3), in particular, being under compressive pre-stress in an unloaded state of said rolling support device (112).

6. The rail vehicle unit according to any one of claims 1 to 5, wherein

- said torsion bar (112.1), in a reference configuration during an operational state of said rail vehicle unit, has a mode of bending vibration showing at least one relative maximum of bending deflection at a bending maximum location;
- said intermediate element (114.1, 114.2), along said torsion bar axis (112.6), being located at a distance from said bending maximum location which is less than 10% of said support distance, preferably less than 5% of said support distance, more preferably 3% to 0% of said support distance;
- said reference state configuration being a configuration wherein, under omission of said at least one intermediate element (114.1, 114.2), said torsion bar (112.1) is exclusively connected to said second vehicle component (111) via said first support element (113.1) and said second support element (113.2);
- said operational state of said rail vehicle unit, in particular, being a state wherein said rail vehicle unit is operated at its nominal operating speed.

7. The rail vehicle unit according to claim 6, wherein said intermediate element (114.1, 114.2) is adapted to provide, compared to said reference configuration, a reduction of a maximum amplitude of said bending vibrations by at least 80%, preferably by at least 90%, more preferably by at least 95%.

8. The rail vehicle unit according to any one of claims 1 to 7, wherein

- two intermediate elements (114.1, 114.2) are provided;
- each of said intermediate elements (114.1, 114.2) being located, along said torsion bar axis (112.6), at an intermediate element distance from the respective closer one of said first support element (113.1) and said second support element (113.2);
- said intermediate element (114.1, 114.2) distance being 25% to 45% of said support distance, preferably 30% to 40% of said support distance, more preferably 33% to 37% of said support distance.

9. The rail vehicle unit according to any one of claims 1 to 8, wherein

- it comprises a running gear (102);
- said first vehicle component, in particular, being a running gear frame (104) of said running gear;
- said second vehicle component, in particular, being a bolster (111) or a wagon body supported on said running gear frame (104) via a secondary spring device (106).

10. The rail vehicle unit according to claim 9, wherein

- said second vehicle component is a bolster (111) extending in a transverse direction of said rail vehicle unit;
- said first support element (113.1) and said second support element (113.2) being located in the region of transversally opposite ends of said bolster (111).

11. The rail vehicle unit according to any one of claims 1 to 10 , wherein

- it comprises a wheel unit (103) defining a track width;
- said support distance being at least 120% of said track width, preferably at least 150% of said track width, more preferably 160% to 180% of said track width.

12. The rail vehicle unit according to any one of claims 1 to 11, wherein it is adapted for a nominal operating speed above 250 km/h, preferably above 300 km/h, more preferably above 350 km/h.

13. A rail vehicle with a rail vehicle unit (102) according to any one of claims 1 to 12.

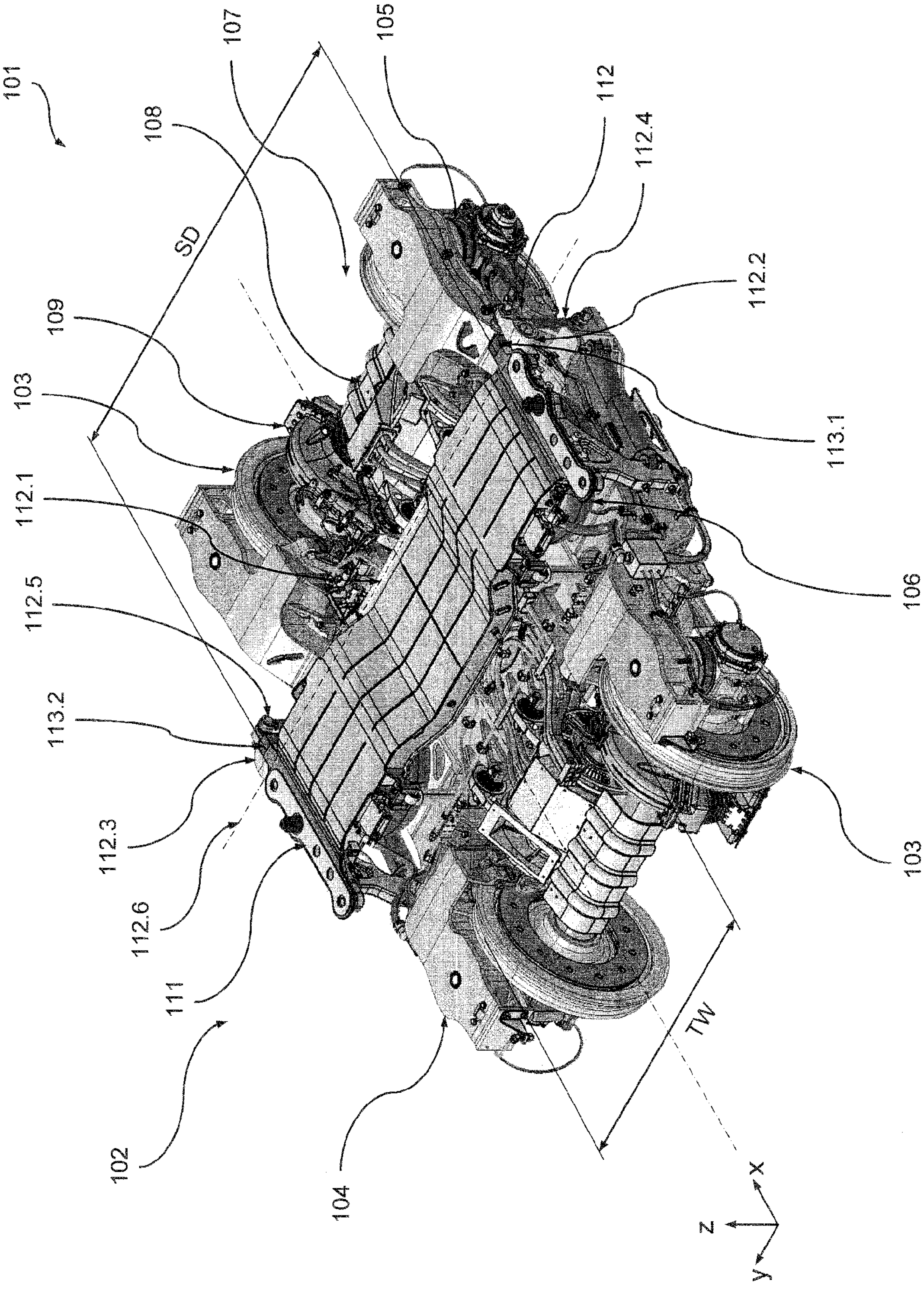
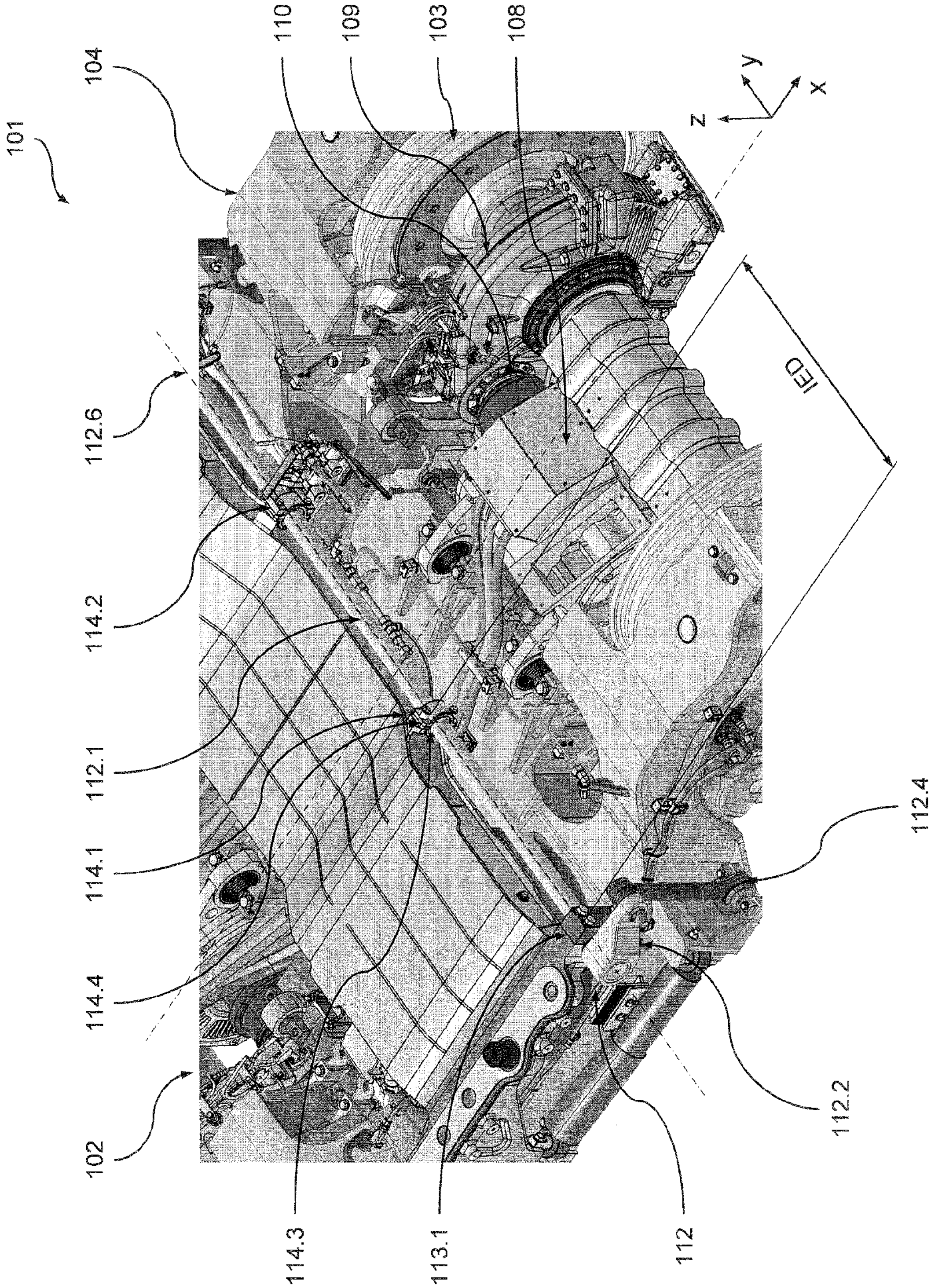

101
107
105
108
112
112.4
SD
109
112.2
103
113.1
112.1
106
112.5
113.2
112.3
103
112.6
111
TW
102
104
x
z
y

Fig. 1


101
104
110
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103
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z
y
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IED
112.6
114.2
112.1
114.1
114.4
102
114.3
113.1
112
112.2
112.4

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 11 15 8510

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 0 397 291 A2 (WERKSPOOR SERVICES BV [NL]) 14 November 1990 (1990-11-14) * column 1, line 39 - line 47 * * column 3, line 4 - line 15; figures 1,2 * -----	1,8,13	INV. B61F5/24
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TECHNICAL FIELDS SEARCHED (IPC)

B61F
B61G
B60G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	2 August 2011	Chlosta, Peter

CATEGORY OF CITED DOCUMENTS

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