(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 368 781 A1

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.09.2011 Bulletin 2011/39

(51) Int Cl.:
B61F 19/06 *(2006.01)*

(21) Application number: **10157308.7**

(22) Date of filing: **23.03.2010**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA ME RS

(71) Applicant: **Bombardier Transportation GmbH**
10785 Berlin (DE)

(72) Inventors:
- **Bolbrinker, Dirk**
  14793 Ziesar (DE)
- **Haas, Jan-Philipp**
  34121 Kassel (DE)

(74) Representative: **Cohausz & Florack**
Patent- und Rechtsanwälte
Partnerschaftsgesellschaft
Bleichstraße 14
40211 Düsseldorf (DE)

(54) **Impact protection for a running gear of a rail vehicle**

(57) The invention relates to a running gear for a rail vehicle, in particular a high speed rail vehicle, comprising a wheel set (105), a running gear frame (104) and a shielding device (109), the running gear frame (104) being supported on the wheel set (105). The shielding device (109) is connected to the running gear frame (104) via a support structure (108) and is spatially associated to at least a shielded component (107) of the running gear (103). The shielding device (109) shields a shielded part (107.1) of the shielded component (107) against impacts of objects (B), in particular pieces of ballast, lifted from a track (T) used during operation of the vehicle. The shielding device (109) and/or the support structure (108) comprises an impact energy absorbing device (109.2, 109.3, 110), the impact energy absorbing device (109.2, 109.3, 110) being adapted to absorb a noticeable fraction of an impact energy of one of the objects (B) hitting the shielding device (109).

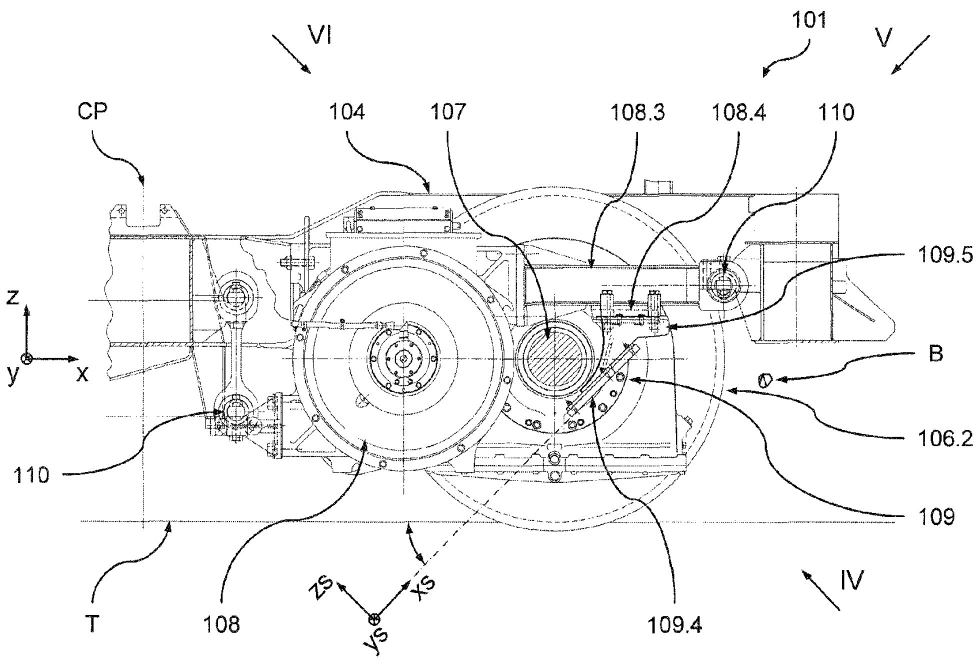

Fig. 3

EP 2 368 781 A1

Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a running gear for a rail vehicle, in particular a high speed rail vehicle, comprising a wheel set, a running gear frame and a shielding device, the running gear frame being supported on the wheel set. The shielding device is connected to the running gear frame via a support structure and is spatially associated to at least a shielded component of the running gear. The shielding device shields a shielded part of said shielded component of the running gear against impacts of objects, in particular pieces of ballast, lifted from a track used during operation of the vehicle.

[0002] Rail vehicles running at high speeds, e.g. at operating speeds beyond 180 km/h or more, often face the problem that, e.g. due to the air flow conditions developing on the underside of the vehicle, typically, in combination with certain adverse events or circumstances, loose objects such as, for example, loose pieces of ballast are lifted from the part of the track currently used (i.e. travelled along) and hit components of the vehicle, in particular, components of the running gear.

[0003] Such objects, depending on their relative speed with respect to the vehicle, may not only damage the vehicle components they hit. They may also be further accelerated and reflected back down onto the track bed where their considerably increased kinetic energy eventually causes one or more other objects, typically pieces of ballast, to be lifted up and hit the vehicle. In summary, this may lead to an avalanche effect also referred to as ballast flight with a greatly increased number of pieces of ballast hitting the vehicle underside components in the rear part of a train. Such ballast flight situations may not only lead to a considerable damage to the vehicle. The track and its surroundings may also be heavily affected.

[0004] In order to avoid such ballast flight situations it has been suggested in US 7,605,690 B2 (the entire disclosure of which is incorporated herein by reference) to acoustically detect the build up of ballast flight at an early stage, provide a corresponding signal (e.g. to the driver or a vehicle control) and to take appropriate countermeasures such as reducing the speed of the vehicle. However, in particular, on explicit high speed lines, reduction of the operating speed of the vehicle typically is highly undesired. Furthermore, these countermeasures may only become effective after a certain number of impacts and the associated damage to the components hit had already occurred.

[0005] As an approach to deal with the vehicle related part of the ballast flight problem it is known to provide protective coatings to the affected vehicle components (e.g. according to EN 13261). However, these coatings, e.g. made of synthetic materials such as polyurethane (PU), are not suited to withstand the high impact loads occurring at very high operating speeds for an appropriate amount of time and, furthermore, require extensive maintenance work (in particular, if directly coated onto the surface of the respective vehicle component). Furthermore, they are not suitable to solve the ballast flight related problems on the track side.

[0006] A further approach to deal at least with parts of the ballast flight problem has been suggested in WO 2006/021514 A1 (the entire disclosure of which is incorporated herein by reference). This document discloses a generic running gear for a rail vehicle wherein so called deflector elements are provided. These deflector elements are intended to form a shield protecting components of the vehicle from being hit by such objects lifted up from the track. The generally plate shaped deflector elements, at least in the sections prone to be hit, are explicitly designed to have a very low inclination with respect to the longitudinal direction of the running gear (i.e. the driving direction of the vehicle) to largely avoid any transfer of kinetic energy from the vehicle to the hitting object, which otherwise would be likely to cause the avalanche effect as outlined above.

[0007] However, this low inclination of the relevant impact parts of the deflector elements with respect to the longitudinal direction of the running gear results in a very large size of these deflector elements. More precisely, for example, in total, virtually the entire underside of the running gear ahead of a wheel set shaft (including the gap between the wagon body and the bogie in the area of the bogie cutout) has to be shielded in order to protect the wheel set shaft. Such large shielding devices, however, considerably add to the complexity of the running gear. Furthermore, integration of such large shields in a modern high speed running gear (typically having very little free building space available) requires considerable constructional effort.

SUMMARY OF THE INVENTION

[0008] It is thus an object of the invention to, at least to some extent, overcome the above disadvantages and to provide a running gear that, with simple design and reduced expense, provides proper impact protection of the components of the running gear while at the same time reducing the risk of ballast flight.

[0009] This and other objects are achieved according to the present invention which is based on the technical teaching that a running gear having simple, cheap and compact design while providing proper impact protection of the vehicle components at reduced risk of ballast flight may be achieved if the shielding device and, in addition or as an alternative, the support structure comprises an impact energy absorbing device absorbing a noticeable fraction of an impact energy of one of the objects hitting the shielding device.

[0010] This impact energy absorption by the shielding device itself and/or its support has the advantage that, on the one hand, a steeper inclination with respect to the longitudinal direction if the running gear (or vehicle, respectively) may be selected for the impact surface of the shielding device, while (thanks to the energy absorption) energy transfer to the parts hitting the shielding device is still acceptably low (reducing the risk of ballast flight). This allows a more space saving configuration properly shielding the relevant components of the running gear while being easier to integrate into a modern running gear.

[0011] Thus, according to one aspect, the present invention relates to a running gear for a rail vehicle, in particular a high speed rail vehicle, comprising a wheel set, a running gear frame and a shielding device, the running gear frame being supported on the wheel set. The shielding device is connected to the running gear frame via a support structure and is spatially associated to at least a shielded component of the running gear. The shielding device shields a shielded part of the shielded component against impacts of objects, in particular pieces of ballast, lifted from a track used during operation of the vehicle. The shielding device and/or the support structure comprises an impact energy absorbing device, the impact energy absorbing device being adapted to absorb a noticeable fraction of an impact energy of one of the objects hitting the shielding device.

[0012] It will be appreciated that the shielding device may be used to shield any desired component of the running gear from such impacts. Preferably, the shielded component is a part of the wheel set, in particular, a wheel set shaft of the wheel set, since, here, the shielding device is particularly beneficial (considering the considerable safety relevance of the structural integrity of the wheel set, in particular, of the wheel set shaft).

[0013] The amount of impact energy absorption provided by the energy absorbing device may be selected as a function of the likelihood of ballast flight buildup identified for the specific vehicle (prior to implementation of the present invention). This likelihood, in turn, among others, is a function of the speed range of the vehicle to be expected under normal operating conditions. Here, a relevant magnitude is the nominal maximum operation speed of the vehicle (i.e. the maximum speed to be achieved over longer periods under normal operating conditions), since the risk of ballast flight buildup has to be kept at an acceptable level for this nominal maximum operation speed as well. Thus, in general, it applies that a higher nominal maximum operation speed requires a higher level of impact energy absorption.

[0014] With preferred embodiments of the invention, the shielding device shields the shielded part against impacts of pieces of ballast lifted from a ballast bed of a track used during operation of the vehicle, wherein the ballast bed comprises pieces of ballast having a maximum nominal diameter and the vehicle has a maximum nominal operating speed. A piece of ballast of the ballast bed having the maximum nominal diameter defines a nominal impact energy when hitting the shielding device at a nominal relative impact speed, the nominal relative impact speed being directed exclusively parallel to a longitudinal direction of the running gear and having an amount equal to the maximum nominal operating speed of the vehicle. In this case, to achieve proper reduction of the risk of ballast flight buildup, the impact energy absorbing device is adapted to absorb at least 5% of the nominal impact energy, in particular at least 15% of the nominal impact energy, preferably at least 25% of the nominal impact energy.

[0015] Impact energy absorption may be achieved at one or more suitable points in the kinematic chain between the impact surface (hit by the lifted objects) of the shielding device and the running gear frame. With preferred embodiments of the running gear according to the invention, the impact energy absorbing device comprises a first impact energy absorbing element arranged at the shielding device and forming at least a part of an impact surface for the objects. In preferably simple cases, the first impact energy absorbing element may be a plate shaped element, which is particularly easy to manufacture and handle. Furthermore, preferably, the first impact energy absorbing element may be releasably mounted to the shielding device leading to low maintenance effort.

[0016] It will be appreciated that one single energy absorbing element may be sufficient. However, maintenance is greatly simplified any rendered more cost efficient if the impact energy absorbing device comprises a plurality of first impact energy absorbing elements arranged at the shielding device, the plurality of first impact energy absorbing elements, preferably, jointly forming substantially the entire impact surface for the objects of the shielding device.

[0017] Impact energy absorption may be achieved in any suitable way, e.g. by providing a specific structural design of the energy absorbing element providing energy absorption or dissipation, respectively, by friction between components or parts of the energy absorbing element. With further embodiments of the invention, the first impact energy absorbing element comprises an impact energy absorbing material. Here, any suitable material providing a sufficient amount of impact energy absorption over sufficiently long periods or a sufficient number of individual impacts, respectively, may be chosen. Appropriate synthetic materials may be chosen as the impact energy absorbing material.

[0018] However, with very ecologically and economically beneficial variants of the invention, a wood material, preferably a laminated wood material is chosen as the impact energy absorbing material. The wood material, apart from its beneficial ecological effects, has the crucial advantage that it provides good and long term energy absorption due to its long term overall structural integrity maintained despite the local impacts. Although severe hits may locally harm the impact energy absorbing element, the fibrous wood structure (under such typically predominantly compressive loads) in a beneficial way prevents rapid overall disintegration of the impact energy absorbing element. This results in an advantageously long operating lifetime of the impact energy absorbing element.

[0019] In any case, it will be appreciated that arbitrary combinations of different energy absorbing materials may of course be used as well.

[0020] As mentioned initially, the energy absorption allows a more favorable arrangement (in particular, a greater inclination with respect to of the longitudinal direction of the running gear) of the impact surface of the shielding the device. It should be noted that, in the sense of the present invention, the impact surface is to be considered the part of the of the shielding device that has a likelihood of being hit by an object vertically lifted from the track (e.g. a ballast bed) of more than 10% to 20% at the nominal maximum operating speed of the vehicle (as outlined above).

[0021] Hence, with preferred embodiments of the invention, the shielding device defines an impact surface for the objects, at least 50% of the impact surface, preferably at least 80% of the impact surface, more preferably at least 90% of the impact surface, being inclined with respect to a longitudinal axis of the running gear by an inclination angle. Here, the inclination angle ranges from 35° to 70°, in particular from 40° to 60°, preferably from 45° to 50°, such that a comparatively space-saving configuration is achieved that is more easily integrated in the typically strictly limited space available in the running gear.

[0022] With other preferred embodiments of the invention, at least a part of the impact energy absorption is provided via the support of the shielding device. Hence, with a certain embodiments of the running gear according to the invention, the shielding device comprises a shielding element, the shielding element being spatially associated to the shielded component and being connected to the running gear frame via a second impact energy absorbing element of the impact energy absorbing device. This has the advantage that, on the one hand, the energy absorption does not necessarily have to occur in the region of the impact surface such that a very simple design of the impact surface may be chosen, if desired. Furthermore, on the other hand, additional energy absorption may be achieved in a region remote from the impact surface increasing the overall impact energy absorption and, eventually, alleviating and energy absorption related problems or restrictions in the region of the impact surface.

[0023] Energy absorption may be achieved in any suitable location and in any suitable way in the region of the support of the shielding device. For example, one of the components (e.g. a support element) of the support structure itself may be designed as corresponding energy absorbing element. Preferably, the shielding element is connected to a support element of the support structure, the second impact energy absorbing element being arranged between the shielding element and the support element and/or between the support element and the running gear frame.

[0024] With advantageous embodiments of the invention, one or more components of the running gear, which are provided anyway for other functional reasons, also integrate the function of the support structure and/or the function of the second energy absorbing element. Hence, with certain preferred embodiments of the running gear according to the invention, the support structure comprises a support arm of a drive motor driving the wheel set, the support arm forming a support element of the support structure supporting the shielding device. With such a design, a highly functionally integrated configuration may be achieved.

[0025] The connection between the shielding device and the support structure may be achieved in any suitable way. More precisely, any type of connection (positive connection, frictional connection, adhesive connection etc) or arbitrary combinations thereof may be chosen. Preferably, a configuration is chosen that provides a connection that is failsafe insofar as it secures the shielding device against displacement (up to complete loss of the shielding device) even if fixing elements (such as, typically, threaded bolts, clamps etc) fail during operation of the vehicle.

[0026] Hence, preferably, the shielding device comprises a shielding element, the shielding element being spatially associated to the shielded component and defining a first connecting section cooperating with a second connecting section defined by the support structure. The first connecting section and the second connecting section define a positive connection, the positive connection being effective in a height direction of the running gear and/or in a longitudinal direction of the running gear, thereby providing security against displacement in the respective direction.

[0027] With certain preferred embodiments of the invention, the first connecting section comprises a pair of first brackets of the shielding element and the second connecting section comprises a pair of second brackets of the support structure. Each of the first brackets defines a longitudinal first bracket axis, while each of the second brackets defines a longitudinal second bracket axis. At least one first bracket axis and/or at least one second bracket axis is inclined with respect to a longitudinal direction of the running gear such that such a securing positive connection is obtained in a very simple manner. Preferably, at least one first bracket axis and/or at least one second bracket axis is inclined with respect to a plane defined by a longitudinal direction and a transverse direction of the running gear. This leads to a very beneficial configuration with a positive connection in, both, the longitudinal direction and the height direction providing a very high degree of safety against displacement.

[0028] The present invention also relates to a rail vehicle, in particular a high speed rail vehicle, comprising a wagon body and at least one running gear according to the invention, the wagon body being supported on the running gear. With such a vehicle that the embodiments and advantages as outlined above in the context of the running gear according to the invention may be realized to the same extent. Hence, it is here merely referred to the explanations given above.

[0029] As mentioned initially, the present invention is particularly effective in the context of high-speed rail vehicles. Hence, preferably, a nominal maximum operating speed is defined for the rail vehicle, the nominal maximum operating speed being greater than 180 km/h, preferably being greater than 200 km/h, more preferably greater than 240 km/h.

[0030] Further embodiments of the invention will become apparent from the dependent claims and the following description of preferred embodiments which refers to the appended figures. All combinations of the features disclosed, whether explicitly recited in the claims or not, are within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

Figure 1 is a schematic side view of a preferred embodiment of the rail vehicle according to the invention comprising a preferred embodiment of the running gear according to the invention;

Figure 2 is a schematic top view of a part of the running gear of Figure 1 (seen in a section along line 11-11 of Figure 1);

Figure 3 is a schematic sectional representation of a part of the running gear of Figure 2 (seen in a section along line 111-111 of Figure 2);

Figure 4 is a schematic bottom view of the shielding device of the running gear of Figure 3 (seen in the direction of arrow IV of Figure 3);

Figure 5 is a schematic side view of the shielding device of the running gear of Figure 3 (seen in the direction of arrow V of Figure 3);

Figure 6 is a schematic top view of the shielding device of the running gear of Figure 3 (seen in the direction of arrow VI of Figure 3);

Figure 7 is a schematic sectional representation of a detail of the running gear of Figure 2 (seen in a section along line VII-VII of Figure 2).

DETAILED DESCRIPTION OF THE INVENTION

[0032] In the following, a preferred embodiment of a high-speed rail vehicle 101 according to the invention will be described with reference to Figures 1 to 7. The vehicle 101 comprises a wagon body 102 supported at both of its ends (via a secondary suspension) on a preferred embodiment of a running gear according to the invention in the form of a bogie 103. The bogie 103 runs on a track T with a ballast bed comprising pieces of ballast B having a defined maximum diameter d_{max}.

[0033] In order to simplify the explanations given below, a x,y,z-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 103 (and the vehicle 101, respectively), the y-axis designates the transverse direction of the running gear 103 (and the vehicle 101, respectively) and the z-axis designates the height direction of the running gear 103 (and the vehicle 101, respectively).

[0034] As can be seen from Figures 2 and 3 (both showing views of the end side half of the running gear 103 located on the right hand side of Figure 1) media comprises a running gear frame 104 supported (in a conventional manner via a secondary suspension) on the two wheel sets 105. Each wheel set 105 comprises two wheels 106.1, 106.2 connected by a wheel set shaft 107. Each wheel set 105 is driven by an associated drive unit 108 (comprising a motor 108.1 and a gear 108.2) suspended via a drive unit suspension to the running gear frame 104.

[0035] The vehicle 101 has a nominal maximum operating speed v_{max} above 240 km/h such that it faces the problem of ballast flight as it has been outlined above. Hence, it is necessary, among others, to protect safety relevant and impact sensitive components of the running gear 103 such as the (otherwise uncovered) part 107.1 of the wheel set shaft 107 against impacts of pieces of ballast B or other objects lifted in the height direction (z-direction) from the track T (comprising a ballast bed). Furthermore, there is not only the need to protect the components of the running gear 103 against impacts. It is also desirable to at least reduce the likelihood of a buildup of such ballast flight situations.

[0036] In the present example, both these needs are addressed by a shielding device 109 closely spatially associated to the wheel set shaft 107 on the end side part of the shaft facing away from the running gear center. The shielding device 109 is closely spatially associated to free part 107.1 of the wheel set shaft 107 located adjacent to the motor 108.1 between the brake disc 105.1 and the wheel 106.1. In order to simplify the explanations given below, a xs,ys,zs-coordinate system has been introduced into the Figures, the relation of which with respect to the x,y,z-coordinate system can be taken from Figure 2.

[0037] The shielding device 109 comprises a shielding element 109.1 connected to the running gear frame 104 via a support structure in the form of a support arm 108.3. The support arm 108.3 is a part of the suspension supporting the drive device 108, and, hence, in a beneficial and space saving manner integrates the function of supporting the drive device 108 and the shielding device 109.

[0038] The generally planar and plate shaped shielding element 109.1, on its side facing away from the shaft 107 and down towards the track T, carries a plurality of first impact energy absorbing elements 109.2, 109.3. The generally planar and plate shaped impact energy absorbing elements 109.2, 109.3 (apart from negligible small gaps formed in between them) together form substantially the entire impact surface 109.4 (defining the xs,ys-plane) of the shielding device 109, i.e. the part of the of the shielding device 109 that has a likelihood of being hit by an object B vertically lifted from the track T (e.g. a ballast bed) of more than 10% to 20% during normal operation at the nominal maximum operating speed V_{max} of the vehicle (as outlined above).

[0039] Each first energy absorbing element 109.2, 109.3 is made of a, preferably laminated, wood material providing excellent and long term impact energy absorption due to its long term overall structural integrity maintained despite heavy local impacts. This long term overall structural integrity is caused by the fibrous wood structure as it had been outlined above.

[0040] Each first energy absorbing element 109.2, 109.3 is releasably connected to the shielding element 109.1 via a plurality of screw connections. Hence, rapid exchange of the respective first impact energy absorbing element 109.2, 109.3 is guaranteed.

[0041] Further impact energy absorption is provided by a second impact energy absorbing element in the form of rubber bearings 110 via which the support arm 108.3 and other parts of the drive unit 108, respectively, are elastically connected to the running gear frame 104.

[0042] Hence, in the embodiment shown, in total, considerable and well noticeable impact energy absorption is achieved. More precisely, a total amount of impact energy absorption is achieved, wherein at least 15% of a nominal impact energy E_n of a piece of ballast B is absorbed. The nominal impact energy E_n is defined by a piece of ballast B having a maximum nominal diameter d_{max} (of the pieces of ballast in the ballast bed of the track T) and hitting the impact surface 109.4 at a nominal relative impact speed V_i. The nominal relative impact speed V_i is directed exclusively parallel to the longitudinal direction of the running gear 103 and has an amount equal to the maximum nominal operating speed V_{max}.

[0043] As can be seen from Figure 2, the shielding element 109.1 is arranged such that the impact surface 109.4 is inclined with respect to the longitudinal axis (x-axis) of the running gear 103 by an angle $\alpha = 45°$, which has several advantages. However, with other embodiments of the invention having non-planar shielding elements and/or non-planar energy absorbing elements (i.e. an arbitrarily curved and/or polygonal impact surface) at least 50% (up to at least 90%) of the impact surface are inclined with respect to the longitudinal axis by such a rather steep inclination angle.

[0044] Furthermore, it will be appreciated that, with other embodiments of the invention, other rather steep inclination angles α may be chosen. Typically, the inclination angle α ranges from 35° to 70° and preferably is about $\alpha = 45° \pm 5°$. This rather steeply inclined arrangement of the impact surface 109.4 has several advantages.

[0045] First, depending on the impact angle (at which the object B hits the impact surface 109.4) this inclination angle α produces a deflection of the hitting object B in a direction roughly vertically (i.e. roughly parallel to the height direction, i.e. the z-direction), downwards onto the track T. The subsequent (roughly) vertical impact on the track T has the advantage that the likelihood of lifting further objects B from the track T is reduced compared to a track bed impact at an oblique angle.

[0046] The impact energy absorption provided by the first energy absorbing elements 109.2, 109.3 and the second impact energy absorbing element 110 is also effectively reducing the likelihood of lifting further objects B from the track T since it reduces the kinetic energy of the object B, such that an overall reduction of the risk of ballast flight buildup is achieved,

[0047] Furthermore, the (rather steep) inclination angle α leads to a comparatively space-saving configuration of the shielding device 109 with a comparatively small dimension of the shielding device 109 in the xs-direction such that the shielding device 109 may be easily integrated in the typically strictly limited space available in the running gear 103.

[0048] The connection between the shielding device 109 and the support arm 108.3 is achieved via a pair of first brackets 109.5 of the shielding element 109.1 forming a first connecting section and a pair of second brackets 108.4 of the support arm 108.3 forming a second connecting section. As can be seen, among others, from Figure 7 the first brackets 109.5 and the second brackets 108.4 pair-wise cooperate such that a positive connection is formed, which is effective in the height direction (z-direction) of the running gear 103. Further connecting elements, such as threaded bolts 111 (reaching through bores in the first brackets 109.5 and second brackets 108.4) are used to secure the shielding element 109.1 to the support arm 108.3.

[0049] Each of the first brackets 109.5 defines a longitudinal first bracket axis 109.6, while each of the second brackets 108.4 defines a longitudinal second bracket axis 108.5 (see Figure 2). The bracket axes 109.6, 108.5 are inclined with respect to the longitudinal direction (x-direction) of the running gear 103 such that such substantially V-shaped arrangement of the first and second connecting section is achieved.

[0050] This V-shaped configuration, on the one hand, has the advantage that the pair of first brackets 109.5 of the shielding element 109.1 may be simply hooked into the pair of second brackets 108.4 (from the side facing away from the shaft 107).

[0051] On the other hand, the V-shaped configuration may also provide security against displacement of the shielding element 109.1 in the longitudinal direction (x-direction) in case of a failure of the connecting elements 111. To this end, a slight inclination (by a few degrees, e.g. 5° to 10°) of the plane defined by the bracket axes 109.6, 108.5 with respect to the xy-plane may be chosen such that, in case of failure of the connecting elements

111, the shielding element 109.1 (e.g. under the influence of the vibrations present under normal operation) may slide towards the shaft 107 until a positive connection is formed between the first brackets 109.5 and the second brackets 108.4 in the longitudinal direction (x-direction).

[0052] However, it will be appreciated that this inclination, on the one hand, does not necessarily have to be present since the longitudinal forces generated by impacts may lead to the same result. Furthermore, with other embodiments of the invention, a stronger inclination may be chosen (for example 30° to 45°), e.g. together with a positive connection between the first and second brackets in the longitudinal direction (x-direction) formed already under normal operating conditions.

[0053] Hence, in any case, a failsafe connection is achieved insofar as it secures the shielding device 109 against displacement (up to complete loss of the shielding device 109) even if the connecting elements 111 fail during operation of the vehicle.

[0054] It will be appreciated that, in the present embodiment, a corresponding shielding device 109 is associated to the other wheel set 105 of the running gear 103 in a manner (point or mirror) symmetric with respect to the longitudinal center plane CP of the running gear 103, such that the vehicle 101 is suitable for bi-directional operation with same protection to its components.

[0055] In the foregoing, the invention has been described in the context of protecting the wheel set shaft 107. However, it will be appreciated that the shielding device may be used to shield any other desired component of the running gear 103 from such impacts. For example other security relevant and/or impact sensitive components, such as e.g. an antenna or other components of a train control system may be the shielded component.

Claims

1. A running gear for a rail vehicle, in particular a high speed rail vehicle, comprising

   - a wheel set (105),
   - a running gear frame (104) and
   - a shielding device (109);
   - said running gear frame (104) being supported on said wheel set (105);
   - said shielding device (109) being connected to said running gear frame (104) via a support structure (108) and being spatially associated to at least a shielded component (107) of said running gear (103);
   - said shielding device (109) shielding a shielded part (107.1) of said shielded component (107) against impacts of objects (B), in particular pieces of ballast, lifted from a track (T) used during operation of said vehicle;

   characterized in that

   - said shielding device (109) and/or said support structure (108) comprises an impact energy absorbing device (109.2, 109.3, 110);
   - said impact energy absorbing device (109.2, 109.3, 110) being adapted to absorb a noticeable fraction of an impact energy of one of said objects (B) hitting said shielding device (109).

2. The running gear according to claim 1, wherein said shielded component (107) is a part of said wheel set (105), in particular, a wheel set shaft (107) of said wheel set (105).

3. The running gear according to claim 1 or 2, wherein

   - said shielding device (109) shields said shielded part (107.1) against impacts of pieces of ballast (B) lifted from a ballast bed of a track (T) used during operation of said vehicle;
   - said ballast bed comprising pieces of ballast (B) having a maximum nominal diameter;
   - said vehicle having a maximum nominal operating speed;
   - a piece of ballast (B) of said ballast bed having said maximum nominal diameter defining a nominal impact energy when hitting said shielding device (109) at a nominal relative impact speed, said nominal relative impact speed being directed exclusively parallel to a longitudinal direction of said running gear (103) and having an amount equal to said maximum nominal operating speed of said vehicle;
   - said impact energy absorbing device (109.2, 109.3, 110) being adapted to absorb at least 5% of said nominal impact energy, in particular at least 15% of said nominal impact energy, preferably at least 25% of said nominal impact energy.

4. The running gear according to any one of the preceding claims, wherein

   - said impact energy absorbing device (109.2, 109.3, 110) comprises a first impact energy absorbing element (109.2, 109.3) arranged at said shielding device (109) and forming at least a part of an impact surface (109.4) for said objects (B);
   - said first impact energy absorbing element (109.2, 109.3), in particular, being a plate shaped element;

   and/or

   - said first impact energy absorbing element (109.2, 109.3), in particular, being releasably mounted to said shielding device (109).

5. The running gear according to claim 4, wherein

   - said impact energy absorbing device (109.2,

109.3, 110) comprises a plurality of first impact energy absorbing elements (109.2, 109.3) arranged at said shielding device (109);
- said plurality of first impact energy absorbing elements (109.2, 109.3), in particular, jointly forming substantially the entire impact surface (109.4) for said objects (B) of said shielding device (109).

6. The running gear according to claim 4 or 5, wherein

- said first impact energy absorbing element (109.2, 109.3) comprises an impact energy absorbing material;
- said impact energy absorbing material, in particular, being a wood material, preferably a laminated wood material.

7. The running gear according to any one of the preceding claims, wherein

- said shielding device defines an impact surface (109.4) for said objects (B);
- at least 50% of said impact surface (109.4), preferably at least 80% of said impact surface (109.4), more preferably at least 90% of said impact surface (109.4), being inclined with respect to a longitudinal axis of said running gear (103) by an inclination angle;
- said inclination angle ranging from 35° to 70°, in particular from 40° to 60°, preferably from 45° to 50°.

8. The running gear according to any one of the preceding claims, wherein

- said shielding device (109) comprises a shielding element (109.1);
- said shielding element (109.1) being spatially associated to said shielded component (107);
- said shielding element (109.1) being connected to said running gear frame (104) via a second impact energy absorbing element (110) of said impact energy absorbing device (109.2, 109.3, 110).

9. The running gear according to claim 8, wherein

- said shielding element (109.1) is connected to a support element (108.3) of said support structure (108);
- said second impact energy absorbing element (110) being arranged between said shielding element (109) and said support element (108.3) and/or between said support element (108.3) and said running gear frame (104).

10. The running gear according to any one of the preceding claims, wherein

- said support structure (108) comprises a support arm (108.3) of a drive motor (108.1) driving said wheel set (105);
- said support arm (108.3) forming a support element of said support structure (108) supporting said shielding device (109).

11. The running gear according to any one of the preceding claims, wherein

- said shielding device (109) comprises a shielding element (109.1);
- said shielding element (109.1) being spatially associated to said shielded component (107);
- said shielding element (109.1) defining a first connecting section cooperating with a second connecting section defined by said support structure (108);
- said first connecting section and said second connecting section defining a positive connection, said positive connection being effective in a height direction of said running gear (103) and/or in a longitudinal direction of said running gear (103).

12. The running gear according to claim 11, wherein

- said first connecting section comprises a pair of first brackets (109.5) of said shielding element (109.1) and
- said second connecting section comprises a pair of second brackets (108.4) of said support structure (108);
- each of said first brackets (109.5) defining a longitudinal first bracket axis (109.6);
- each of said second brackets (108.4) defining a longitudinal second bracket axis (108.5);
- at least one first bracket axis (109.6) and/or at least one second bracket axis (108.5) being inclined with respect to a longitudinal direction of said running gear (103); and,
- in particular, at least one first bracket axis (109.8) and/or at least one second bracket axis (108.5) being inclined with respect to a plane defined by a longitudinal direction and a transverse direction of said running gear (103).

13. A rail vehicle, in particular a high speed rail vehicle, comprising

- a wagon body (102) and
- at least one running gear (103) according to any one of the preceding claims;
- said wagon body (102) being supported on said running gear (103).

14. The rail vehicle according to claim 13, wherein

- a nominal maximum operating speed is defined for said rail vehicle;
- said nominal maximum operating speed being greater than 180 km/h, preferably being greater than 200 km/h, more preferably greater than 240 km/h.

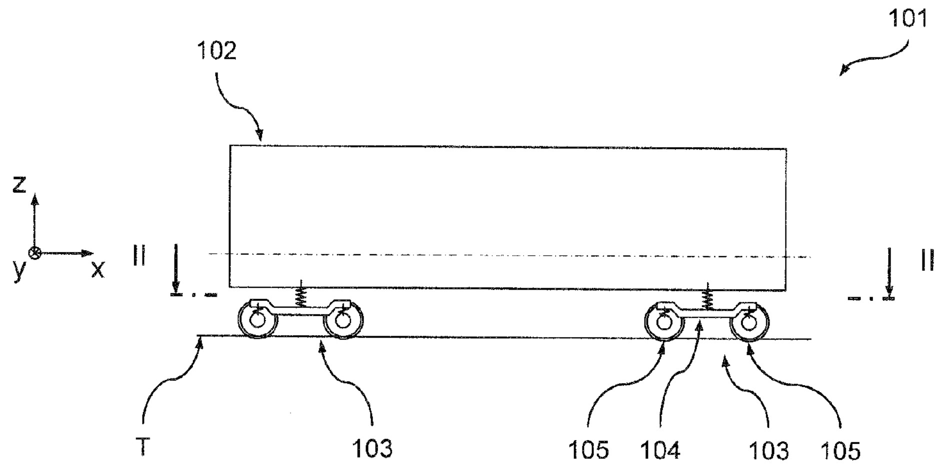
101
102
z
y
x
II
II
T
103
105
104
103
105

Fig. 1

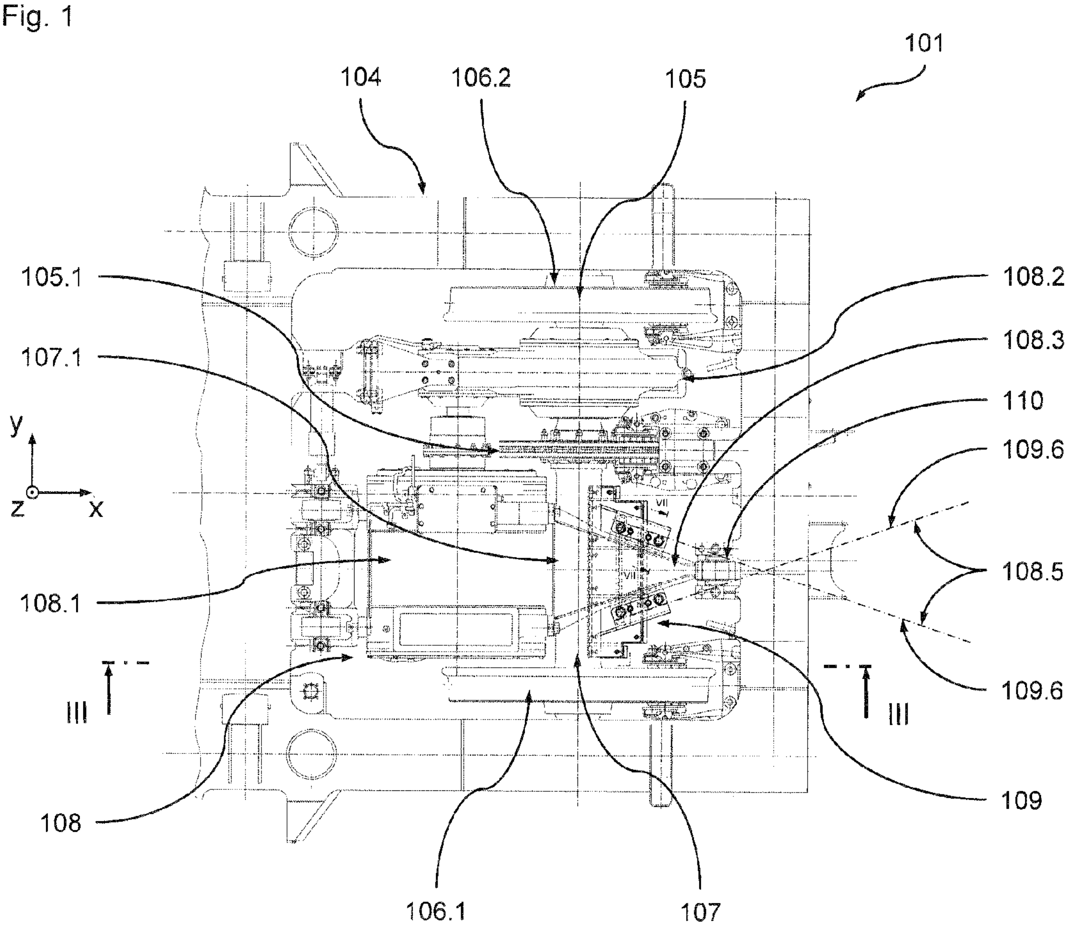
101
104
106.2
105
105.1
107.1
108.2
108.3
110
109.6
y
z
x
108.5
108.1
109.6
III
III
108
109
106.1
107

Fig. 2

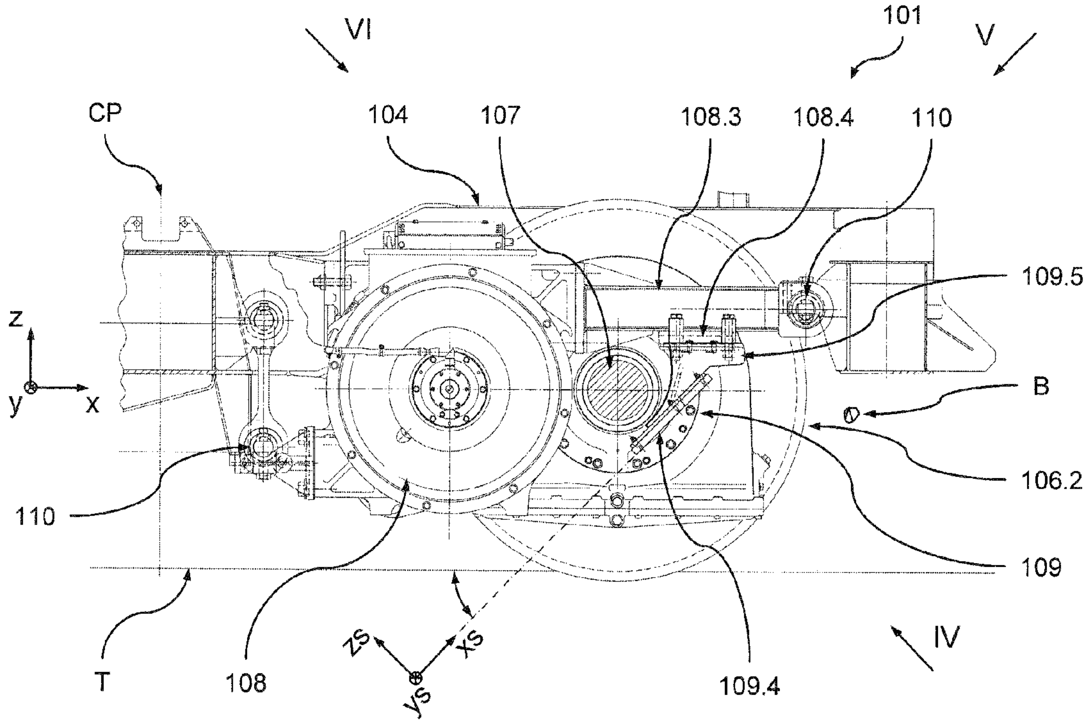
VI
101
V
CP
104
107
108.3
108.4
110
109.5
z
y
x
B
106.2
110
109
T
108
zs
xs
ys
IV
109.4

Fig. 3

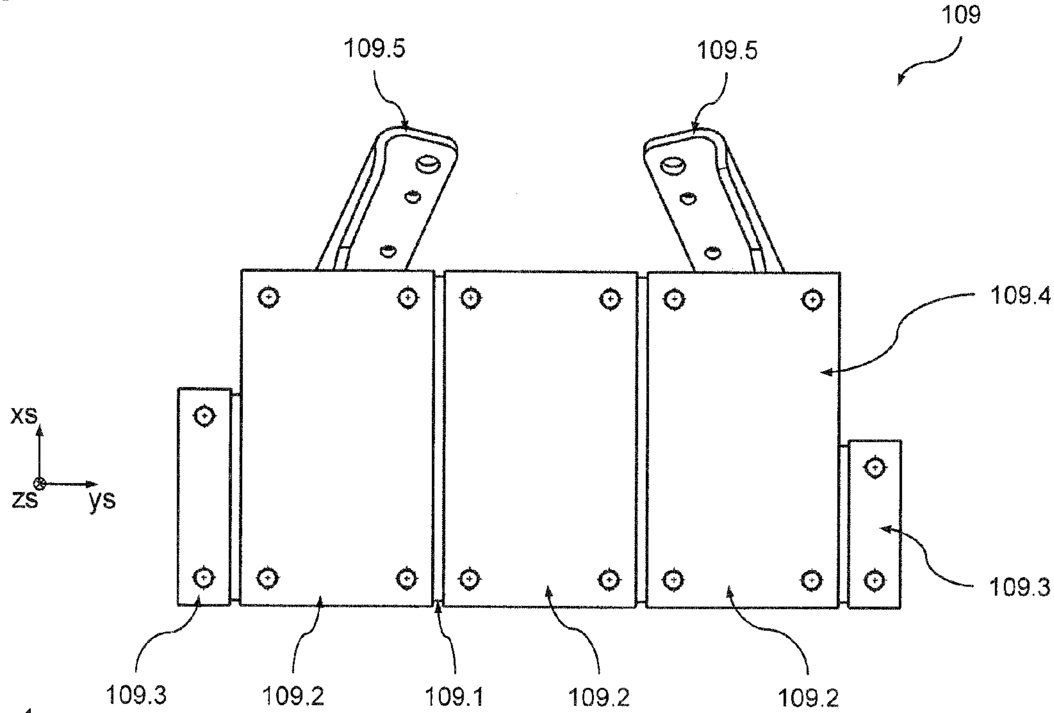
109
109.5
109.5
109.4
xs
zs
ys
109.3
109.3
109.2
109.1
109.2
109.2

Fig. 4

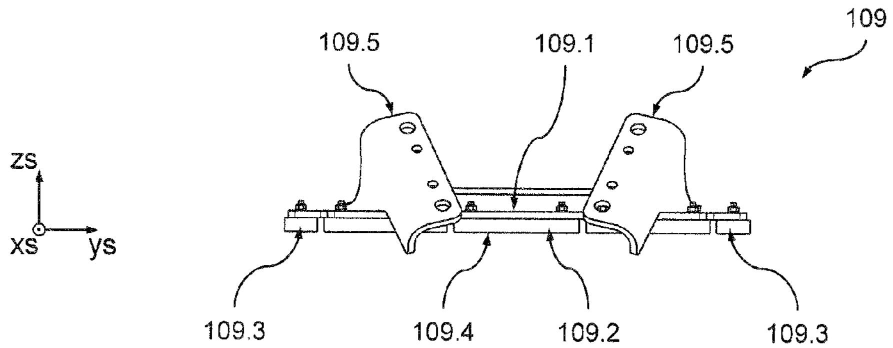

Fig. 5

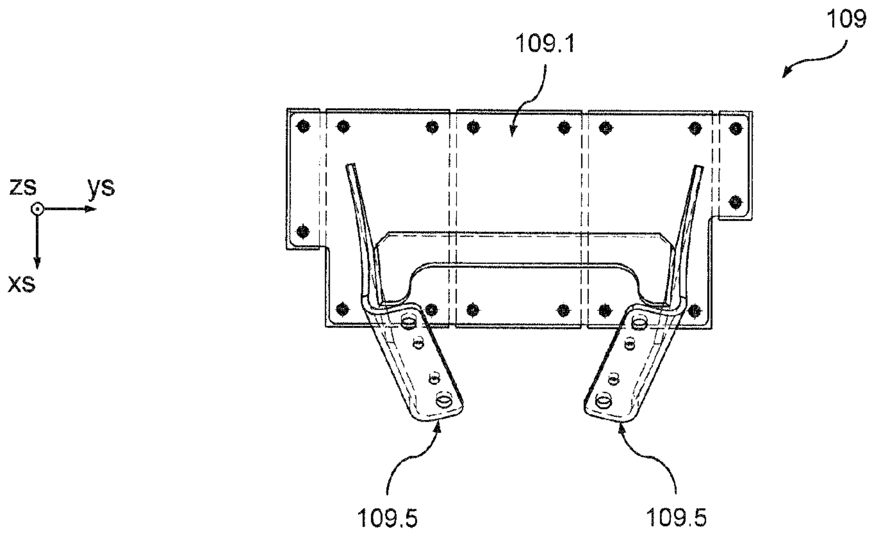

Fig. 6

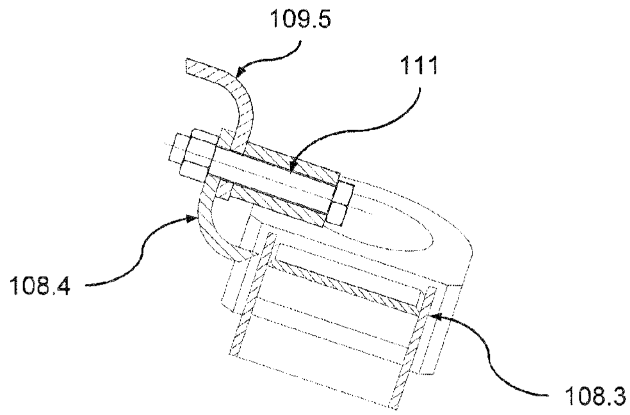

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 15 7308

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D	WO 2006/021514 A1 (SIEMENS AG [DE]; SCHROEDER-BODENSTEIN KASPAR [DE]) 2 March 2006 (2006-03-02) * page 5, paragraph 1 - page 7, paragraph 3; figures 2-6 * -----	1-5,8,9, 11-14	INV. B61F19/06
Y	DE 10 2006 004814 A1 (BOMBARDIER TRANSP GMBH [DE]) 14 June 2007 (2007-06-14) * paragraphs [0001], [0009], [0014] * * paragraph [0022] - paragraph [0026] * * paragraph [0039] * * paragraph [0051] - paragraph [0058] * * paragraph [0066] - paragraph [0067]; figures 1-4,8 * -----	1-5,8,9, 11-14	
A	EP 1 106 467 A1 (ANF IND [FR]) 13 June 2001 (2001-06-13) * paragraph [0013] - paragraph [0016]; figures 1,2 * -----	1,13	

TECHNICAL FIELDS SEARCHED (IPC)

B61F
B61D
B61K
B60R
E01H

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	19 August 2010	Chlosta, Peter

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 15 7308

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-08-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006021514 A1	02-03-2006	AT 462631 T	15-04-2010
		CN 101005978 A	25-07-2007
		DE 102004041090 A1	02-03-2006
		EP 1781523 A1	09-05-2007
		ES 2342088 T3	01-07-2010
		RU 2351494 C2	10-04-2009
DE 102006004814 A1	14-06-2007	AT 428614 T	15-05-2009
		EP 1957337 A1	20-08-2008
		WO 2007065682 A1	14-06-2007
		ES 2323388 T3	14-07-2009
EP 1106467 A1	13-06-2001	FR 2801554 A1	01-06-2001

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 7605690 B2 **[0004]**
- WO 2006021514 A1 **[0006]**