

CHASSIS AND COMMERCIAL VEHICLE

The present invention relates to a chassis for a commercial vehicle, in particular for a military commercial vehicle, and a commercial vehicle, in particular a military commercial vehicle, with such a chassis.

Off-road commercial vehicles, for example trucks, can have a rigid but torsionally soft chassis and a torsionally stiff interchangeable superstructure, such as a container, mounted on the chassis. During off-road driving, the chassis can warp, and the torsionally stiff superstructure either interferes with the warping, which can introduce high stresses into the chassis frame, or the superstructure itself is overstressed.

DE 27 26 448 A1 shows a bearing arrangement of a rigid superstructure on a chassis frame of a commercial vehicle. The superstructure is supported at two points at its front and rear end by elastically flexible bearings in the area of the central longitudinal axis of the vehicle and is connected to the longitudinal members of the chassis frame or a subframe mounted on it by two further bearings located opposite each other in a transverse plane of the vehicle and arranged between the first bearing points.

DE 29 11 722 A1 describes a device for the elastic support of a torsionally stiff superstructure on a torsionally soft chassis frame of motor vehicles. The device comprises two pairs of resilient bearing points arranged transversely and symmetrically to the longitudinal axis of the vehicle and a bearing point located at one end of the superstructure in the longitudinal central axis and resilient on all sides, one pair of bearing points being supported from the front end of the superstructure with suspension that is hard in the compression direction and soft in the tension direction and with large compensation paths, the other pair of bearing points is located in the area of the rear axle and the individual bearing point

is located at the rear end of the frame, whereby the longitudinal and transverse forces can only be transmitted by the front and rear bearing points and the vertical forces by all bearing points.

5 EP 0 214 990 B1 describes a multi-axle motor vehicle with a torsionally flexible frame and a superstructure which is supported on this frame by means of support members and is not subject to much torsion, whereby in the direction of the longitudinal extension of the vehicle in the central area of the superstructure a connection is provided between the vehicle and the frame which flexibly absorbs
10 vertical forces and longitudinal forces and allows limited relative movements between the frame and the superstructure. At least one support member is arranged in at least one further region offset in the direction of the longitudinal extent of the vehicle, a lateral shear support connection absorbing transverse forces being provided in at least one region of the superstructure between the latter and
15 the frame.

DE 101 06 495 A1 shows a truck with a rigid but torsionally soft chassis frame on which a twistable subframe is mounted, which carries a flexurally and torsionally stiff superstructure that is connected to the subframe at at least three points via
20 movement bearings. At least one of these movement bearings is designed as a swivel bearing, the swivel axis of which runs approximately in the longitudinal center axis of the vehicle. At least two of the motion bearings are designed as supports which are arranged laterally on both sides of the swivel axis and are spaced from the swivel bearing in the vehicle steering direction.

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Against this background, one task of the present invention is to provide an improved chassis for a commercial vehicle.

Accordingly, a chassis for a commercial vehicle, especially for a military commercial vehicle, is provided. The chassis comprises a chassis frame extending along a
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longitudinal direction of the chassis, a cross beam fixedly connected to the chassis frame for supporting an interchangeable superstructure to be placed on the chassis, a pendulum cross beam pivotally mounted on the chassis frame for supporting the superstructure, a first swing element, which is rotatably mounted on the chassis frame about a first axis of rotation and which is rotatably mounted on the pendulum cross beam about a second axis of rotation, and a second swing arm element which is rotatably mounted on the chassis frame about a first axis of rotation and which is rotatably mounted on the pendulum cross beam about a second axis of rotation.

Because the pendulum cross beam is not directly pivoted on the chassis frame but is connected to the chassis frame via the first swing arm element and the second swing arm element, an instantaneous center around which the pendulum cross beam rotates can be positioned below the chassis frame. This allows the chassis frame to twist without subjecting the superstructure placed on the cross beam and the pendulum cross beam to excessive mechanical stress. It also prevents excessive stresses from being introduced into the chassis frame due to the torsional rigidity of the superstructure.

The chassis can be part of the commercial vehicle. However, the chassis is also suitable for a trailer, especially for a trailer of the commercial vehicle. This means that the chassis can be part of a trailer, in particular a commercial vehicle trailer or truck trailer. The commercial vehicle and the trailer can form a set, especially a commercial vehicle set or a truck set, whereby both the commercial vehicle and the trailer can have such a chassis. However, the commercial vehicle can also be combined with a trailer without such a chassis to form a set.

In addition to the longitudinal direction in which the chassis frame extends, the chassis is assigned a transverse direction, in which the cross beam and the pendulum cross beam extend, and a height direction. The longitudinal direction, the

transverse direction and the height direction are positioned perpendicular to each other and preferably form a coordinate system of the chassis. The chassis preferably comprises several axles, especially drive axles on which wheels are mounted. The height direction is oriented in particular from the axles in the direction of the chassis frame, especially in the direction of the pendulum cross beam.

The chassis frame preferably comprises at least two longitudinal beams extending along the longitudinal direction, which can be firmly connected to each other by means of a plurality of crossbars or trusses running in the transverse direction. The chassis frame is preferably torsionally soft and rigid. The longitudinal beams can optionally each have several longitudinal sectional beams, for example hollow box sectional beams, U-sectional beams, or I-sectional beams. The components of the chassis frame are firmly connected to each other and can be bolted, riveted, or welded together, for example.

The fact that the cross beam is "firmly" connected to the chassis frame means in particular that the cross beam is immovable in relation to the chassis frame and in particular that it cannot be twisted or displaced in relation to the chassis frame. For example, the cross beam is bolted, riveted, or welded to the chassis frame. In the transverse direction, the cross beam preferably projects laterally on both sides of the chassis frame.

The fact that the pendulum cross beam is "pivotably" mounted on the chassis frame may mean in particular that the pendulum cross beam can perform a pivoting movement in relation to the chassis frame. The swivel movement can be, for example, a combination of a rotary movement and a linear movement, especially along the height and transverse directions. The swivel movement can also be a pure rotary or rotational movement.

Preferably, the pendulum cross beam is not mounted directly on the chassis frame, but indirectly by means of the swing arm elements. The swing arm elements are thus arranged between the chassis frame and the pendulum cross beam and thus connect the pendulum cross beam pivotably with the chassis frame. The pendulum cross beam protrudes in the transverse direction preferably on both sides laterally beyond the chassis frame. The pendulum cross beam can preferably be steplessly deflected or swiveled from a neutral or starting position into a large number of deflection positions.

The interchangeable superstructure may be, for example, a flatbed, a container, a box, a tank or the like, or may include one of these. The superstructure can be cuboid, for example. The superstructure is mounted on the cross beam and the pendulum cross beam. The cross beam and the pendulum cross beam preferably form a superstructure interface or a superstructure carrying apparatus of the chassis.

The fact that the superstructure is "interchangeable" means in particular that different types of superstructures can be interchanged. However, this does not exclude the possibility that the superstructure is firmly connected to the chassis, for example bolted to it. However, the connection between the superstructure and the chassis can be disconnected in order to be able to exchange the superstructure.

The first swing arm element and the second swing arm element are preferably of identical design. The swing arm elements can have a bone-shaped geometry with a rod-shaped base section, to which ring-shaped receiving sections are connected at the ends on both sides. Each receiving section preferably includes an opening. The opening is preferably a hole in the middle of the respective receiving section. Axle elements can be accommodated in the openings, which allow the swing arm elements to be swiveled about the respective first axis of rotation and the second axis of rotation. The axle elements can be provided on the chassis frame and on the pendulum cross beam.

Preferably, the chassis frame, the first swing arm element, the second swing arm element and the pendulum cross beam form a linkage gear of the chassis. Such a linkage gear comprises a frame, a coupler and swing arms connecting the coupler to the frame. In this case, the chassis frame is the frame of the linkage gear, the pendulum cross beam is the coupler of the linkage gear, and the swing elements are the swing arms of the linkage gear. In particular, the first axis of rotation of the first swing arm element does not coincide with the first axis of rotation of the second swing arm element. These are two different first axes of rotation. Accordingly, the second axis of rotation of the first swing arm element preferably does not coincide with the second axis of rotation of the second swing arm element. These are two different second rotation axes.

According to an embodiment, the first two axes of rotation of the swing elements, viewed in a transverse direction of the chassis, are arranged at a greater distance from one another than the second two axes of rotation of the swing arm elements, so that the first swing arm element and the second swing arm element are positioned obliquely to each other.

In the transverse direction, the two second rotation axes are thus preferably arranged between the two first rotation axes.

According to another embodiment, the first swing arm element and the second swing arm element are positioned obliquely with respect to one another such that the first swing arm element and the second swing arm element run towards one another.

In particular, the first swing arm element and the second swing arm element run towards each other, viewed against the height direction, so that the first swing arm element and the second swing arm element are arranged in a V-shape.

Conversely, the first swing arm element and the second swing arm element run away from each other when viewed along the height direction.

According to another embodiment, an extension of the first swing arm element
5 and an extension of the second swing arm element intersect one another in an instantaneous center, which is positioned below the pendulum cross beam, as viewed in a height direction of the chassis.

As mentioned before, the height direction is oriented from the axles of the chassis
10 towards the chassis frame. The instantaneous center is positioned below the chassis frame in the height direction. An "extension" in this case means a straight line running through the first and the second axis of rotation of the first swing arm element and through the first and the second axis of rotation of the second swing arm element, respectively. The term "extension" can therefore be
15 replaced by the term "straight line". These straight lines meet or intersect at the instantaneous center. In the case of a plane movement of a rigid body, e.g., the pendulum cross beam, an "instantaneous center" or "motion pole" is that point in space from which the body can be regarded and treated as only rotating. When the pendulum cross beam is deflected, it preferentially moves in a plane spanned
20 by the height and the transverse direction. Depending on whether the pendulum cross beam is deflected or not, the pendulum cross beam or the instantaneous center can be swung or shifted from the previously mentioned starting position to any number of deflection positions. The instantaneous center moves along the height and the transverse direction. Along the longitudinal direction the instantaneous center does not move in particular. However, the instantaneous center is
25 always located below the pendulum cross beam, especially below the chassis frame, when viewed in the height direction. When the pendulum cross beam is deflected or swiveled from the starting position to the deflection position or to different deflection positions, the instantaneous center preferably moves on a trajectory curve. In particular, the trajectory curve lies in a plane spanned by the
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height direction and the transverse direction. The trajectory curve can be circular, elliptical or oval. This means that the trajectory curve can be part of a circle, an ellipse or an oval.

- 5 According to another embodiment, the two second axes of rotation of the swing arm elements are positioned between the two first axes of rotation of the swing arm elements and the instantaneous center as viewed in the height direction.

10 Seen in the transverse direction, the instantaneous center lies, especially in the starting position, centrally between the two second axes of rotation and between the two first axes of rotation. Here the two second axes of rotation are located between the two first axes of rotation. In the deflection position or in the deflection positions, the instantaneous center is preferably off-center as viewed in the transverse direction.

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According to another embodiment, the two first axes of rotation of the swing arm elements are positioned at the same height as viewed in the height direction, the two second axes of rotation of the swing arm elements being positioned at the same height as viewed in the height direction in a starting position of the pendulum cross beam.

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In particular, the first two axes of rotation are fixed and do not change their position in the height and transverse directions when the pendulum cross beam is deflected. Since the second axes of rotation are provided on the pendulum cross beam, they change their position in the height direction as well as in the transverse direction when the pendulum cross beam is deflected from its starting position to any deflection position.

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According to another embodiment, in each case two first swing arm elements and two second swing arm elements are provided, the pendulum cross beam being

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arranged, as viewed in the longitudinal direction, in each case between the two first swing arm elements and between the two second swing arm elements.

This means that there can be four swing arm elements, with the pendulum cross beam positioned between the first two swing arm elements and between the second two swing arm elements. This prevents the pendulum cross beam from tilting around the transverse direction. This reduces the danger of tilting of the pendulum cross beam and/or the swing arm elements. However, this is optional. Exactly one first swing arm element and exactly one second swing arm element can also be provided. This means that exactly two or at least two swing arm elements are preferred. In the case that only one first swing arm element and only one second swing arm element are provided, the pendulum cross beam is preferably arranged between the swing arm elements and the chassis frame when viewed in the longitudinal direction. This means that in this case the swing arm elements are preferably provided on the outside of the pendulum cross beam. Alternatively, if only a first swing arm element and only a second swing arm element are provided, the swing arm elements can also be provided on the inside of the pendulum cross beam. In this case, the swing arm elements are arranged between the pendulum cross beam and the chassis frame as seen in the longitudinal direction.

According to another embodiment, the first swing arm element is mounted rotatably about its first axis of rotation on a first axle element attached to the chassis frame, the second swinging arm element being mounted rotatably about its first axis of rotation on a second axle element attached to the chassis frame.

Preferably, the chassis frame comprises a connecting beam arranged between the two longitudinal beams, which firmly connects the two longitudinal beams. The first axle element and the second axle element can be attached to the connecting beam. For example, the first axle element and the second axle element are

welded, riveted, or bolted to the connecting beam. The axle elements are accommodated in the respective openings of the receiving sections of the swing arm elements. For this purpose, corresponding bearings, e.g., slide bearings or roller bearings, can be provided in the receiving sections. Alternatively, the axle elements can also be non-rotatably connected to the swing arm elements, whereby the axle elements are then rotatably mounted on the chassis frame, in particular on the connecting beam. Also, in this case, corresponding bearings, such as plain bearings or roller bearings, can be provided. Axle elements can also be provided on the pendulum cross beam, which allow the swing arm elements to swivel about their second axes of rotation. Thus, the pendulum cross beam can also include a first axle element and a second axle element. These axle elements can be accommodated in the receiving sections of the swing arm elements, in which the axle elements of the chassis frame are not received.

According to another embodiment, the first axle element and the second axle element, as viewed in the longitudinal direction, are guided past or through the pendulum cross beam.

This allows a particularly compact design when viewed in the height direction.

According to another embodiment, the pendulum cross beam comprises a first side section, a second side section and a base section arranged between the first side section and the second side section, wherein the first side section and the second side section extend out over an upper side of the base section, wherein the first axle element and the second axle element are passed between the first side section and the second side section past the pendulum cross beam.

In particular, the pendulum cross beam has a V-shaped geometry through which the axle elements pass. When viewed in the height direction, the side sections protrude in particular beyond the axle elements. The base section is preferably

box-shaped or cuboid. The pendulum cross beam is preferably hollow. The pendulum cross beam can be a hollow box section or be constructed from hollow box sections. The pendulum cross beam can also be composed of several I-shaped or U-shaped sectional girders.

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According to another embodiment, the pendulum cross beam comprises a first opening through which the first axle element is passed and a second opening through which the second axle element is passed.

10 The openings can be oval or rectangular with rounded corners, for example. The openings extend along the transverse direction and the height direction, where the dimension of the openings is larger along the transverse direction than along the height direction. By providing the openings, it is not necessary to guide the axle elements past the pendulum cross beam, as they can be passed through it.

15 This means that the pendulum cross beam can have a continuous top flange or a continuous flat top surface. In this case, the bottom of the pendulum cross beam can be provided with a recess or clearance for a trailer coupling.

According to another embodiment, the cross beam is arranged at the front of the
20 chassis frame, the pendulum cross beam being arranged at the rear of the chassis frame.

"Front" here means assigned to a driver's cab of the commercial vehicle. "Rear" here means turned away from the driver's cab.

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According to another embodiment, the chassis further comprises a spring and/or damping apparatus which is arranged between the chassis frame and the pendulum cross beam.

The spring and/or damping apparatus can be a pure spring apparatus or a pure damping apparatus, but also a combined spring and damping apparatus. The spring and/or damping apparatus may comprise a spring element, for example a cylindrical spring or a pneumatic spring element, and a damping cylinder. Preferably, the spring and/or damping apparatus is located between one of the longitudinal beams of the chassis frame and the pendulum cross beam and connects them to each other. Several spring and/or damping apparatuses may be provided. For example, two spring and/or damping apparatuses may be provided, which are provided on both sides of the chassis frame.

Furthermore, a commercial vehicle, in particular a military commercial vehicle, comprising such a chassis is provided.

The commercial vehicle is preferably a land vehicle, especially a truck. The commercial vehicle is preferably a military commercial vehicle. The commercial vehicle can therefore also be called a military commercial vehicle. In particular, the commercial vehicle is an off-road truck. The commercial vehicle can be a protected vehicle. A plurality of axles is preferably provided on the chassis frame. This means that the commercial vehicle is a multi-axle vehicle, especially a three-axle vehicle. The commercial vehicle preferably includes an all-wheel drive. The commercial vehicle can therefore also be called an all-wheel-drive commercial vehicle. The commercial vehicle can be a wheel vehicle. Alternatively, the commercial vehicle can also be a tracked vehicle.

As mentioned above, the chassis can also be part of a trailer. In this case, a trailer, especially a trailer for a military commercial vehicle, comprising such a chassis is proposed.

According to an embodiment, the commercial vehicle further comprises an interchangeable superstructure, which is placed on the cross beam and on the pendulum cross beam.

5 As mentioned before, the superstructure is preferably torsionally stiff. The superstructure is preferably cuboid. The superstructure can be for example a flatbed, a container, a box, a tank or similar. Different superstructures can be provided, which can be exchanged. The superstructure can be firmly connected to the chassis, for example bolted to it. However, the connection between the superstructure
10 and the chassis is detachable in order to exchange the superstructure.

The designs and characteristics described for the chassis apply to the proposed commercial vehicle and to the proposed trailer accordingly and vice versa.

15 In the present case, "one" is not necessarily to understand as limiting to exactly one element, rather several elements, like two, three or more, can be intended. Also, every other counter used here is not to understand as limiting to exactly the mentioned number of elements. Rather, numerical deviations upwards and downwards are possible, unless otherwise stated.

20 Other possible implementations of the chassis and/or the commercial vehicle also include combinations of features or designs not explicitly mentioned before or in the following regarding the embodiments. The expert will also add individual aspects as improvements or additions to the respective basic shape of the chassis
25 and/or the commercial vehicle.

Further advantageous designs and aspects of the chassis and/or the commercial vehicle are the subject of the sub-claims as well as the embodiments of the chassis and/or the commercial vehicle described below. Furthermore, the chassis

and/or the commercial vehicle are explained in more detail on the basis of preferred designs with reference to the enclosed figures.

- Fig. 1 shows a schematic side view of an embodiment of a commercial vehicle;
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- Fig. 2 shows a schematic top view of an embodiment of a chassis for the commercial vehicle according to Fig. 1;
- 10 Fig. 3 shows a schematic rear view of the commercial vehicle according to Fig. 1;
- Fig. 4 shows a schematic view of an embodiment of a swing arm element for the chassis according to Fig. 2;
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- Fig. 5 shows a schematic sectional view of the swing arm element according to the intersection line V-V of Fig. 4;
- Fig. 6 shows the detail view VI according to Fig. 3;
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- Fig. 7 shows an enlarged schematic top view of the chassis according to Fig. 2;
- Fig. 8 shows a schematic perspective partial view of the chassis according to Fig. 2;
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- Fig. 9 shows a schematic rear view of another embodiment of a commercial vehicle;

Fig. 10 shows a schematic perspective view of the commercial vehicle according to Fig. 9;

Fig. 11 shows a schematic perspective view of an embodiment of a chassis for the commercial vehicle according to Fig. 9;

Fig. 12 shows a schematic view of an embodiment of a pendulum cross beam for the chassis according to Fig. 11; and

Fig. 13 shows a schematic perspective partial view of another embodiment of a chassis for the commercial vehicle according to Fig. 9.

In the figures, identical or functionally identical elements have been provided with the same reference signs, unless otherwise indicated. Hidden components are shown in the figures with dashed lines.

Fig. 1 shows a schematic side view of an embodiment of a commercial vehicle 1. The commercial vehicle 1 is a land vehicle. The commercial vehicle 1 is especially a military commercial vehicle. The commercial vehicle 1 can therefore also be described as a military commercial vehicle. The commercial vehicle 1 can be a truck as shown in Fig. 1. In particular, the commercial vehicle 1 is an off-road truck. The commercial vehicle 1 can be a protected vehicle.

A coordinate system with an x-direction or longitudinal direction L, a y-direction or height direction H and a z-direction or transverse direction Q is assigned to the commercial vehicle 1 or to a chassis 2 of the commercial vehicle 1. The directions H, L, Q are oriented perpendicular to each other. The height direction H is oriented parallel to a gravity direction g. The gravity direction g is oriented from top to bottom in the orientation of Fig. 1.

The commercial vehicle 1 comprises chassis 2 with a chassis frame 3 extending in the longitudinal direction L. The chassis frame 3 is flexurally rigid and torsionally soft and extends from a driver's cab 4 to the rear of the commercial vehicle 1. "Torsionally soft" means in particular that the chassis frame 3 can twist around the longitudinal direction L.

A plurality of axles 5 to 7 is provided on the chassis frame 3. This means that the commercial vehicle 1 is a three-axle vehicle. The number of axles 5 to 7 is however arbitrary. The commercial vehicle 1 includes preferably a four-wheel drive. This means that all axles 5 to 7 are driven. The commercial vehicle 1 can therefore also be called an all-wheel-drive commercial vehicle. The commercial vehicle 1 can be a wheeled vehicle as shown in Fig. 1. Alternatively, the commercial vehicle 1 can also be a tracked vehicle. The height direction H is oriented from the axles 5 to 7 towards the chassis frame 3.

The chassis 2 is suitable for supporting an interchangeable and torsionally rigid superstructure 8 of the commercial vehicle 1 in addition to the driver's cab 4. The superstructure 8 can be, for example, a flatbed, a container, a suitcase, a tank, or the like. In Fig. 1 a superstructure 8 is shown in the form of a flatbed. The driver's cab 4 is preferably protected against bullets, booby traps, improvised explosive devices (IED), mines or similar.

However, the chassis 2 is also suitable for a trailer (not shown), especially for a trailer of the commercial vehicle 1. This means that the chassis 2 can be part of a trailer, especially a commercial vehicle trailer or truck trailer. The commercial vehicle 1 and the trailer can form a set, especially a commercial vehicle set or a truck set, whereby both the commercial vehicle 1 and the trailer can have such a chassis 2. However, the commercial vehicle 1 can also be combined with a trailer without such a chassis 2 to form a set.

Fig. 2 shows a highly simplified schematic view of an embodiment of a chassis 2 for the commercial vehicle 1. The chassis 2 comprises two longitudinal beams 9, 10 running in the longitudinal direction L. The longitudinal beams 9, 10 can each be made up of several profiles or profile girders, in particular steel profiles. The longitudinal beams 9, 10 are spaced apart in the transverse direction Q and run parallel to each other. The longitudinal beams 9, 10 can be connected to each other with a plurality of cross beams or beams not shown, running in the transverse direction Q and thus forming the rigid and torsionally soft chassis frame 3. The cross beams may be welded, riveted, bolted, or otherwise firmly connected to the longitudinal beams 9, 10.

To support the superstructure 8, the chassis 2 comprises a cross beam 11 arranged at the front, which runs in the transverse direction Q and thus perpendicular to the longitudinal beams 9, 10. The cross beam 11 can be constructed in several parts. The cross beam 11 is firmly connected to the longitudinal beams 9, 10, e.g., bolted, riveted, or welded to them. In addition, the chassis 2 includes a pendulum cross beam 12 arranged at the rear, which is pivotably mounted on chassis frame 3. The cross beam 11 and the pendulum cross beam 12 form a superstructure support apparatus 13 for supporting the superstructure 8. The superstructure support apparatus 13 is a superstructure interface or can be designated as such. The cross beam 11 can, for example, be a sectional beam running in the transverse direction Q in the form of a hollow box girder, a U-girder, an I-girder, or the like. The same applies to the pendulum cross beam 12.

The longitudinal beams 9, 10 are preferably made of a steel material. However, the longitudinal beams 9, 10 can also be made of titanium, magnesium, or aluminum. Furthermore, the longitudinal beams 9, 10 can also be made of a glass fiber reinforced plastic (GRP) or a carbon fiber reinforced plastic (CFP). Likewise, the cross beam 11 and the pendulum cross beam 12 can each be made of a steel,

titanium, magnesium or aluminum material, a glass fiber reinforced plastic or a carbon fiber reinforced plastic.

The cross beam 11 and the pendulum cross beam 12 each have support sections
 5 14, 15 at the ends on which the superstructure 8 rests and to which the super-
 structure 8 can be attached. The support sections 14, 15 can be equipped with
 standardized connecting pieces to accommodate containers, for example. Other
 designs of end sections of the cross beam 11 and the pendulum cross beam 12 are
 also possible. The connection between the cross beam 11 or the pendulum cross
 10 beam 12 and the support sections 14, 15 can be made, for example, by a welded
 connection, although screwing or riveting is also possible.

Fig. 3 shows a rear view of the commercial vehicle 1, where the superstructure 8
 is shown as a container. Preferably, the pendulum cross beam 12 is a hollow box
 15 beam or hollow box profile. For example, the pendulum cross beam 12 can be a
 welded component made of a plurality of plates, profiles, or the like. The pendu-
 lum cross beam 12 has a box-shaped design and comprises a cuboid base section
 16 with a lower side 17 and an upper side 18 spaced from the lower side 17 in the
 height direction H. The base section 16 is arranged between two obliquely posi-
 20 tioned side sections 19, 20. The side sections 19, 20 extend beyond the upper side
 18 in the height direction H. The side sections 19, 20 are followed by the support
 sections 14, 15, on which the superstructure 8 rests. As mentioned above, the su-
 perstructure 8 can be firmly connected to the support sections 14, 15. However,
 the superstructure 8 can be detached, e.g., by means of a screw connection, and
 25 connected to the support sections 14, 15, so that the superstructure 8 can be re-
 placed.

The chassis 2 also includes a first swing arm element 21A and a second swing
 arm element 22A, with the help of which the pendulum cross beam 12 is pivot-
 30 ably mounted on the chassis frame 3. The swing arm elements 21A, 22A are

preferably of identical design. The swing arm elements 21A, 22A are each pivotally mounted on the chassis frame 3 and on the pendulum cross beam 12.

As Figs. 4 and 5 show, the first swing arm element 21A comprises a rod-shaped base section 23, which can have a rectangular or round cross-section, for example. At the end of the base section 23, a first receiving section 24 and a second receiving section 25 are provided. The base section 23 is thus arranged between the receiving sections 24, 25. The base section 23 can have a smaller cross-sectional area than the receiving sections 24, 25, resulting in a bone-shaped geometry of the first swing arm element 21A. However, the first swing arm element 21A can also have a rectangular geometry in the top view according to Fig. 4.

Each receiving section 24, 25 has an opening 26, 27 in the middle, in which, for example, a shaft or axle can be received. The openings 26, 27 are preferably designed as circular bores and are rotationally symmetrical to a respective center or symmetry axis 28, 29. Bearing elements, such as plain bearings or roller bearings, can be provided in or at the openings 26, 27.

As mentioned before, the second swing arm element 22A is identical to the first swing arm element 21A, so that a detailed description of the second swing arm element 22A is not necessary. The swing arm elements 21A, 22A can, for example, be made of a steel alloy, a titanium alloy, an aluminum alloy, a magnesium alloy, a glass fiber reinforced plastic material, a carbon fiber reinforced plastic material or a combination of these materials.

Fig. 6 shows the detail view VI according to Fig. 3. Fig. 6 shows only a part of the chassis 2. Fig. 7 shows a schematic top view of the chassis 2. Also, in Fig. 7 only a part of the chassis 2 is shown. Fig. 8 shows a schematic perspective partial view of the chassis 2. In the following, Fig. 6 to 8 are referred to simultaneously.

Two first swing arm elements 21A, 21B and two second swing arm elements 22A, 22B are provided. The pendulum cross beam 12 is arranged between the two first swing arm elements 21A, 21B and between the two second swing arm elements 22A, 22B, viewed in the longitudinal direction L. However, only one first swing arm element 21A and only one second swing arm element 22A can be provided. The swing arm elements 21A, 21B, 22A, 22B are identically constructed.

The first swing arm elements 21A, 21B are each mounted on the chassis frame 3 so that they can rotate about a first axis of rotation 30. For this purpose, an axle element 31 can be provided on the chassis frame 3, which is rotatably mounted in the respective opening 26 of the first receiving section 24 of the first swing arm elements 21A, 21B. The axle element 31 can be firmly connected to the chassis frame 3. For this purpose, a box-shaped connecting beam 32 can be provided, which is arranged between the longitudinal beams 9, 10 and firmly connected to them, for example welded, riveted, or bolted to them. Alternatively, the axle element 31 can also be rotatably mounted on the chassis frame 3. In this case, the axle element 31 is non-rotatably connected to the first swing arm elements 21A, 21B.

Furthermore, the first swing arm elements 21A, 21B are mounted on the pendulum cross beam 12 so that they can rotate about a second axis of rotation 33. For this purpose, a bolt-shaped axle element 34 can be provided on the pendulum cross beam 12, which is rotatably mounted in the respective opening 27 of the second receiving sections 25 of the first swing arm elements 21A, 21B. Alternatively, the axle element 34 can also be rotatably mounted on the pendulum cross beam 12. In this case, the axle element 34 is non-rotatably connected to the first swing arm elements 21A, 21B.

The second swing arm elements 22A, 22B are mounted on the chassis frame 3 and can be rotated about a first axis of rotation 35. For this purpose, the chassis

frame 3 can have an axle element 36 which, like the axle element 31, is firmly connected to the connecting beam 32. The axle element 36 is rotatably mounted in the respective opening 26 of the first receiving sections 24 of the second swing arm elements 22A, 22B. Alternatively, the axle element 36 can also be rotatably mounted on the chassis frame 3. In this case, the axle element 36 is non-rotatably connected to the second swing arm elements 22A, 22B.

Like the first swing arm elements 21A, 21B, the second swing arm elements 22A, 22B are also mounted on the pendulum cross beam 12 so that they can rotate about a second axis of rotation 37. For this purpose, the pendulum cross beam 12 has an axle element 38 which is rotatably mounted in the respective opening 27 of the second receiving sections 25 of the second swing arm elements 22A, 22B. Alternatively, the axle element 38 can also be rotatably mounted on the pendulum cross beam 12. In this case, the axle element 38 is non-rotatably connected to the second swing arm elements 22A, 22B.

The axle element 31 can be described as the first axle element of the chassis frame 3. The axle element 36 can be described as the second axle element of the chassis frame 3. The axle element 34 can be described as the first axle element of the pendulum cross beam 12. The axle element 38 can be described as the second axle element of the pendulum cross beam 12.

As Figs. 6 and 7 also show, the first two axes of rotation 30, 35 of the swing arm elements 21A, 21B, 22A, 22B are arranged further apart from each other in the transverse direction Q than the second two axes of rotation 33, 37 of the swing arm elements 21A, 21B, 22A, 22B. Thus, the first swing arm elements 21A, 21B and the second swing arm elements 22A, 22B are positioned obliquely to each other in such a way that the swing arm elements 21A, 21B, 22A, 22B run towards each other when viewed against the height direction H and vice versa run

away from each other when viewed along the height direction H. The swing arm elements 21A, 21B, 22A, 22B are thus arranged in a V-shape.

An extension 39 of the first swing arm elements 21A, 21B running through the
 5 two axes of rotation 30, 33 of the first swing arm elements 21A, 21B and an extension 40 of the second swing arm elements 22A, 22B running through the two axes of rotation 35, 37 of the second swing arm elements 22A, 22B meet or intersect each other in an instant center of rotation or instantaneous center 41, whereby both the swing arm elements 21A, 22A as well as the swing arm ele-
 10 ments 21B, 22B can each be assigned such an instantaneous center 41. These two instantaneous centers 41 of the swing arm elements 21A, 21B, 22A, 22B can lie on a common axis (not shown), which extends along the longitudinal direction L.

In the present case, an "extension" means a straight line running through the
 15 axes of rotation 30, 33 and 35, 37, respectively. By an "instantaneous center" is to be understood that point in space around which a rigid body, for example the pendulum cross beam 12, can be regarded and treated as only rotating. The instantaneous center 41 is displaceable when the pendulum cross beam 12 is swung. In particular, the instantaneous center 41 is displaced when the pendu-
 20 lum cross beam 12 is swiveled along the height direction H and along the transverse direction Q. However, the instantaneous center 41 does not shift along the longitudinal direction L.

Fig. 6 shows the pendulum cross beam 12 once in a neutral or starting position
 25 P1 and once in a strongly schematized deflection position P2. Fig. 6 shows only the swing arm elements 21A, 22A. The number of deflection positions P2 is arbitrary. In the deflection position P2, the reference signs of the deflected components or elements are marked with an upper line. In the deflection position P2, the pendulum cross beam 12', the swing arm elements 21A', 22A', the second axes

of rotation 33', 37', the extensions 39', 40' and the instantaneous center 41' are deflected. "Deflected" means displaced in relation to the starting position P1.

When the pendulum cross beam 12 is swiveled from the starting position P1 to the deflection position P2 or to different deflection positions P2, the instantaneous center 41, 41' moves on a trajectory curve 42. The trajectory curve 42 lies in a plane defined by the height direction H and the transverse direction Q. The trajectory curve 42 can be circular, elliptical, or oval. This means that the trajectory curve 42 can be part of a circle, an ellipse, or an oval.

The chassis frame 3, the pendulum cross beam 12, the first swing arm elements 21A, 21B and the second swing arm elements 22A, 22B form a linkage gear 43 of the chassis 2. Such a linkage gear 43 comprises a frame, one or more swing arms and a coupler. In this case, the chassis frame 3 is the frame of the linkage gear 43, the pendulum cross beam 12, which is not directly connected to the chassis frame 3, is the coupler and the swing arm elements 21A, 21B, 22A, 22B are the swing arms of the linkage gear 43.

As Fig. 6 further shows, the instantaneous center 41, 41' is always positioned below the pendulum cross beam 12 or below the chassis frame 3 in every position P1, P2 viewed in the height direction H. As mentioned before, the height direction H is oriented from the axles 5 to 7 in the direction of the chassis frame 3, in particular in the direction of the pendulum cross beam 12.

The fact that the instantaneous center 41, 41' is always located below the pendulum cross beam 12 when viewed in the height direction H means that the chassis frame 3 can be subject to considerable distortion, for example during off-road driving, without excessive forces being applied to the superstructure 8 or excessive deformation and stresses occurring in the chassis frame 3 due to the

torsionally rigid superstructure 8. The introduction of high torsional forces into the superstructure 8 is also prevented.

As shown in Fig. 6, the two second axes of rotation 33, 33', 37, 37' of the swing
 5 arm elements 21A, 21B, 22A, 22B are positioned between the two first axes of rotation 30, 35 and the instantaneous center 41, 41' when viewed in the height direction H. The first two axes of rotation 30, 35 are positioned at the same height as viewed in the height direction H. Furthermore, the second axes of rotation 33, 37 are also positioned at the same height in the starting position P1, as viewed in
 10 the height direction H. In the deflection position P2, however, the two second axes of rotation 33', 37' are positioned at different heights when viewed in the height direction H.

The pendulum cross beam 12 in turn is arranged between the swing arm ele-
 15 ments 21A, 21B, 22A, 22B, viewed in the longitudinal direction L. The swing arm elements 21B, 22B, viewed in the longitudinal direction, are arranged between the pendulum cross beam 12 and the chassis frame 3, in particular the connecting beam 32 of the chassis frame 3. The two axle elements 31, 36 are guided past the pendulum cross beam 12. In particular, the two axle elements 31, 36 are
 20 passed between the two side sections 19, 20. The first two axes of rotation 30, 35 can be arranged below the support sections 14, 15, viewed in the height direction H.

Fig. 9 shows a schematic rear view of another embodiment of a commercial vehi-
 25 cle 1. The commercial vehicle 1 as shown in Fig. 9 differs from commercial vehicle 1 as shown in Fig. 1 only in that an alternatively designed pendulum cross beam 12 is provided. Fig. 10 shows a schematic perspective view of the commercial vehicle 1 according to Fig. 9. Fig. 11 shows a schematic perspective view of an embodiment of a chassis 2 for the commercial vehicle 1 according to Fig. 9. In the
 30 following, reference is made to Figs. 9 to 11 simultaneously.

The longitudinal beams 9, 10 can each be connected to several, for example two, profile beams 44, 45 of the chassis 2 extending in the longitudinal direction L.

The pendulum cross beam 12 comprises a first opening 46 through which the axle element 31 passes and a second opening 47 through which the axle element 36 passes. The openings 46, 47 can be oval or rectangular with rounded corners, for example. The openings 46, 47 completely break through the pendulum cross beam 12 along the longitudinal direction L.

In this embodiment of the pendulum cross beam 12, the cross beam has a flat upper side 18 or a continuous upper belt and again comprises a base section 16 and two side sections 19, 20 arranged on both sides of the base section 16. In this case, however, the side sections 19, 20 do not extend beyond the upper side 18. On the underside, i.e., facing away from the upper side 18, the pendulum cross beam 12 comprises a recess or clearance 48, through which a trailer coupling, for example, can be passed. The aforementioned trailer can be coupled to the trailer coupling. The longitudinal beams 9, 10 can be firmly connected to each other by means of a plurality of cross bars or cross beams 49, of which only one is provided with a reference sign in Fig. 11. The cross beams 49 run in the transverse direction Q.

As shown in Fig. 12, the pendulum cross beam 12 of the commercial vehicle 1 can also be deflected from a starting position P1 to any number of deflection positions P2 as shown in Fig. 9.

Fig. 13 shows a schematic perspective partial view of another embodiment of a chassis 2 for the commercial vehicle 1 according to Fig. 9. The chassis 2 according to Fig. 13 differs from the chassis 2 according to Fig. 11 only in that a spring and/or damping apparatus 50 is provided, which is arranged between the chassis frame 3 and the pendulum cross beam 12. The spring and/or damping apparatus

50 can, for example, have a cylindrical spring and/or a damping cylinder. For example, the spring and/or damping apparatus 50 is attached to the rear of the pendulum cross beam 12 and connects it to the longitudinal beam 10. For this purpose, a fastening element 51, for example in the form of a steel angle or a bolt, 5 may be provided on the pendulum cross beam 12. The spring and/or damping apparatus 50 can also be used on the commercial vehicle 1 as shown in Fig. 1.

Several spring and/or damping apparatuses 50 may be provided. For example, one spring and/or damping apparatus 50 is provided on each side of the chassis 10 frame 3. However, the number of spring and/or damping apparatuses 50 is not limited.

Although the present invention was described by means of embodiments, it can be modified in many ways.

LIST OF REFERENCE SIGNS

	1	Commercial vehicle
	2	Chassis
5	3	Chassis frame
	4	Driver's cab
	5	Axle
	6	Axle
	7	Axle
10	8	Superstructure
	9	Longitudinal beam
	10	Longitudinal beam
	11	Cross beam
	12	Pendulum cross beam
15	12'	Pendulum cross beam
	13	Superstructure support apparatus
	14	Support section
	15	Support section
	16	Base section
20	17	Lower side
	18	Upper side
	19	Side section
	20	Side section
	21A	Swing arm element
25	21A'	Swing arm element
	21B	Swing arm element
	22A	Swing arm element
	22A'	Swing arm element
	22B	Swing arm element
30	23	Base section

	24	Receiving section
	25	Receiving section
	26	Opening
	27	Opening
5	28	Symmetry axis
	29	Symmetry axis
	30	Axis of rotation
	31	Axle element
	32	Connecting beam
10	33	Axis of rotation
	33'	Axis of rotation
	34	Axle element
	35	Axis of rotation
	36	Axle element
15	37	Axis of rotation
	37'	Axis of rotation
	38	Axle element
	39	Extension
	39'	Extension
20	40	Extension
	40'	Extension
	41	Instantaneous center
	41'	Instantaneous center
	42	Trajectory curve
25	43	Linkage gear
	44	Profile beam
	45	Profile beam
	46	Opening
	47	Opening
30	48	Clearance

	49	Cross beam
	50	Spring and/or damping apparatus
	51	Fastening element
5	g	Gravity direction
	H	Height direction
	L	Longitudinal direction
	P1	Starting position
	P2	Deflection position
10	Q	Transverse direction

AMENDED CLAIMS

1. Chassis (2) for a commercial vehicle (1), in particular for a military commercial vehicle, comprising

5 a chassis frame (3) extending along a longitudinal direction (L) of the chassis (2),

a cross beam (11) configured to be firmly connected to the chassis frame (3) for supporting an interchangeable superstructure (8) which can be placed on the chassis (2),

10 a pendulum cross beam (12, 12') configured to be pivotably mounted on the chassis frame (3) for supporting the superstructure (8),

a first swing arm element (21A, 21A', 21B) which is configured to be rotatably mounted on the chassis frame (3) about a first axis of rotation (30) and which is configured to be rotatably mounted on the pendulum cross beam (12, 12') about
15 a second axis of rotation (33, 33'), and

a second swing arm element (22A, 22A', 22B) which is configured to be rotatably mounted on the chassis frame (3) about a first axis of rotation (35) and which is configured to be rotatably mounted on the pendulum cross beam (12, 12') about a second axis of rotation (37, 37'),

20 wherein the chassis is configured for an extension (39, 39') of the first swing arm element (21A, 21A', 21B) and an extension (40, 40') of the second swing arm element (22A, 22A', 22B) to intersect one another at an instantaneous center (41, 41') which is configured to be positioned below the pendulum cross beam (12, 12'), as viewed in a height direction (H) of the chassis (2), and

25 wherein the chassis is configured for the two second axes of rotation (33, 33', 37, 37') of the swing arm elements (21A, 21A', 21B, 22A, 22A', 22B) to be positioned between the two first axes of rotation (30, 35) of the swing arm elements (21A, 21A', 21B, 22A, 22A', 22B) and the instantaneous center (41, 41') as viewed in the height direction (H).

2. Chassis according to claim 1,

characterized in that

the chassis is configured for the two first axes of rotation (30, 35) of the swing arm elements (21A, 21A', 21B, 22A, 22A', 22B), viewed in a transverse direction (Q) of the chassis (2), to be arranged at a greater distance from one another than the two second axes of rotation (33, 33', 37, 37') of the swing arm elements (21A, 21A', 21B, 22A, 22A', 22B) so that the first swing arm element (21A, 21A', 21B) and the second swing arm element (22A, 22A', 22B) are positioned obliquely to each other.

10

3. Chassis according to claim 2,

characterized in that

the chassis is configured for the first swing arm element (21A, 21A', 21B) and the second swing arm element (22A, 22A', 22B) to be positioned obliquely with respect to one another such that the first swing arm element (21A, 21A', 21B) and the second swing arm element (22A, 22A', 22B) run towards one another.

15

4. Chassis according to one of claims 1 - 3,

characterized in that

the chassis is configured for the two first axes of rotation (30, 35) of the swing arm elements (21A, 21A', 21B, 22A, 22A', 22B) to be positioned at the same height as viewed in the height direction (H), and for the two second axes of rotation (33, 37) of the swing arm elements (21A, 21A', 21B, 22A, 22A', 22B) to be positioned at the same height as viewed in the height direction (H) in a starting position (P1) of the pendulum cross beam (12, 12').

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5. Chassis according to one of claims 1 - 4,

characterized in that

the chassis is configured, in each case two first swing arm elements (21A, 21A', 21B) and two second swing arm elements (22A, 22A', 22B) are provided, for the

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pendulum cross beam (12, 12') to be arranged, as viewed in the longitudinal direction (L), in each case between the two first swing arm elements (21A, 21A', 21B) and between the two second swing arm elements (22A, 22A', 22B).

5 6. Chassis according to one of claims 1 - 5,
characterized in that
the chassis is configured for the first swing arm element (21A, 21A', 21B) to be
mounted rotatably about its first axis of rotation (30) on a first axle element (31)
attached to the chassis frame (3), and for the second swing arm element (22A,
10 22A', 22B) to be mounted rotatably about its first axis of rotation (35) on a second
axle element (36) attached to the chassis frame (3).

7. Chassis according to claim 6,
characterized in that
15 the chassis is configured for the first axle element (31) and the second axle ele-
ment (36), as viewed in the longitudinal direction (L), to be guided past or
through the pendulum cross beam (12, 12').

8. Chassis according to claim 7,
20 characterized in that
the chassis is configured for the pendulum cross beam (12, 12') to comprise a first
side section (19), a second side section (20) and a base section (16) to be arranged
between the first side section (19) and the second side section (20), for the first
side section (19) and the second side section (20) to extend out over an upper side
25 (18) of the base section (16), and for the first axle element (31) and the second
axle element (36) to be passed between the first side section (19) and the second
side section (20) past the pendulum cross beam (12, 12').

9. Chassis according to claim 7,
30 characterized in that

the chassis is configured for the pendulum cross beam (12, 12') to comprise a first opening (46) for the first axle element (31) to pass therethrough and a second opening (47) for the second axle element (36) to pass therethrough.

- 5 10. Chassis according to one of claims 1 - 9,
characterized in that
configured for the cross beam (11) to be arranged at the front on the chassis
frame (3), and for the pendulum cross beam (12, 12') to be arranged at the rear of
the chassis frame (3).
- 10 11. Chassis according to one of claims 1 - 10,
further comprising
a spring and/or damping apparatus (50) configured for arrangement between the
chassis frame (3) and the pendulum cross beam (12, 12').
- 15 12. Commercial vehicle (1), in particular military commercial vehicle, compris-
ing a chassis (2) according to one of claims 1 - 11.
- 20 13. Commercial vehicle according to claim 12,
further comprising
an interchangeable superstructure (8), configured to be placed on the cross beam
(11) and on the pendulum cross beam (12, 12').