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(54) **Rail vehicle, in particular a low-floor rail vehicle**

(57) The invention relates to a rail vehicle, in particular a low floor rail vehicle, comprising a carbody (2) having a plurality of seats (3) and a bogie (4) arranged be-

neath the carbody (2), said bogie being driven by a motor (5), wherein the motor (5) is arranged in a region between two seats (3).

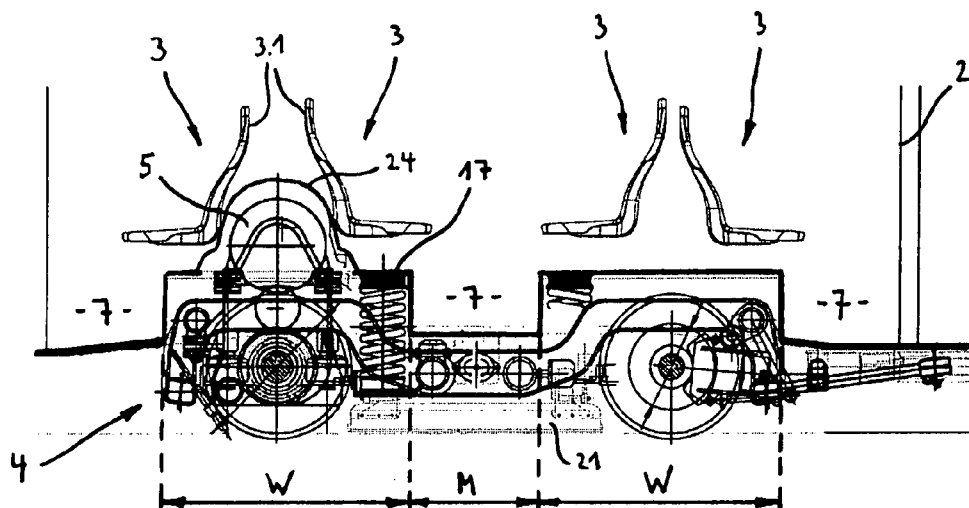


Fig. 2

Description

[0001] The invention relates to a rail vehicle, in particular a low-floor rail vehicle, comprising a carbody having a plurality of seats and a bogie arranged beneath the carbody, said bogie being driven by a motor.

[0002] Rail vehicles of this type are used in particular in the field of local public transport, for example as trams in conurbations, and consist of a plurality of carbodies arranged behind one another for carrying passengers. A number of seats for passengers are arranged inside the carbodies. Usually some of the carbodies are supported by bogies that are distributed over the length of the vehicle which are arranged beneath the carbodies on the rails. For driving the vehicle some of the bogies are motor-driven.

[0003] The bogies connect a plurality of wheel sets in a common framework, which is arranged beneath the respective carbody and rotatably about a perpendicular axis so as to rotate relative to the approximately elongate carbody when travelling through horizontal bends. The number of wheel sets connected in a single bogie is typically two, but bogies with three or more axles are also known for specific applications, for example if high demands are placed on their loading capacity. The motors for driving the bogies are usually located inside the bogie frame.

[0004] Particularly in the field of low-floor rail vehicles, which have a low boarding level in order to enable passengers to access the vehicle with ease, the height of the bogie has proven to be critical since it is difficult to place passenger seats in those regions of the carbodies beneath which the bogie is arranged. In conventional low-floor rail vehicles the floor of the vehicle is arranged at a height of 350 mm above the rails for passenger access. Owing to constructional constraints, such as the diameter of the wheels, it is not possible to construct the bogie in such a way that it is planar and arranged completely beneath the floor of the vehicle.

[0005] In the case of low-floor rail vehicles in particular, it is therefore necessary for the floor surface of the vehicle to be offset upwardly in those regions of the carbodies beneath which the bogies are arranged in order to provide sufficient space for the bogie. This means that edges, which passengers find bothersome, are produced in these regions. Furthermore, passenger seating can often not be placed in these regions or can only be placed here with considerable limitations regarding seating comfort and the number of seats, the total number of seats provided in the rail vehicle thus being reduced.

[0006] The object of the present invention is to provide a rail vehicle in which it is possible to arrange seats in those regions of the carbodies beneath which the bogies are arranged, without compromising the comfort of passengers when seated.

[0007] This object is achieved with a rail vehicle of the aforementioned type by arranging the motor in the region between two seats.

[0008] Owing to fact that the motor for driving the bogie is arranged high up in the region between two seats, the other regions of the carbody can be constructed in a low lying manner. The regions of the carbody above the bogie can be used to accommodate seats, without the seated comfort of passengers being compromised by the bogie. The motor may be arranged in an upper region of the bogie and the other components of the bogie may be configured so as to be constructed low down, in such a way that the other components do not impair the arrangement of seating.

[0009] In an embodiment of the invention it is proposed that the bogie comprises two wheel sets, each driven by a separate motor. The wheel sets may consist of two wheels and an axle rigidly connecting the two wheels together, the wheels optionally being configured as resilient type wheels so as to improve comfort during travel.

[0010] In this regard it is further proposed that the two motors are arranged on opposite sides of the vehicle, a uniform weight distribution being obtained alongside favourable behaviour of the bogie when travelling through bends.

[0011] In this case it is advantageous for each of the two motors to be arranged in a region between two seats. The two motors can be mounted in these regions without the number of seats that may be arranged above the bogie being less than the number of seats that may be arranged in regions of a carbody having no bogie.

[0012] An embodiment in which the backs of the seats are mutually opposed and in which the motor is arranged, at least in part, in the region between the backs of the seats is particularly advantageous. The backs of the seats are usually arranged at a specific incline relative to the vertical in such a way that a trapezoid space is formed between the backs of the seats for arranging the motor. The backs of the seats are also spaced apart by a specific minimum distance in the region of their upper ends in order to prevent two passengers, sitting with their backs to one another, from banging heads. This gap has proven to be particularly advantageous for arrangement of the motor.

[0013] A further embodiment provides for the motor to be arranged above the wheel sets and for a legroom to extend inside the carbodies in the region between the wheel sets, transverse to the direction of travel of the bogie. The bogies are relatively tall in the region of the wheel sets owing to the diameter of the wheels in the wheel sets. In any case the arrangement of the motors in these tall regions enables a planar and low construction in the region between the wheel sets. This intermediate region of the bogie may be used in the carbody for a low legroom extending transverse to the longitudinal direction of the vehicle. Passengers can use this legroom to rest their legs comfortably without any edges or steps compromising seated comfort.

[0014] It is further proposed that the floor of the legroom zone is planar and extends from one side of the vehicle to the opposite side. Edges that may trip up pas-

sengers are thus avoided. The legroom in the region of the bogie may be arranged falling in line with the other floor regions of the carbody. Annoying projections, slopes, convex protrusions, etc. are avoided.

[0015] Since details regarding the construction of the bogie have not yet been discussed, the bogie will be described in detail hereinafter.

[0016] In a advantageous embodiment the bogie comprises a bogie frame comprising two longitudinal struts, the motors being arranged on the upper faces of the longitudinal struts. The bogie is tall over regions where the motors are arranged on the upper faces of the longitudinal struts. These taller regions are adapted to match the gaps between the seats, in which gaps the motor is to be arranged, in such a way that these regional elevations have little influence on the arrangement of seating above the bogie.

[0017] As a further embodiment it is proposed that the longitudinal struts comprise an indentation in the region between the motors. An indentation of this type in the longitudinal struts allows a low overall height of the bogie to be obtained in the region between the motors and in the region between two wheel sets, in such a way that the carbody can extend downwards relatively far in this region and the corresponding regions can be used, for example as low-lying legroom for passengers.

[0018] From a constructional point of view an advantageous embodiment is one in which the two longitudinal struts are interconnected via crossbars. It is not necessary to configure the bogie with a closed and, in this respect, a heavy bogie frame.

[0019] With respect to the overall height of the bogie, it is advantageous for the axles of the crossbars to be arranged in the region of the indentation.

[0020] Another embodiment, which is also advantageous with respect to the overall height of the bogie, provides for the axles of the crossbars to be arranged beneath the axles of the wheel sets.

[0021] The crossbars are advantageously fixed in openings in the longitudinal struts. For example the openings may be through holes, into which the crossbars are inserted and then rigidly connected to the longitudinal struts by welding. It is also conceivable for the openings to be recessed portions arranged in the underside, into which the crossbars can be inserted from beneath and then welded to the longitudinal struts.

[0022] Another advantageous embodiment is one in which the ends of the crossbars extend beyond the longitudinal struts toward the exterior of the vehicle. Further components of the bogie may be fixed to the free ends of the crossbars in a low-lying position close to the rails.

[0023] The ends of the crossbars are advantageously provided with mountings for the arrangement of spring members. The mountings may be configured in such a way that they allow the spring members to be accommodated low down in a region close to the wheel set, beneath the seat face of the seat. The spring members can be arranged in the region beneath the seat faces of the pas-

senger seats without reducing seated comfort or the space required to fit seats in place.

[0024] It is further proposed that the crossbars are arranged in the region between the wheel sets. This also makes it possible to obtain a low construction of the bogie in the indentation between the wheel sets.

[0025] In order to transfer torque from one longitudinal strut to the opposite longitudinal strut it is advantageous for the crossbars to be circular, in particular annular in cross-section. Crossbars configured in this manner can twist under corresponding loading of the longitudinal struts and afterwards force the two longitudinal struts toward their original position, similarly to a torsion bar. Thus the crossbars can be torsion-elastic.

[0026] Since the arrangement of the wheel sets within the bogie frame has not yet been discussed, this arrangement will be explained in detail hereinafter.

[0027] An embodiment that is advantageous from a constructional point of view for arranging the wheel sets on the bogie provides for the wheel sets to be mounted in axle boxes arranged on the longitudinal struts. The axle boxes may contain the bearing members for bearing the wheel set axles and may be mounted on the longitudinal struts in an opening therein or beneath said longitudinal struts. For example conical plain bearing members may be used as the bearing members.

[0028] The axle boxes advantageously comprise a spring assembly in order to damp the carbody. Vibration of the carbodies is attenuated and comfort during travel is improved by this first suspension being arranged directly on the wheel sets.

[0029] In this regard it is also proposed that the axle boxes comprise a resilient rubber-metal member, which surrounds the bearing region of the wheel set. This rubber-metal member serves to attenuate vibration of the carbodies. The rubber-metal member also makes it possible for the axle of the wheel set to move relative to the bogie frame within a specific region.

[0030] Since the details of the connection of the bogie to the carbody have not yet been discussed, this connection will be explained in detail hereinafter.

[0031] With respect to the rotation of the bogie beneath the bogie frame of the vehicle it is advantageous for the bogie to be articulated to the carbody, rotatably about a point of rotation arranged in front of or behind the bogie relative to the direction of travel.

[0032] The bogie may advantageously be connected to the carbody via two tie members. The tie members may be connected to the bogie in a low-lying position on the bogie side, this being advantageous with respect to the overall height of the bogie. For example the tie members may be connected to the longitudinal struts in the vicinity of their underside via corresponding mountings.

[0033] Furthermore, the tie members may be resiliently connected in the region of their connection to the bogie and/or in the region of their connection to the carbody. Relative movement between carbodies and bogies, in particular when travelling through tight bends, can be al-

lowed to some extent by the resilient connection. In travelling conditions of this type the bogie may adopt a position in which it is rotated relative to the carbody owing to resilient deformation in the region of the connection to the tie members.

[0034] The rotation of the bogie is advantageously limited by stops. It is thus ensured that the bogie does not rotate too much, what could lead to components mounted on the bogie colliding with the carbody.

[0035] Rotation is advantageously limited to an angle less than 5°, in particular less than 3°. It has proven to be particularly advantageous if rotation is limited to an angle of 1.5° at most.

[0036] Since details regarding the motors and their connection to the wheel sets have not yet been explained in detail, this aspect will be described hereinafter.

[0037] In this regard a first advantageous embodiment is one in which the motors are arranged above the wheel sets and are connected to the wheel set via a gear box extending substantially vertically. The bogie is relatively high in the region of the wheel sets owing to the arrangement of the motors above the wheel sets. In order to drive the wheel set arranged beneath the motors it is necessary to connect the motors to the wheel sets via a suitable transmission unit comprising gearing.

[0038] Since the wheel set is resiliently mounted within the axle boxes it is advantageous, in accordance with another embodiment, for the gear box to comprise means for compensating for movement of the wheel set within the first spring assembly. A reliable drive is thus facilitated, even if the wheel set moves relative to the longitudinal struts, for example when travelling through tight bends.

[0039] The means are advantageously formed of a resilient coupling, in particular comprising a rubber resilient material.

[0040] In order to supply gear box oil even to those gearwheels of the gear box which are arranged higher and thus to prevent wear, it is proposed in accordance with another embodiment for the gear box to comprise an oil circulation pump. The oil circulation pump can pump gear box oil collected in the lower region of the gear box into regions of the gear box arranged at a higher vertical level.

[0041] It is also proposed for the motors to be water-cooled. The waste heat produced by the motors is thus reduced in the region of seating in the carbody. Water-cooled motors are also advantageous with respect to the noise they produce.

[0042] Whilst details regarding the bogie and the arrangement of the bogie beneath the carbody have been discussed above, further embodiments relating to the articulation between two adjacent carbodies will be described below.

[0043] In this regard an embodiment is advantageous in which two adjacent carbodies are coupled to one another via an upper and a lower damping arrangement. The damping arrangements may attenuate the opposed movement of the carbodies. Jerky movement, for exam-

ple when travelling through a horizontal bend, is avoided.

[0044] It is further provided for the upper damping arrangement to comprise a damper that extends diagonally relative to the longitudinal direction of the vehicle.

[0045] In this case it is also advantageous for the damper to be articulated at one end to an articulation point arranged in the vertical longitudinal central plane of the vehicle and at the other end to an articulation point that is offset laterally relative to the longitudinal central plane of the vehicle.

[0046] The lower damping arrangement may be arranged in the region of a coupling for coupling two carbodies, in particular a ball-and-socket coupling. The lower damping arrangement, which is arranged in the vicinity of the floor of the carbody and therebeneath, may attenuate movement of the car when travelling through bends.

[0047] It is also advantageous if the lower damping arrangement comprises two dampers. In this case one of the dampers may be arranged on one side of the coupling and the other damper may be arranged on the other side of the coupling.

[0048] Further details and advantages of the invention will now be described with reference to the accompanying drawings of an preferred embodiment, in which:

- Fig. 1 shows two low-floor rail vehicles of differing length, in each case in a schematic side and plan view;
- Fig. 2 is an enlarged side view of a carbody in the region of a bogie;
- Fig. 3 is a perspective view of a carbody in the region of a bogie, in which not all components of the bogie and the carbody are shown for reasons of clarity;
- Fig. 4 is a schematic plan view of the region shown in Fig. 3, viewed from the inside of the carbody;
- Fig. 5 is a side view of the bogie and the seats arranged thereabove;
- Fig. 6 is a perspective view of the bogie;
- Fig. 7 is a side view of the bogie from the direction denoted in Fig. 6 by VII;
- Fig. 8 is a front view from the direction denoted in Fig. 6 by VIII;
- Fig. 9 is a plan view of the bogie from the direction denoted in Fig. 7 by IX;
- Fig. 10 is a perspective view of the upper damping arrangement provided between two carbodies;

- Fig. 11 is a plan view of the damping arrangement according to Fig. 10;
- Fig. 12 is an alternative embodiment of the upper damping arrangement shown in Fig. 10;
- Fig. 13 is a view of the upper damping arrangement according to Fig. 12 corresponding to the view in Fig. 11;
- Fig. 14 is a perspective view of the lower damping arrangement, and
- Fig. 15 is a plan view of the lower damping arrangement according to Fig. 14, viewed from beneath the vehicle.

[0049] Fig. 1 shows two rail vehicles 1 of differing length, said vehicles being so called low-floor rail vehicles. In the vehicles 1 shown, the vehicle floor is at a height of approximately 350 mm above the rails, thus allowing passengers easy boarding to the inside of the rail vehicle 1.

[0050] The rail vehicles 1 are both formed modularly from a plurality of carriages 2 that are interconnected via articulations 30 in such a way that the carriages 2 can pivot against one another when travelling through bends. The carriages 2 are supported by bogies 4 that are arranged beneath the carriages 2 and are arranged rotatably about a vertical axis relative to the carriages 2 arranged thereabove. Not all of the carriages 2 are equipped with bogies 4. In the embodiments shown in Fig. 1 the vehicle 1 has an alternating arrangement of carriages 2 with a bogie 4 and carriages 2 without a bogie 4. Not every bogie 4 needs to be motor-driven.

[0051] A plurality of seats 3 is arranged inside the rail vehicle 1, said seats 3 optionally being arranged individually or in rows transverse to the longitudinal direction of the vehicle 1 or parallel to the longitudinal direction of the vehicle 1. Depending on the configuration of the seats 3 the rail vehicle 1 shown in Fig. 1a may comprise a number of 42 to 54 seats 3.

[0052] Referring to Fig. 1b, a rail vehicle 1 comprising a greater number of seats 3 is shown, this rail vehicle 1 being composed of a total of seven carriages 2 whereas the rail vehicle 1 shown in Fig. 1a is composed of five carriages 2.

[0053] As is already suggested by the views of Fig. 1, the bogies 4 arranged beneath the carriages 2 extend into the interior of the rail vehicle 1 owing to the low floor construction thereof, which places some constraints on the arrangement of the seats 3 in the regions of the bogies 4.

[0054] Hereinafter details regarding the bogie 4 will first be explained with reference to Fig. 6 to 9 before the arrangement of the seats 3 in the region of a motor-driven bogie 4 arranged beneath the carriage is described in greater detail with reference to the drawings shown in

Fig. 2 to 5.

[0055] Referring to the perspective view in Fig. 6, the bogie 4 comprises two wheel sets 6, but more wheel sets 6 may also be provided.

[0056] The wheel sets 6 each consist of two wheels 6.1 that are rigidly interconnected via an axle 6.2. The wheels 6.1 rotate at the same speed owing to the connection of the two wheels 6.1 via the axle 6.2. The wheels 6.1 are resilient type wheels in order to reduce the transfer of ground vibrations to the carriages 2 and thus increasing comfort during travel as well as reducing the noise level.

[0057] The bogie 4 further comprises a bogie frame 8, which comprises of two longitudinal struts 9 extending in the longitudinal direction of the vehicle and two crossbars 10 interconnecting the longitudinal struts 9.

[0058] The longitudinal struts 9 are configured as warp resistant steel profiles, to which the other components of the bogie 4 are fixed. The wheel sets 6 are mounted rotatably at the end regions of the longitudinal struts 9. The longitudinal struts 9 comprise an indentation 9.4 in their central region M between the wheel sets 6. The indentation 9.4 points toward the rails, the bogie 4 being relatively low in the central region M (see Fig. 7). The longitudinal struts 9 are connected to the crossbars 10 in the region of the indentation 9.4, in such a way that the axles of the crossbars 10 are arranged beneath the axles of the wheel sets 6. The longitudinal strut 9 is taller than the central region M on either side of the central region M in the region W of the wheel sets 6.

[0059] The crossbars 10 pass through openings 9.3 in the longitudinal struts 9 and are rigidly connected to said struts 9, for example by welding. The crossbars 10 are annular in cross-section and are tubular in shape. If forces act on the longitudinal struts 9 torque may be absorbed by the crossbars 10, which deform in a manner similar to torsion bars. The length of the crossbars 10 is such that the free ends thereof project laterally beyond the longitudinal struts 9 toward the exterior of the vehicle. Mountings 11 are formed in the region of the ends of the crossbars 10 and receive spring members 12.

[0060] The wheel sets 6 are mounted on the longitudinal struts 9 by axle boxes 13 that comprise a bearing for rotatably mounting the axle 6.2 of the wheel set 6. For example the bearing may be a compact cartridge conical bearing. The axle boxes 13 also comprise a first suspension for damping the carriages 2. This first suspension is made of a resilient rubber-metal member that radially surrounds the bearing region of the wheel set 6. These rubber-metal elements can have a conical shape. The first suspension allows it to the axle 6.2 of the wheel set 6 to move relative to the longitudinal struts 9 and the bogie frame 8 of the bogie 6, for example so as to compensate for differences in speed when travelling through tight bends.

[0061] Through the elements of the first suspension are transmitted both vehicle 1 vertical loads as well as the longitudinal and transversal forces due to the traction,

braking and guiding of the wheel sets 6.

[0062] A second suspension for also uncoupling the carbody 2 is formed by the spring members 12 that are fixed low down to the free ends of the crossbars 10. The springs 12 are provided on their upper faces with resilient members 17, which form elastic seats for the carbody 2 arranged thereabove (see also the view in Fig. 2). The bogie 4 is connected to the carbody 2 in vertical direction via said second suspension which transmits the vertical and transversal loads through the elastic members 17 and uncouples the bogie 4 from the carbody 2. Dampers 26 are used for controlling the displacements between the bogie 4 and the carbody 2 in order to achieve good driving comfort for the passengers.

[0063] The mountings 11 are configured in such a way that the springs 12 of the second suspension are fixed low down to the bogie 4, the bogie 4 thus being constructed in a low manner with a relatively large spring deflection. The springs 12 are also arranged by the mountings 11 offset laterally relative to the axles of the crossbars 10, in such a way that the components of the second suspension are arranged in the region W of the wheel sets 6 (see Fig. 7). The region W is arranged under the seats 3 what will be described in greater detail herein later.

[0064] The bogie 4 is driven by motors 5. In the embodiment shown in the drawings an electric motor 5 is provided for each wheel set 6. The motors 5 are arranged on the upper faces 9.1 of the longitudinal struts 9 in the region aside of the indentation 9.4. As illustrated in Fig. 7, the motors 5 arranged in the region of the wheel sets W form the highest points of the bogie 4. This allows a low construction of the middle region M. The motors 5 are arranged on opposite sides of the vehicle 1, above the wheel sets 6 in opposite corner regions of the bogie 4.

[0065] The motors 5 are connected to the wheel sets 6 via gear boxes 16 extending vertically in order to drive the wheel sets 6. The gear boxes 16 comprise a plurality of gear stages arranged above one another and are provided with means 27 for compensating for any movement of the wheel set 6 within the first suspension. For example these means 27 may be a resilient coupling 27 that compensates for any movement of the wheel set 6 within the first spring assembly. The gear case 16 can be rigidly joined to the motor 5 and in a flexible way to the wheel set 6 by using an elastic coupling 27.

[0066] Since the gear steps of the transmission unit 16 are arranged above one another vertically, an oil circulation pump is provided for the uppermost transmission step to ensure a sufficient supply of lubricant, the oil circulation pump continuously feeding gear box oil from the lowermost point of the gear box 16 toward the upper end of the gear box 16.

[0067] The bogie 4 also comprises a set of braking means that are fixed to the bogie frame 8. In the embodiment shown in the drawings a disk brake 20 consisting of a brake disk 20.1 and a brake caliper 20.2 are provided at each wheel 6.1. An electromagnetic brake 21 is also

provided (see Fig. 2).

[0068] In addition, a lubricant system 22 and a sand system 23 are provided for improving traction, for example during winter travel.

[0069] The bogie 4 is connected to the carbody 2 in longitudinal direction by two tie members 14 extending in the longitudinal direction of the vehicle. The ties 14 are connected at one end to the bogie 4 and at the other end to carbody 2. The connection points of the ties 14 are rubber resilient. In this embodiment the end regions of the ties 14 are loop-shaped, a connecting bolt 14.1 being provided inside each of the loops and being surrounded radially by a rubber resilient material 14.2. The resilient connection prevents any jerky stressing between the carbody 2 and the bogie 4 when the rail vehicle 1 pulls up at a platform or slows down. The rubber resilient material 14.2 may also be compressed when travelling through bends, in such a way that the bogie 4 may rotate beneath the carbody 2. The ties 14 extend in the longitudinal direction of the vehicle away from the bogie frame 8, in such a way that a virtual axis of rotation A is produced which is arranged in the region either in front of or behind the bogie frame 8 depending on whether the ties 14 are arranged in front of or behind the bogie 4 relative to the direction of travel.

[0070] Stops 18 are provided in order to limit the transversal movements of the bogie 4 beneath the carbody 2 and cooperate with a structure fixed to the carbody 2 in such a way that the rotation of the bogie 4 about the axis of rotation A is limited to a specific angular range, in this embodiment an angular range of $\pm 1.5^\circ$ relative to the longitudinal direction of the vehicle. The Stops 18 are embodied as elastic lateral buffers.

[0071] Vertical movements of the bogie 4 are limited by stops 28. The stops 28 are embodied as elastic vertical buffers.

[0072] Since details regarding the bogie 4 have been discussed above, the arrangement of the bogie 4 beneath the carbody 2 will now be explained before discussing in greater detail the articulations 30 provided between the carbodies 2.

[0073] As illustrated in the views of Fig. 4 and 5, a total number of 16 seats 3 is provided in the region of the bogie 4. The seats 3 are arranged in groups of four in which the backs 3.1 of the seats 3 are mutually opposed. The higher regions W of the bogie 4 are arranged beneath these groups of seats, whereas the lower central region M is arranged between two groups of seats in the region of a legroom zone 7 of the carbody 2 (see also Fig. 2).

[0074] A space with an approximately trapezoid cross-section is provided between the backs 3.1 of the seats 3. The motors 5 forming the highest point of the bogie 4 extend into this cross-section, at least in part. This makes it possible to arrange the seats 3 conveniently in the region of the bogie 4, despite the large overall height of the regions W. A central corridor 25 is provided in the region of the bogie connection, the central corridor 25 being arranged in level with a foot region 7 where passengers

place their feet. Stepped edges that may trip up passengers, ramped surfaces and the like are not required owing to the construction of the bogie 4 and its arrangement beneath the carbody 2.

[0075] The motors 5 are located in a housing 24 that conceals them. The motors 5 extend in a direction transverse to the longitudinal direction of the vehicle. The motors 5 are approximately cylindrical, the housings 24 thus also being approximately cylindrical in part. The housings 24 are somewhat larger than the motors 5 so if the bogie 4 rotates relative to the carbody 2, the motors 5 rotating together with the bogie 4 are prevented from colliding with the housing 24, which is fixed to the carbody 2. The transverse movement of the motors 5 inside the housing 24 is limited by the stops 15, i.e. even if the bogie 4 rotates through an angle of 1.5° relative to the longitudinal central plane of the vehicle, the motor 5 will not contact its housing cover 24.

[0076] The cover 24 may consist of a sound-insulating and heat-insulating material so as to reduce the motor noise and motor heat to which passengers are subjected. For this reason the motors 5 are also water-cooled, which also reduces the heat and noise produced thereby compared to conventional electric motors.

[0077] The arrangement, in accordance with the invention, of the bogie 4 and of the motor 5 between two seats 3 allows it to arrange the seats 3 in a manner which fully utilises the space available above the bogie 4. The seats 3 are arranged in a direction transverse to the longitudinal direction of the vehicle, with their backs 3.1 mutually opposed, in the region above the wheel set 6 (see also the view in Fig. 3).

[0078] The articulations 30 provided between the carbodies 2 which influence the movement of the bogie 4 under the carbody 2 will now be described in detail with reference to the views in Fig. 10 to 15.

[0079] The articulations 30 comprise a coupling 31 which connects the carbodies 2 to one another by a ball-and-socket joint, similarly to a trailer coupling (see in particular the view in Fig. 14). In the embodiment shown in the figures a carbody 2 without a bogie is coupled with a carbody 2 carried by a bogie 4.

[0080] An upper damping arrangement 100 is provided in the region of the upper faces of the carbodies 2. The upper damping arrangement 100 is of pivot type and consists of a damper 101 extending diagonally relative to the longitudinal direction of the vehicle and pivotably articulated at the articulation points 102, 103. One articulation point 103 is arranged in the side region of the carbody 2 whilst the other articulation point 102 is arranged approximately in the longitudinal central plane of the rail vehicle. When travelling through bends the carbodies 2 pivot against one another, the damper 101 being stretched or compressed in such a way that the pivoting movement is comfortable for the passengers (see Fig. 10 and 11). In accordance with the embodiment shown in Fig. 12 and 13, a damping member 104 extending in the longitudinal direction of the vehicle is also provided with the upper

damping arrangement 100 so as to damp the movement between the adjacent carbodies 2 in the case of vertical bends, i.e. when travelling uphill or downhill. The damping member 104 extends from the articulation point 102 to a further articulation point 105, which is also arranged approximately within the longitudinal central plane of the vehicle. When travelling through vertical bends this member 104 is compressed or stretched.

[0081] Fig. 14 and 15 illustrate a lower damping arrangement 120 being of ball joint type and consisting of two dampers 121, 122. These dampers 121, 122 are provided beneath the carbodies 2 approximately in line with the coupling 130. The dampers 121, 122 extend into the lateral regions of the carbodies 2 in a direction parallel to the longitudinal direction of the vehicle.

List of reference numerals

[0082]

1	rail vehicle
2	carbody
3	seat
3.1	seat back
3.2	seat face
4	bogie
5	motor
6	wheel set
6.1	wheel
6.2	axle
7	legroom
8	bogie frame
9	longitudinal strut
9.1	upper face
9.2	underside
9.3	opening
9.4	indentation
10	crossbar
11	recess

12	spring member
13	axle box
14	tie
14.1	connecting bolt
14.2	rubber resilient material
15	stop
16	transmission unit
17	resilient member
20	disk brake
20.1	brake disk
20.2	brake saddle
21	electromagnetic brake
22	lubricant system
23	sand system
24	housing
25	aisle
30	articulation
100	upper damping arrangement
101	damper
102	articulation point
103	articulation point
104	damping member
105	articulation point
120	lower damping arrangement
121	damper
122	damper
130	coupling
P:	point of rotation
M:	central region

W: wheel set region

A: axis of rotation

5

Claims

1. Rail vehicle, in particular a low floor rail vehicle, comprising a carbody (2) having a plurality of seats (3) and a bogie (4) arranged beneath the carbody (2), said bogie being driven by a motor (5), **characterised in that** the motor (5) is arranged in a region between two seats (3).
2. Rail vehicle according to claim 1, **characterised in that** the backs (3.1) of the seats (3) are mutually opposed, and **in that** the motor (5) is arranged in the region between the backs (3.1) of the seats, at least in part.
3. Rail vehicle according to either claim 1 or claim 2, **characterised in that** the motor (5) is arranged above the wheel sets (6) and a legroom (7) extends in the region between the wheel sets (6), transverse to the direction of travel of the bogie (4).
4. Rail vehicle according to any one of the preceding claims, **characterised in that** the bogie (4) comprises a bogie frame (8) comprising two longitudinal struts (9), the motors (5) being arranged on the upper faces (9.1) of the longitudinal struts (9).
5. Rail vehicle according to any one of the preceding claims, **characterised in that** the wheel sets (6) are mounted in axle boxes (13) arranged on the longitudinal struts (9).
6. Rail vehicle according to claim 5, **characterised in that** the axle boxes (13) comprise a spring assembly for decoupling the carbody (2).
7. Rail vehicle according to any one of the preceding claims, **characterised in that** the bogie (4) is articulated to the carbody (2), rotatably about a point of rotation (P) arranged in front of or behind the bogie (4) relative to the direction of travel.
8. Rail vehicle according to claim 7, **characterised in that** the bogie (4) is connected to the carbody (2) via two ties (14).
9. Rail vehicle according to either claim 7 or claim 8, **characterised in that** the ties (14) are resiliently connected in the region of their connection to the bogie (4) and/or in the region of their connection to the carbody (2).
10. Rail vehicle according to any one of the preceding

claims, **characterised in that** the rotation of the bogie (4) is limited by stops (15).

11. Rail vehicle according to any one of the preceding claims, **characterised in that** the motors (5) are arranged above the wheel sets (6) and are connected to the wheel set (6) via a transmission unit (16) extending substantially vertically. 5
12. Rail vehicle according to claim 11, **characterised in that** the transmission unit comprises means for compensating for movement of the wheel set within the first spring assembly. 10
13. Rail vehicle according to claim 12, **characterised in that** the means are formed of a resilient coupling, in particular comprising a rubber resilient material. 15
14. Rail vehicle according to any one of the preceding claims, **characterised in that** two adjacent carbodies are coupled to one another via an upper (100) and a lower (120) damping arrangement. 20
15. Rail vehicle according to claim 14, **characterised in that** the upper damping arrangement (100) comprises a damper (101) which extends diagonally relative to the longitudinal direction of the vehicle. 25

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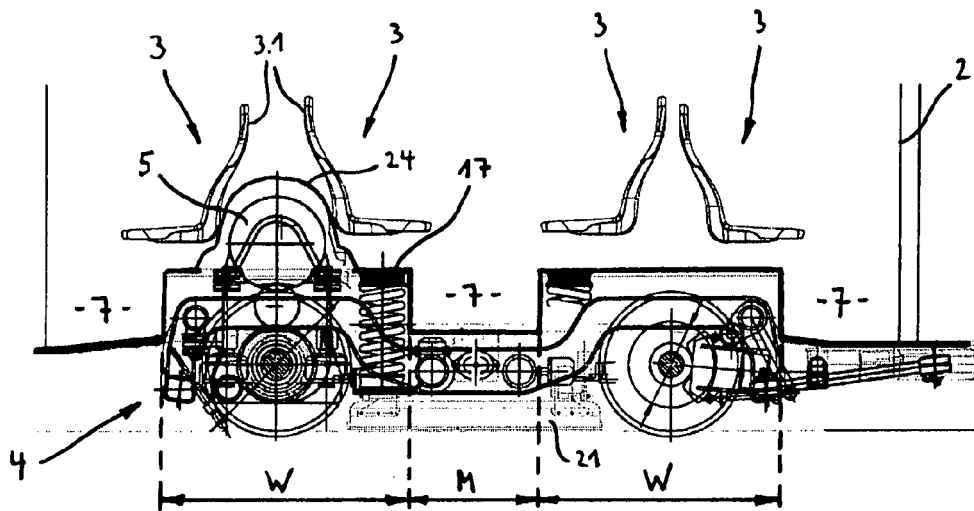
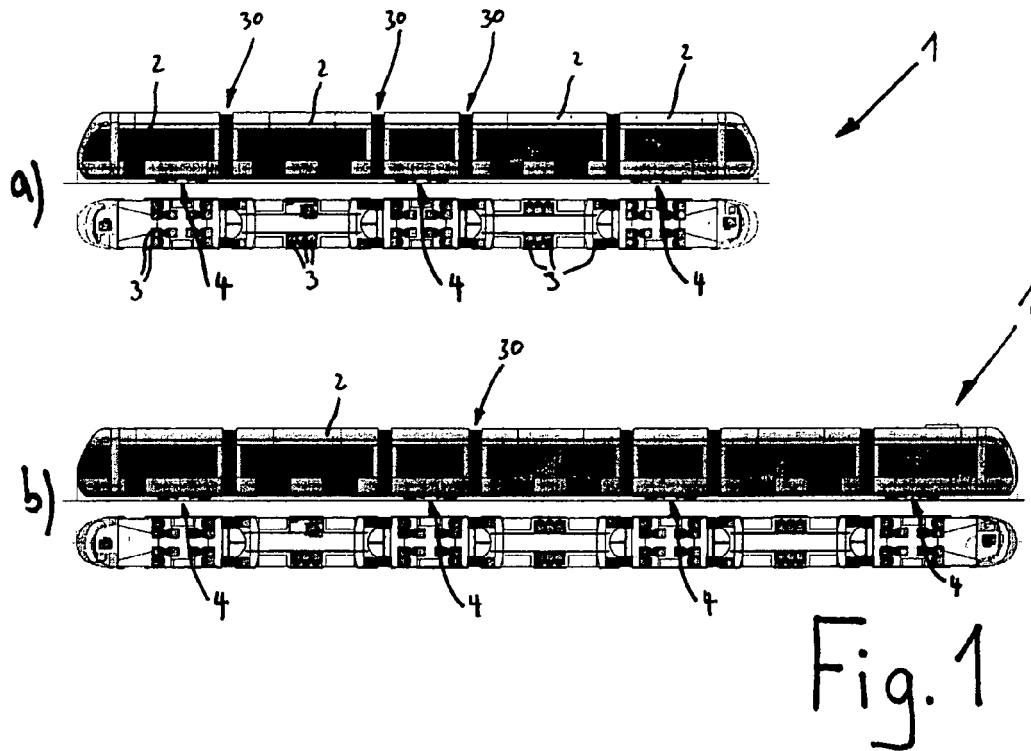
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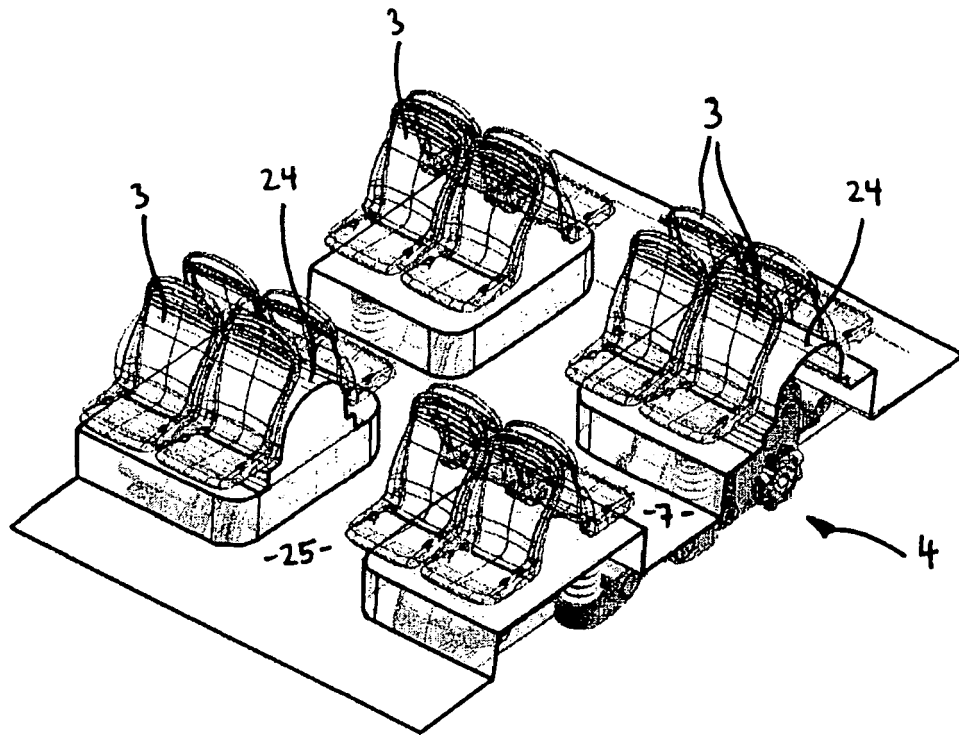


Fig. 3

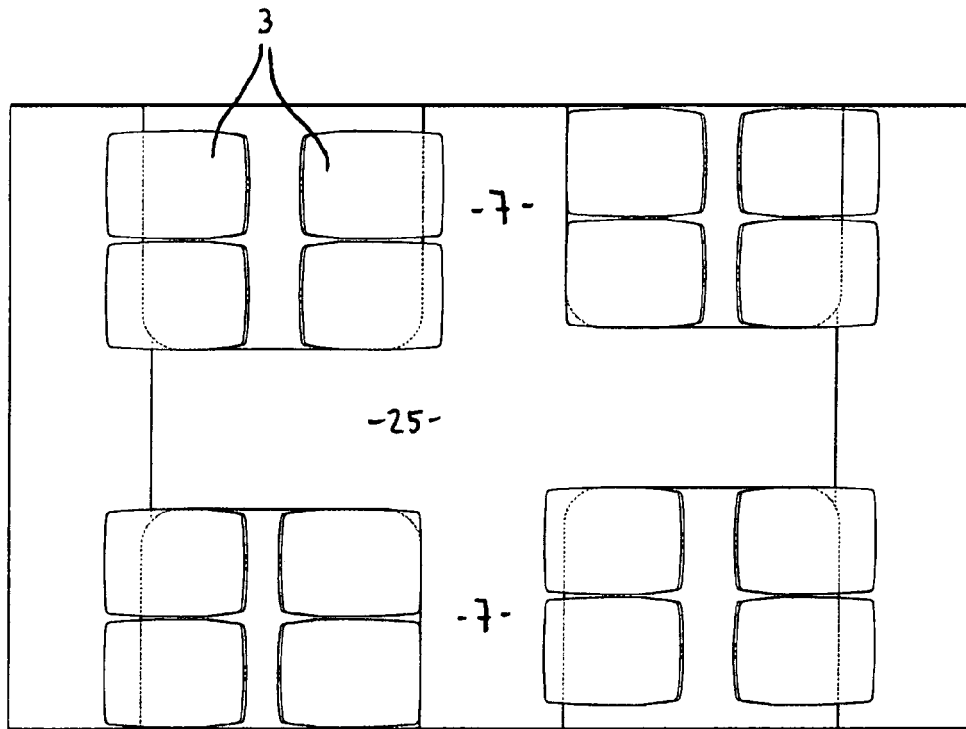


Fig. 4

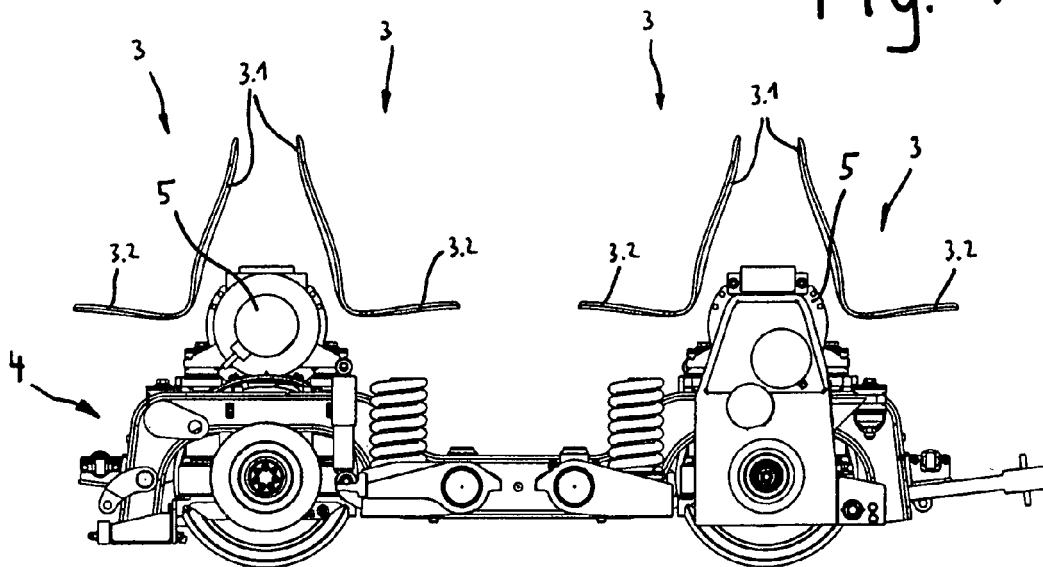
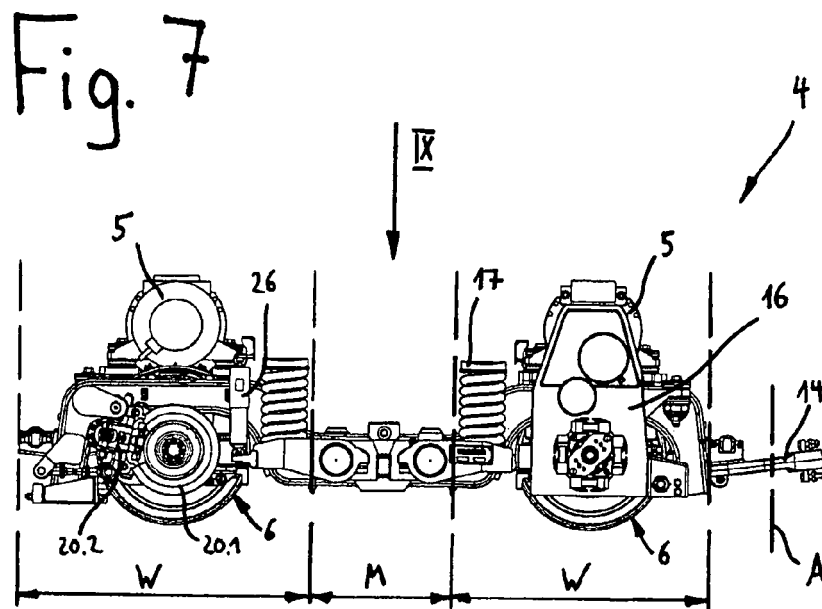
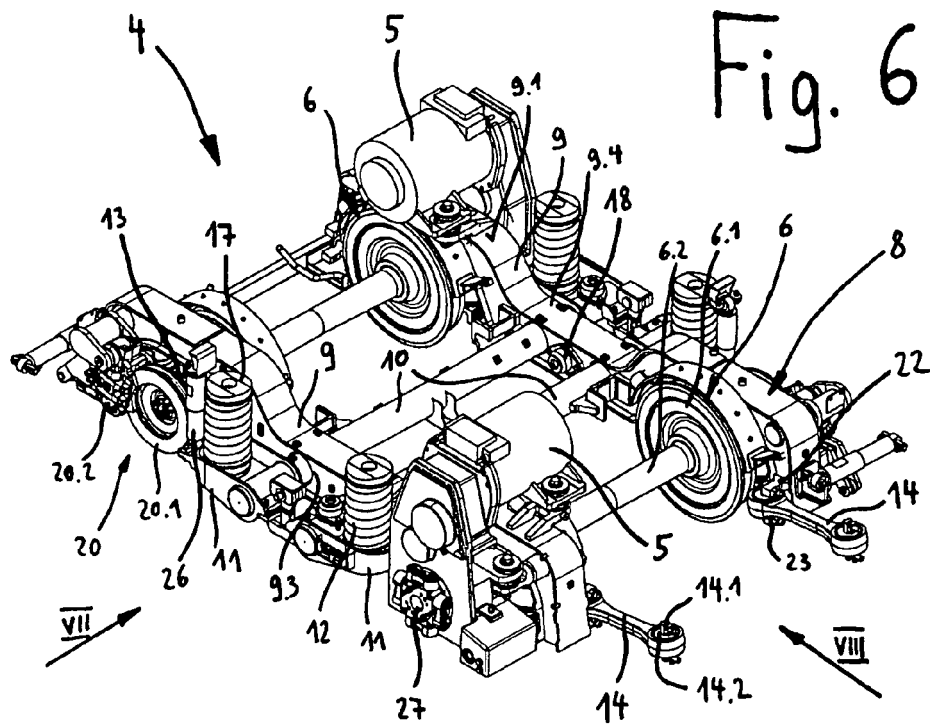


Fig. 5



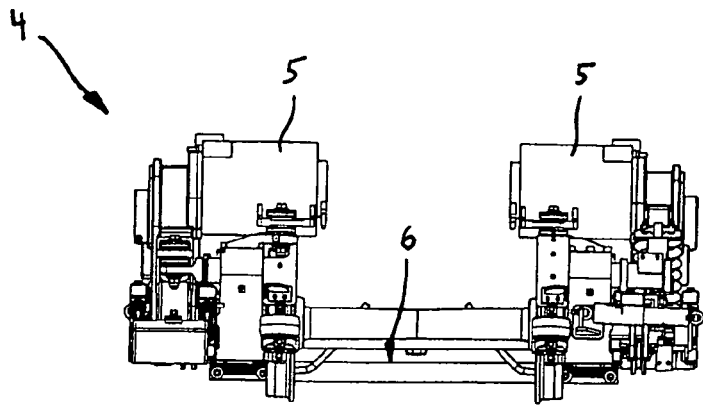


Fig. 8

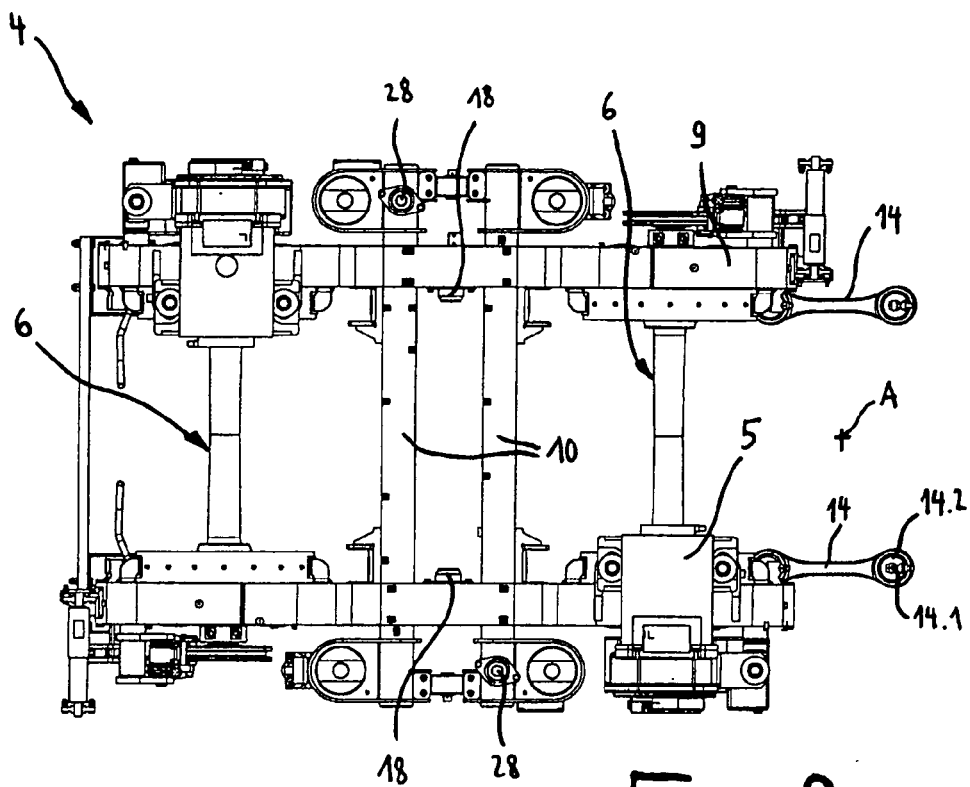


Fig. 9

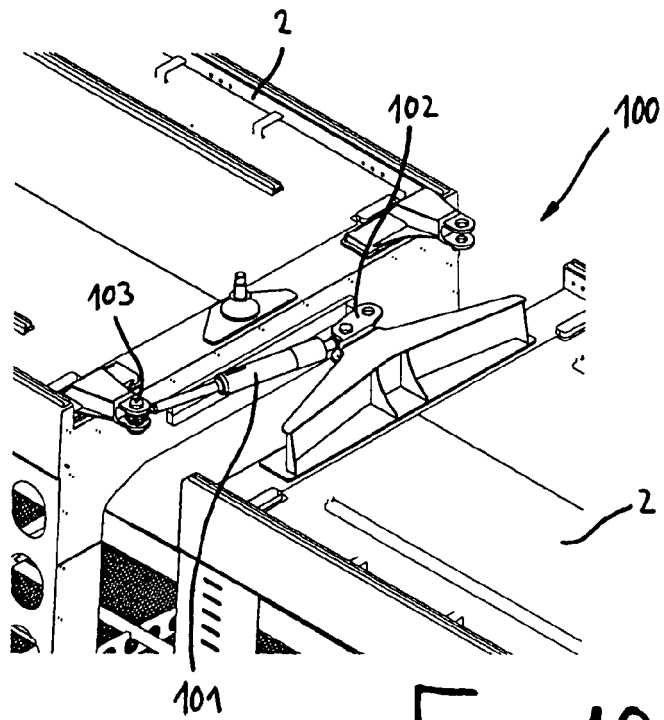


Fig. 10

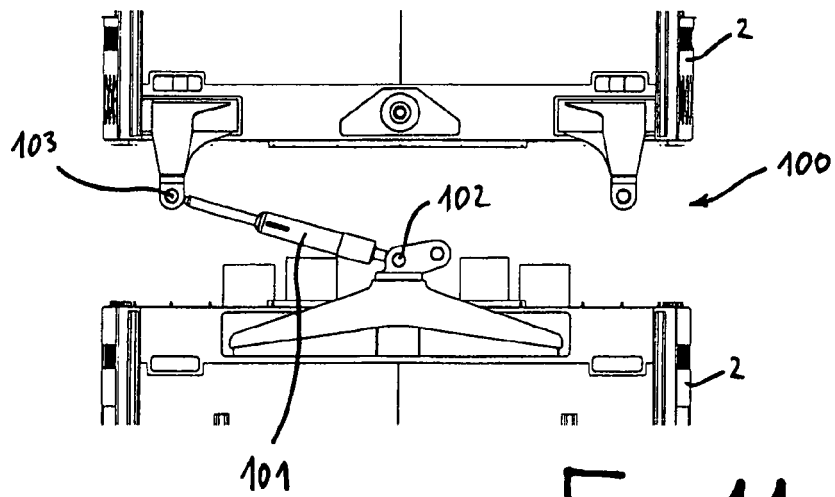


Fig. 11

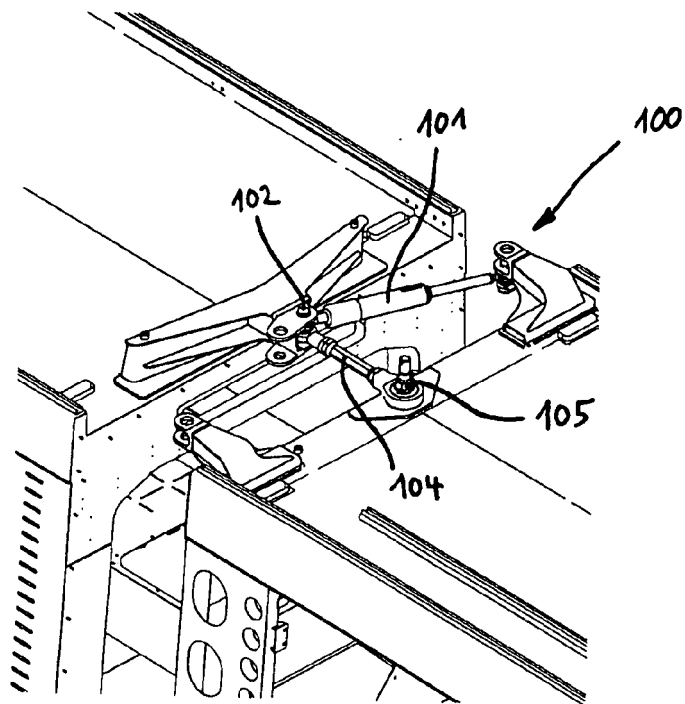


Fig. 12

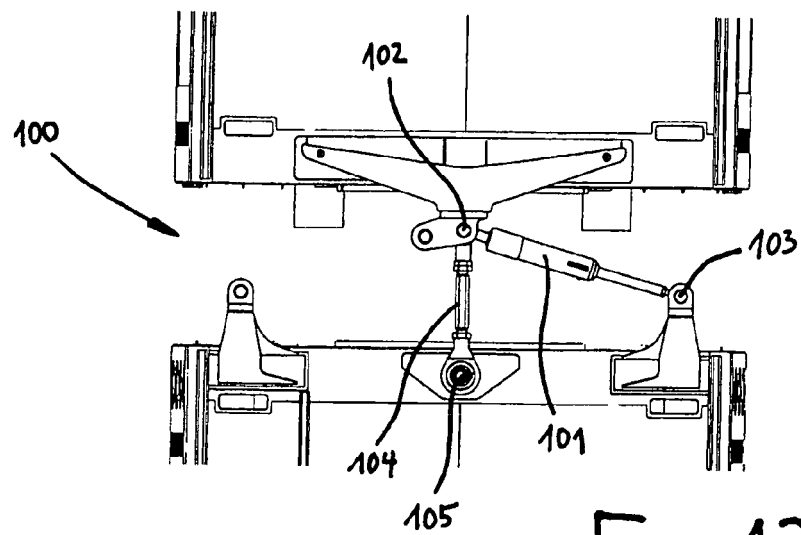


Fig. 13

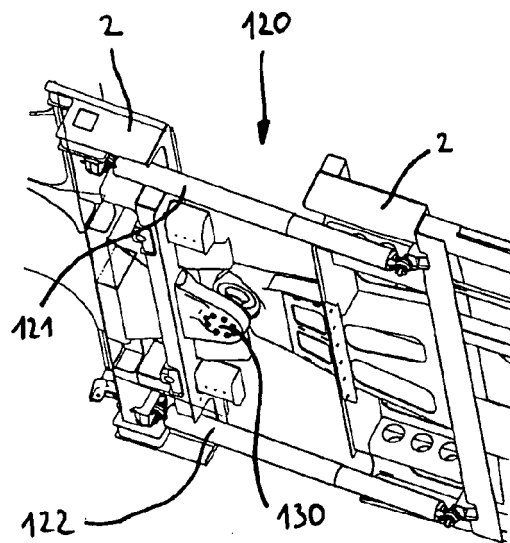


Fig. 14

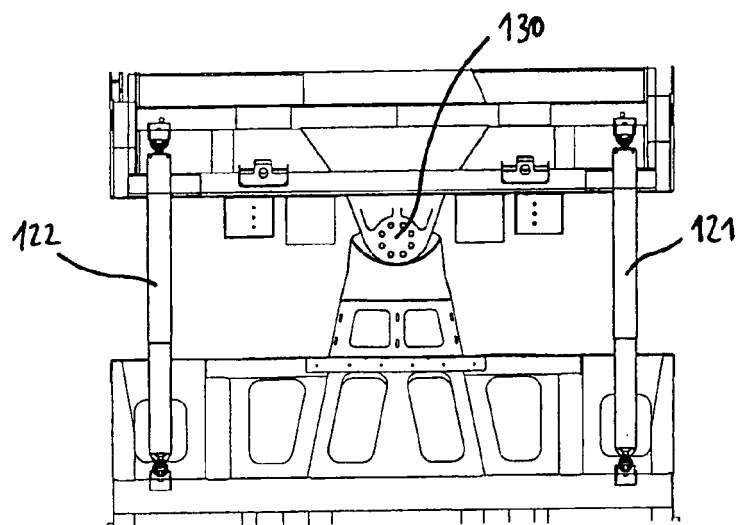


Fig. 15



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Application Number
EP 10 38 0041

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		10 August 2010	Chlost, 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			

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