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(73) Patenthaver: **Thoni, Lothar, Gschwendlistraße 9, 9108 Jakobsbad, Schweiz**

(72) Opfinder: **Thoni, Lothar, Gschwendlistraße 9, 9108 Jakobsbad, Schweiz**

(74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**

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Description

[0001] The present invention relates to a wheel set axle for rail vehicles.

Prior art:

[0002] Rail vehicles are track-guided. The running gear of the railway vehicle is responsible for guiding the wheels of the vehicle on the rails, for transferring the load and for the suspension thereof. In addition, the running gear is also responsible for transferring the driving forces of driven vehicles and for transferring the braking forces of all vehicles. Within the running gear, the wheelset provides the connection to the track.

[0003] A wheelset usually consists of the wheelset bearings and the wheelset axle with two wheels. The wheelset bearings serve to mount the wheelset on the bogie or frame of a rail vehicle. In terms of the construction, the wheelset bearings are usually designed as plain bearings or roller bearings. The wheelset axle rigidly connects the two wheels to each other. Often, one or more brake discs or drive gears are also mounted on the wheelset axle. The wheelset axle of a rail vehicle bears the weight of the vehicle. In doing so, the wheelset axle is subjected to bending and torsional stress. The wheels are usually designed as disc wheels wherein a recess, namely the wheelset hub, is arranged centrally. When a wheelset is manufactured, the wheelset axle is pressed into the hub bore under high pressure by means of a wheelset press. The wheelset axle and wheel are then fitted together, thus forming a rigidly connected unit.

[0004] Conventional wheelsets are made from one piece and have the disadvantage that due to the positive rigid connection between the wheel and the wheelset axle, stresses are built up between the elements when the wheel is loaded. These stresses can then lead to cracking in the wheelset axle, for example. In order to detect a crack in the wheelset axle at an early stage, wheelset maintenance is usually carried out every 250,000 km. However, such maintenance is cost-intensive and leads to downtimes of the rail vehicle. A wheelset axle that requires less frequent maintenance would therefore be desirable.

[0005] DE 39 31 912 A1 relates to a single wheel bearing of a driving wheel on rail vehicles with a transmission housing located on the outside of the driving wheel. Inside the

transmission housing, an axle stub is molded on, the free end of which protrudes outwards through an opening in the housing. On the free end of the axle stub, a bushing, which is fixedly connected to the driving wheel and protrudes into the housing, is mounted by means of a rolling bearing.

[0006] DE 569 368 A relates to a rolling bearing for axles and shafts, preferably for axle bearings of rail vehicles. The rolling bearings are secured on an axle journal by means of clamping sleeves in the known manner by means of an axle nut.

[0007] AT 113 383 B relates to an axle sleeve with two or more roller bearings. For each roller bearing, a conical clamping sleeve is provided for attaching on an axle journal - preferably an axle journal of a rail vehicle..

[0008] CH 296 879 A relates to an axle bearing with axle. A bearing housing is arranged within an axle journal box. Furthermore, a journal of the axle is provided, which protrudes into the bearing housing and has an inner and an outer journal part axially spaced from each other. The two journal sections are of different diameters with the outer journal part having a smaller diameter than the inner journal part.

[0009] DE 658 358 C describes a predominantly hollow axle tube extending along a longitudinal direction and ending in a first wheel flange. The lightweight wheelset described therein comprises a wheel support extending in the opposite direction to the longitudinal direction and having a wheel bearing and a second wheel flange, with the second wheel flange, the first wheel flange and a wheel with a wheel hub arranged therebetween being connected to each other via a flange connection.

[0010] EP 3 094 499 A relates to a wheelset shaft for use in rail vehicles, comprising at least one axle body extending substantially along a longitudinal axis, the axle body having at least a first load coupling section for introducing and/or diverting a force and/or torque into or from a functional component. The axle body at least partially consists of at least one curable first material in which fibers of a substantially non-metallic second material are at least partially embedded.

Summary of the invention:

[0011] It is therefore an object of the present invention to provide a device and a wheelset axle for rail vehicles in order to improve the load transmission in the wheelset and the safety thereof.

[0012] The object is achieved by a device for rail vehicles with the features of claim 1 and a wheelset axle for rail vehicles with the features of claim 12 .

[0013] Preferred embodiment variants are represented in the sub-claims.

[0014] The device for rail vehicles according to the invention initially comprises an axle tube, which is hollow at least in certain sections, extending in a longitudinal direction and ending in a first wheel flange. Furthermore, the device comprises a wheel support extending opposite to the longitudinal direction, comprising a wheel bearing, a second wheel flange and a mandrel as a cone. The second wheel flange, the first wheel flange and a

[0015] wheel with a wheel hub arranged therebetween are connected to each other via a flange connection. In addition, the device provides that the mandrel of the wheel support extends as a cone in a positive-locking manner in the opposite direction to the longitudinal direction through the hub of the wheel into an inner space of the axle tube. At least in the interior of the mandrel there is a central axle which runs in the opposite direction to the longitudinal direction and which ends together with the mandrel in a fastening element arranged within the axle tube, and which is connected to a bolt. The bolt preferably has a spring washer which compensates for the difference in linear expansion of the different materials caused by different coefficients of thermal expansion.

[0016] The unique feature of the device according to the invention is its multi-part construction. As in conventional devices, the wheel is mounted on an axle, namely on the central axle. According to the invention, the wheel is fixedly connected to the central axle by means of a mandrel which surrounds the central axle and is positively guided through the hub of the wheel, the central axle in turn being fixedly connected to the axle tube via a rotation-symmetric fastening element made of steel. In addition, the wheel is held between

two flanges, namely the first wheel flange of the axle tube and the second wheel flange of the axle bearing, which are connected to the wheel via a fixed flange connection. This multi-part construction results in a rigid connection of axle tube and wheel. However, in contrast to known devices, the multi-part construction of the device allows the various components of the device to interact more efficiently under load. This significantly reduces the occurrence of stresses within the device compared to known devices. Thus, the likelihood of stress-induced cracking in the device is decreased. Consequently, the maintenance intervals could be extended when using such a device compared to known devices.

[0017] The device according to the invention can be optimized by selecting suitable materials. For example, it is preferably provided that the axle tube is cast from an aluminum alloy, preferably an aluminum alloy which meets the mechanical requirements of the component. In a preferred embodiment, the axle tube is made of AC-AlSi7Mg0.3 or AC-AlCu4Ti. These alloys are particularly suitable for a casting process which is preferably used to produce the axle tube. Preferably, the casting condition or material condition should correspond to the alloy ST6. Aluminum alloys have the additional advantage that they have a lower dead weight compared to other metals or metal compounds so that considerable weight savings are possible. A component made of an aluminum alloy is comparatively light. Installed in a rail vehicle, lightweight components are advantageous for the energy efficiency of the vehicle.

[0018] The central axle is preferably cast from aluminum. In a preferred embodiment, the mandrel with axle bearing and wheel flange on the outside is cast from steel or alternatively from a calculated lighter material. Preferably, the wheel support is formed in one piece and, accordingly, also the wheel bearing and second wheel flange are made of the same material.

[0019] In a preferred embodiment, the central axle extends longitudinally within the wheel bearing of the wheel support. The wheel bearing and wheel support are accordingly constructed in such a manner that they can be mounted within a wheelset bearing. Preferably, the central axle has a larger diameter in one end section than in its main section. The end section with the larger diameter is preferably the region which accommodates inside the mandrel of the wheel bearing.

[0020] Since the fastening element, preferably a cast part made of steel, is fixedly connected to the central axle, it is subjected to high forces when the wheel is loaded. In order for the fastening element to be able to transmit these forces to the axle tube, it is advantageous if the fastening element is sturdily connected to the axle tube. For this purpose, it is provided in a preferred embodiment that at least one groove is made in the fastening element, into which a pin engages that is cast on the inner wall of the axle tube. Preferably, opposite the first pin, a further pin is cast on the inner wall of the axle tube, which engages in a further groove in the fastening element arranged opposite the first groove. Since the fastening element is preferably round-shaped as a cast part, the wall thickness around the fastening element is preferably balanced and uniform. Usually, the material of the axle tube shrinks onto the fastening element during the casting process.

[0021] It is advantageous if the mandrel, which tapers in the opposite longitudinal direction, rests snugly against the inner walls of the hollow tube. In a preferred embodiment, it is provided that in the region of the end section with the first wheel flange, the wall thicknesses of the axle tube are adapted to the higher loads and are greater than in the main section of the axle tube. However, for calculation reasons, varying the wall thickness can also be useful in other sections of the axle tube, for example to make particularly stressed sections of the axle tube more stable by increasing the wall thickness, or to achieve further material and weight savings.

[0022] In a preferred embodiment, ribbings can be provided within the axle tube, at least in sections, in order to optimize the stability of the axle tube.

[0023] In order to make the first wheel flange more stable against the effects of forces in or against the longitudinal direction, it is provided in a preferred embodiment that, for calculation reasons, support ribs are arranged on the outside of the axle tube between the axle tube running in the longitudinal direction and the first wheel flange extending vertical to the longitudinal direction.

[0024] According to the invention, a wheelset axle for rail vehicles is also claimed, comprising a first device according to the invention and, in mirror image, a second device according to the invention arranged opposite to the longitudinal direction of the first device, wherein the axle tube of the first device is a first end section of an axle and the axle tube of

the second device is a second end section of the axle arranged opposite to a first end section. The wheelset axle according to the invention is formed in one piece and shows all the advantages already mentioned above with respect to the device. The wheelset axle according to the invention is suitable to be mounted in common wheelset bearings of a running gear of a rail vehicle. Brake discs and drive gears can also be mounted on the wheelset axle according to the invention, which can already be taken into account in the casting process.

Ways of carrying out the invention and industrial usability:

[0025] A preferred embodiment of the invention is explained with reference to the attached Figure 1. It shows a cross-section of a part of the wheelset axle for rail vehicles according to the invention. The part of the wheelset axle shown corresponds to device 1 according to the invention, which is preferably of rotation-symmetric construction.

[0026] Device 1 initially comprises an axle tube 2 extending in longitudinal direction LR. The walls of the axle tube 2 are preferably cast from an aluminum casting alloy, preferably AlSi7Mg0.3 or AlCu4Ti. The casting condition or material condition preferably corresponds to ST6. Providing higher mechanical properties on the component is supported by casting technology. In the embodiment shown, the axle tube 2 is initially hollow on the inside in the longitudinal direction. Depending on the variant, struts can be arranged within the axle tube 2 .

[0027] It is not shown in Fig. 1 that the axle tube 2 of device 1 extends further into the opposite direction to the longitudinal direction LR and that it forms a first end section of a wheelset axle which is not shown in full. At its oppositely arranged second end section, the wheelset axle merges into an axle tube of a second device rotated in mirror image by 180° with respect to an axis of rotation DA - with the axis of rotation being oriented perpendicular to the longitudinal direction LR. The second device is therefore also part of the wheelset axle. Due to symmetry, the second device is identical to the first device 1, wherein the longitudinal direction of the second device - corresponding to the orientation of the second device 2 rotated with respect to the first device 1 - is oriented in mirror image opposite to the longitudinal direction LR of the first device 1. The wheelset axle with first device 1 and second device can be mounted in a wheelset bearing which is not shown.

[0028] The axle tube 2 of device 1 ends in the longitudinal direction LR in a first wheel flange 3. Preferably, the first wheel flange 3 is formed in a disk-like manner and connected to a wheel 8, a wheel hub 9 and a second wheel flange 6 via a screw connection. The wheel hub 9 with adapted collar sits on a mandrel 7 and is inserted with a fit at the end of the axle made of aluminum. The first wheel flange 3 and the tube wall of the axle tube 2 are formed in such a manner that the loads can be optimally absorbed by the component. Opposite to the wheel hub 9, the wheel flange 6 is firmly screwed to the wheel 8. Low-wear materials can be used there to reduce noise and shocks.

[0029] Opposite the first wheel flange 3, a second wheel flange 6 with a wheel bearing and cone (mandrel) is arranged. The second wheel flange 6 is preferably also formed in disk-like manner and flanged to wheel 8 on that side of wheel 8 which is opposite the first wheel flange 3. The second wheel flange 6, the wheel 8 and the first wheel flange 3 are fixedly connected to each other by means of several calculated screws 14, which extend through the first wheel flange 6, the wheel 8 and the second wheel flange 3. It is understood that from the inventive idea, other known detachable fasteners can also be used instead of a screw 14. The wheel support 4 comprises a wheel bearing 5 and a mandrel 7 in addition to the second wheel flange 6. Preferably, the wheel support 4 is formed in one piece. The wheel support 4 is produced as a casting made of steel or other materials that meet the mechanical requirements.

[0030] The mandrel 7 of the wheel support 4 is formed as a cone and is arranged at the level of the wheel hub 9 of the wheel 8. It extends in the opposite direction to the longitudinal direction LR through the wheel hub 9 of the wheel 8 into an inner space of the axle tube 2. In this case, it is positively connected to the wheel hub 9 of the wheel 8. In the inner space of the axle tube 2, it rests against the inner walls of the axle tube 2. The material thickness of the walls of the axle tube 2 therefore varies at least in the region of the mandrel 7 so that the diameter of the inner space of the axle tube 2 adapts to the diameter of the tapering mandrel 7. The mandrel 7 ends within a tolerance at a fastening element 11 which is cast into the interior of the axle tube 2, which fastening element is discussed below.

[0031] The wheel support 4 is provided with a bore which serves for a fixed connection,

preferably a screw connection, of the wheel support 4 to the cast part 11 as a fastening element. The screw connection is implemented here with a spring washer in order to compensate for the different coefficients of expansion in the event of temperature changes (not shown). Furthermore, support ribs are arranged on the outer sides of the axle tube 2 between the axle tube 2 extending in the longitudinal direction LR and the first wheel flange 3 extending vertical to the longitudinal direction LR. The support ribs serve to stabilize against loads and forces acting in longitudinal and transverse directions on the first and second wheel flanges 3, 6 with the wheel 8 arranged therebetween. The position and size of the optional support ribs are to be arranged and designed in accordance with the calculation and the installation space.

[0032] The wheel 8 is a turned part made of steel and can be manufactured separately from normal round steel. The centrally arranged axle tube 2 with wheel flanges 3, 6 on both sides accommodates the wheels 8 on both sides, the wheels 8 being screwed to the axle tube 2 via the mandrel 7 designed as a cone with the wheel bearings 5 and the wheel flanges 3, 6.

Patentkrav

1. Indretning (1) til skinnekøretøjer, omfattende:
- et overvejende hult akserør (2), der strækker sig langs en langsgående retning (LR) og ender i en første hjulflange (3);
- en hjulholder (4), der strækker sig modsat den langsgående retning (LR), omfattende et hjulleje (5), en anden hjulflange (6) og en dorn (7) som konus, hvor den anden hjulflange (6), den første hjulflange (3) og et hjul (8), der er anbragt derimellem, er forbundet med hinanden med et hjulnav (9) via en flangeforbindelse, **kendetegnet ved, at** dornen (7) fra hjulholderen (4) som konus formsluttende modsat den langsgående retning (LR) gennem hjulets (8) hjulnav (9) indføjes i akserørets (2) indre rum og ender i et fastgørelseselement (11), der er anbragt og indstøbt i akserøret (2), og er forbundet med dette.

2. Indretning (1) ifølge krav 1, **kendetegnet ved, at** akserøret (2) er støbt af en aluminiumslegering.

3. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** akserøret (2) er støbt af AC-AlSi7Mg0,3 eller AC-AlCu4Ti.

4. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** forbindelsen mellem dornen (7) og fastgørelseselementet (11) resulterer af en sammenskruning.

5. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** dornen (7) er støbt af stål eller et andet materiale, der opfylder lignende mekaniske krav.

6. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** fastgørelseselementet (11) som rotationssymmetrisk drejedel er dannet af stål, der forsynet med indsnøringer er støbt og skrumpeindsat i akserøret 2.

7. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** akserørets (2) vægtykkelse er tilpasset til spændingernes optimale forløb via belastninger og kræfter og til konstruktionsrummets betingelser.

8. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** akserøret (2) omfatter indstøbningsdele som fastgørelseselementer (11) as stål.

9. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** ribninger i det mindste delvist er anbragt i akserøret (2) til stabilisering.

10. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** der på akserørets (2) ydersider mellem akserøret (2), der forløber i den langsgående retning (LR), og den første hjulflange (3), der strækker sig vertikalt i forhold til den langsgående retning (LR), er anbragt støtteribber.

11. Indretning (1) ifølge et af de foregående krav, **kendetegnet ved, at** ribninger afsnitsvist er anbragt i akserøret (2).

12. Hjulsætaksel til skinnekøretøjer, omfattende en første indretning (1) ifølge et af kravene 1 til 11 og en anden indretning ifølge et af kravene 1 til 10, der er anbragt spejlvendt i forhold til den langsgående retning (LR) af den første indretning (1), hvor den første indretnings (1) akserør (2) er et første endeafsnit af en aksel, og den anden indretnings akserør er et andet endeafsnit af akslen, der ligger modsat det første endeafsnit.

13. Hjulsætaksel ifølge krav 12, **kendetegnet ved, at** akserøret (2), der er anbragt i midten med hjulflanger (3, 6) i begge sider optager hjulene (8) i begge sider, hvor hjulene (8) ved hjælp af en som konus udformet dorn (7) med hjullejer (5) og hjulflanger (3, 6) er skruet sammen med akserøret (2).

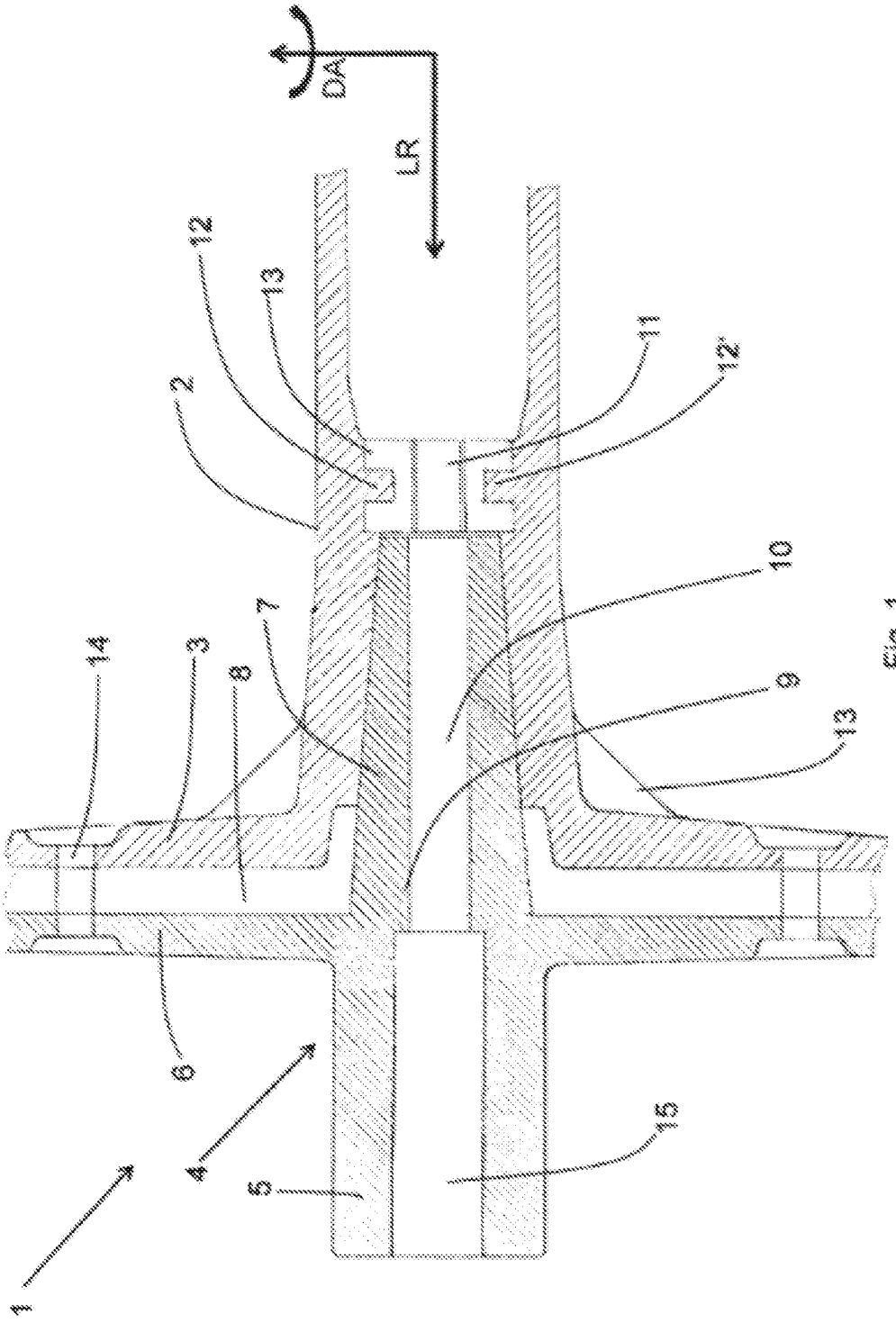

Fig. 1