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

(11) **EP 3 789 262 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.03.2021 Bulletin 2021/10

(51) Int Cl.:
B61F 5/30 *(2006.01)* ***B61F 5/32*** *(2006.01)*

(21) Application number: **20466003.9**

(22) Date of filing: **08.09.2020**

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

(30) Priority: **09.09.2019 CZ 20190571**

(71) Applicant: **VÚKV a.s.**
158 00 Praha 5 (CZ)

(72) Inventors:
- **Capek, Jan**
  19800 Praha 9 (CZ)
- **Bauer, Petr**
  17000 Praha 7 (CZ)
- **Fridrichovský, Tomás**
  58601 Jihlava (CZ)
- **Heptner, Tomás**
  16000 Praha 6 (CZ)
- **Krulich, Pavel**
  18200 Praha 8 (CZ)
- **Malkovský, Zdenek**
  16000 Praha 6 (CZ)
- **Mourecek, Zdenek**
  26727 Liten (CZ)
- **Musil, Jan**
  53361 Choltice (CZ)
- **Získal, Tomás**
  26705 Nizbor (CZ)

(74) Representative: **Loskotová, Jarmila**
K Závetinám 727
155 00 Praha 5 (CZ)

(54) WHEELSET GUIDING FOR RAILWAY VEHICLE IN PARTICULAR FOR A FREIGHT CAR

(57) Wheelset guiding system for railway vehicle bogie, especially for freight car, which is composed from bogie frame (1) and at least two wheelsets (2) with wheels (2a), which are connected with the bogie frame (1) by swing arms (6), which are with the wheelsets (2) assembled by bearings (3) and bearings adapters (4) and obliquely positioned flexible elements (5) on bearing adapter interface (4b) and swing arms (6) are connected by joints (9) and by at least one bogie spring (10) with bogie frame (1), where on the swing arm (6) is arranged at least one bracket (6d) for flexible part (5) mounting and where on the swing arm (6) is arranged at least one guiding bracket (6a) pro the stabilization of the bearing adapter (4) position due to the surface (4c). Invention with advantage minimize hysteresis in the longitudinal movement of the bearing adapter (4) adjacent to the wheelset (2) and allows simultaneously optimize the conditions for stable run in straight track and conditions for wheelset (2) steering in curve by the optimised stabilization force between bearing adapter (4) and guiding bracket (6a) adjacent to the swing arm (6), which optimization is possible simultaneously by two parameters - by vehicle gravity and by position angle of flexible element (5) depending on the vehicle gravity, which effect is allowed due to the swing arm rotation (6).

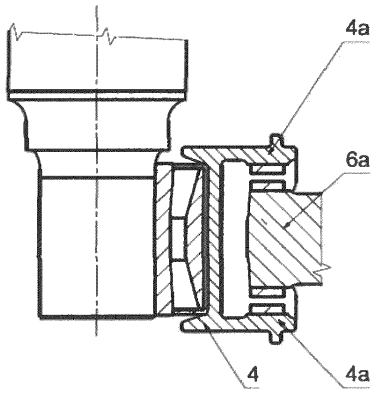

Fig. 6

EP 3 789 262 A1

Description

The field of technology

[0001] The presented invention relates to railway vehicles, in particular freight cars, specifically wheelset guiding system.

The prior art

[0002] Wheelset guiding represents a link between the wheelset and bogie frame. The stiffness of this link shall ensure a stable vehicle ride in the rail without undesirable wheelset yaw oscillation, in other words a stable vehicle ride is ensured. Stable run of the vehicle is ensured by high stiffness of the wheelset guidance and also by friction dumping of wheelsets movements that occurs in its guidance, which reduces undesirable yaw oscillations of the wheelset. At the ride - on start of the curve - the wheel flange starts to attack the rail head side, and as a consequence the bogie starts to turn under vehicle car body. Wheel flange attack leads to the wear of both wheel and rail, significantly higher when compared to the ride in the straight track. It is generally advantageous, when the wheelset guiding allows so called wheelset steering, i.e. the wheelset axis is in curve close to the theoretical radial position, which reduce the wear when passing curve. Simplified - as a theoretical radial position is considered the situation when the wheelset axis goes through the curve radius centre point. The radial position is achieved by a longitudinal movement of the wheelset bearing, other words the wheelset rotates around it's vertical axis - it is so called radial steering. The single wheelsets. in the bogie rotate each to other, one in a clockwise direction and the second one in opposite direction. A low longitudinal stiffness of the wheelset guiding supports the wheelset steering. For a correct function of the wheelset steering is important to make the wheelset guiding system in the longitudinal direction free from a hysteresis - e.g. friction resistance. This is important especially in the moment when the vehicle rides through a transition curve - from curve to the straight. In the case when the wheelset rotation around the vertical axis is influenced by a hysteresis, the wheelsets in the bogie do not return back to the parallel position after leaving the curve. When the wheelsets are not in the parallel position during the ride through the straight, the wheelset is negatively influenced by a permanent effect of the wheel flange attack on to the rail head. This leads to a high wear between the rail and wheel flange - similar to the wear in the curve. The effect of the wheel flange attack on the rail head in the straight track causes an enormous wear and is a symptom of a bad function of the wheelset guiding. Design of the wheelset guiding system represents a difficult compromise at choice between the good properties for the wheelset stabilization and at the good properties for the minimizing of the hysteresis in the guiding for the good steering. Solution of this problem is more complicated by the effect of the high ratio between the gravity force of the loaded and empty vehicle. The loaded freight vehicle can be six times more heavier as the empty vehicle.

[0003] The most spread freight car bogie in the central Europe is the bogie known under the designation Y25. Wheelset guiding system of this bogie is described e.g. in the document FR1340882A. The wheelset guiding system is based on the fix wheelset guidance brackets. The axle box is arranged between these brackets. The wheelset stabilization is ensured by a piston force, which permanently push the axle box on to the one bracket. The piston force - the stabilization force - is produced by a obliquely orientated "Lenoir link" - with a help of a vector gravity force resolution on this link. The link force is derived from the bogie suspension - from one spring load. Advantage of this system is the fact that the force value is adjustable by a link angle and the number of springs acting on to the link. Count of the springs that support the vehicle gravity is based on vehicle load and mutually increase. On the other hand, count of the springs acting on the Lenoir link remains the same with increasing load. Due to this effect, increase of the piston force is not equal to increasing load, but increases slower than the ratio between empty vehicle and loaded vehicle. The piston force is set for the state - empty vehicle with the help of link angle. For the full loaded vehicle is the piston force optimized with the help of the stiffness and number and the way haw are the springs jointed to support the vehicle gravity. Thanks to this, the piston force in loaded state is optimized and this allows the wheelset to turn around the vertical axis. I.e. to be closer to the radial position, which reduces the wear. The significant disadvantage of this system is the fact, that the wheelset rotation strongly depends on the piston movement in the piston guiding bush. The piston movement is influenced by a relative high friction in the piston guiding bush. This friction worse the piston movement or the piston is blocked in the bush due to its jamming. This resistance is reason why the wheelsets do not return into the parallel (nominal) position after leaving the curve. This also leads to a significant wear in the straight track.

[0004] The solution according to EP1484228 (A1) - 2004-12-08 tries to improve the piston leading - movement parameters. This solution also allows to set the piston force as at the solution according to FR1340882A. The piston guiding bush with undesirable hysteresis is changed for the rubber element. This solution was not applied in the praxis because of low load capacity of such element and also very short working life. In addition - this sensitive element is not possible to check in operation by an "eye check".

[0005] Another example of the wheelset guiding is the solution according to the document US3211112 (A) - 1965-10-12. A full loaded rubber spring is arranged between bearing adapter and bogie frame - between guiding brackets - in an oblique position. The resistance against the longitudinal movement is given only by a stiffness of this rubber spring. So the longitudinal movement

is without any friction resistance in comparison to the document FR1340882A. The position between guiding brackets is defined by gravity force resolution on this obliquely arranged rubber element. The stabilization force is given by a position angle of the rubber spring and value of the gravity force which acts form the side frame on the spring. The position of the rubber spring is constant only, i.e. the angle - force resolution - can not depend on the vehicle loading state. At this solution the angle shall be optimized for the state of empty vehicle in order to create the stabilization force ensuring a stable vehicle ride. Disadvantage of this solution is that the stabilization force is given by the constant spring angle only, i.e. that the value of the stabilization force rise with the loading strongly equal, more progressively in comparison to the solution acc. to the document FR1340882A. The reason is that it is impossible in this solution to change the number of the springs supporting the vehicle gravity force and producing the stabilization force. So the stabilization force at this solution is too high for the loaded vehicle, too much higher that would be optimal for the wheelset steering. Such high stabilization force does not allow the wheelset steering for the loaded vehicle and this leads to a higher wear between the wheel and rail.

The gist of invention

[0006] The goal for the presented invention is remove above mentioned disadvantageous and create a guiding wheelset system for railway vehicle, especially for freight car, which is characterized by a minimal hysteresis at wheelset steering and allows to set an optimal stabilization force values not only by the vehicle gravity force, but simultaneously using by another parameter. This parameter is the position angle of the flexible part arranged on the bearing adapter or on axle box and it's variation. This solution combines advantages of the optimal stabilization force characteristics - how to increase the stabilization force in good dependency on the vehicle loading and simultaneously keeping the advantage of the minimal hysteresis in wheelset guiding system in longitudinal direction.

[0007] The design of the this invention is partly based on some existing solutions, wherein the presented wheelset guiding assembly has new arrangement, and is equipped with new components thus completely new wheelset arrangement with new properties is achieved. The principal of the new a guiding wheelset system for railway vehicle, especially for freight car comprising a swing arm, which is jointed to the bogie frame by a flexible joint and comprising bracket as a part of the swing arm which is mounted on the obliquely arranged flexible part, which is arranged on the bearing adapter or axle box. The consequence of this design is that not only the swing arms, but also the flexible elements are rotating at the state of loaded vehicle. This effect influences with advantage the force by which is the bearing adapter pushed on to the swing arm guiding bracket, i.e. the stabilization force. In this way the stabilization force is adjusted not only by the vehicle gravity force value, but also by the force resolution on the obliquely arranged flexible part, which angle position with advantage depends also on the loading.

[0008] The base of this solution is the wheelset guiding by the swing arm e.g. according to the document CZ PV2018-298. The swing arm is jointed to the bogie frame by a flexible joint and comprising bracket as a part of the swing arm for the connection with the flexible part. Internal and external guiding brackets are also arranged on the swing arm. The bearing adapter or axle box is arranged n the wheelset bearing. An interface for the flexible part is arranged on the upper part of the bearing adapter. A surface for the contact with the swing arm internal guiding bracket is arranged on the bearing adapter side. The value of the stabilization force acting between the bearing adapter and the internal guiding bracket is given by the vehicle gravity force and the flexible part position angle related to the top of rail lateral surface. The position angle is adjusted for the empty vehicle to set exactly the stabilization force ensuring the stable vehicle ride. The vehicle gravity force is increasing simultaneously with vehicle loading. The longitudinal stabilization force given by the force resolution on the flexible part is simultaneously increased with the vehicle load (vehicle gravity force). But - simultaneously with the rising vehicle gravity force is rotating the swing arm. Flexible part position angle related to the top of rail surface is with advantage by the rotation of the swing arm. This effect with advantage reduces the increasing tempo of the by resolution given stabilization force - i.e. the stabilization force rise slower as the ratio between the loaded and empty vehicle. By this described parameters - start flexible part position angle and the rotation angle value of the swing arm due to the loading is possible to optimize the force pushing the bearing adapter on to the internal guiding bracket - i.e. stabilization force - for all vehicle load states. The rotation angle value of the swing arm due to the loading is set by the bogie spring characteristics. The longitudinal movement of the bearing adapter or bearing box is allowed by the flexibility of the rubber flexible part arranged between the adapter and swing arm - so the hysteresis is minimized at this movement - there is no friction resistance. This solution ensures stable ride of the empty vehicle and simultaneously maximally supports the effect of the wheelset steering - i.e. minimizing of the wear between the wheel and rail in the curve. Due to the minimal hysteresis is disclosed a risk, that the wheelset does not come in to the parallel position after leaving curve. The flexible part can be designed as a unique or splitted part - i.e. performed in more parts as an one. Independent on the flexible part numbers the flexible part can be shaped in a "V" or "U" shape or totally generally shaped. By this shaping is possible with advantage to set the lateral wheelset guidance parameters. The bogie spring can be orientated in the bogie in a lateral or vertical or in oblique position The swing arm and bear-

ing adapter are equipped with brackets and stop for limiting of the lateral displacement between the wheelset and swing arm. This brackets and stop is with advantage possible to place close to the swing arm joint, which wit advantage reduce the lateral torque acting on the swing arm. The guiding system is also equipped by the wheelset retainer and bearing adapter retainer, which are used at bogie or vehicle lifting on the lifting jacks or by the crane.

[0009] Above described invention with advantage minimizes hysteresis in the longitudinal movement of the bearing adapter in longitudinal direction. (i.e. wheelset rotation around the vertical axis) and ensures the stabile ride in straight track and simultaneously supports wheelset steering in curve due to the fact, that this invention allows to optimize the lateral force between adapter and guiding bracket - stabilization force - simultaneously by two parameters - vehicle gravity force and flexible part position angle, which with advantage is changing in dependency on vehicle gravity force due to the swing arm rotation.

Brief description of the drawings

[0010] Invention is more explained on the figures. On fig. 1 is show the principle of the force resolution on the obliquely arranged flexible element - 1a) at the empty vehicle, 1b) - at the loaded vehicle, on the fig. 2 is an example of the flexible part shaping and arrangement in to the "V" shape and splitting in to the two parts, on the fig.3 is the diagram of the stabilization force characteristics depending on the vehicle load, on the fig. 4 is the side view on the wheel guiding assembly arrange at one wheel of railway vehicle, on the fig. 5 is the guidance assembly in an axonometric view and on the fig. 6 is a section view on the bearing adapter or axle box an internal guiding brackets arranged on the swing arm.

Examples of the invention embodiment

[0011] On the fig. 1, fig. 2, fig 3, fig 4, fig 5 and fig 6 is shown an arrangement of the wheelset guiding system for the railway vehicle especially for the freight car, system comprising swing arms 6, which are in rotation flexible jointed with the bogie frame 1 by the joints 9, this swing arms loads by the brackets 6d flexible part 5. Swing arm 6 rotation, together with the brackets 6d, both depends on the vehicle loading and bogie spring 10 characteristic. On the wheelset 2 with wheels 2a are arranged bearings 3, on the bearings 3 is arranged bearing adapters or axle box 4. On the bearing adapter 4 is created an interface 4b, on this interface 4b is arranged the flexible part 5. Based on the oblique spring part 5 position the gravity force resolution produce longitudinal force which push the bearing adapter 4 and its 4c on to the swing arm 6 bracket 6a. Due to the vehicle loading increases the vehicle gravity force, as a consequence rotate swing arms 6 with brackets 6d around the joint 9 and the position angle of the flexible part 5 changes in relation to the top of rail surface, which with advantage reduce the tempo of the increment of the force which push the adapter 4 and its surface 4c on to the guiding bracket 6a - i.e. the stabilization force. The swing arm 6 are equipped by a stop 6c and the adapter 4 is equipped by brackets 4a for limiting of the lateral wheelset movement between the wheelset and swing arm. The wheelset movement in direction from the bogie centre is blocked by the swing arm bracket 6b. The wheelset guiding assembly is equipped by a wheelset 2 retainer 7 and adapter 4 retainer 8, which ensure the assembly at bogie or vehicle lifting on jacks or on crane.

[0012] On the fig. 1a is also shown the principle of the gravity force resolution the obliquelly arranged flexible part 5 at the empty vehicle, where the swing arm 6 position angle is marked (plus) and on the fig. 1b is shown the gravity force resolution on the flexible part at the loaded vehicle, where the swing arm 6 position angle is marked as (minus). From the pictures it is obvious that the stabilization force is regulated not only by the vehicle load, but also by the flexible part 5 position angle which depends on the vehicle load. On the fig. 11 the curve 11a stabilization force dependency on the vehicle load at the solution acc, to the document FR1340882A, 11b stabilization force dependency on the vehicle load at the solution acc, to the document US3211112 (A) and 11c force dependency on the vehicle load at the solution acc, to the presented invention.

[0013] On the fig. 3 is shown stabilization force dependency on the vehicle load. It is obvious that the solution 11a is advantageous for steering but this solution is connected with the disadvantage of the high hysteresis, 11b is solution without hysteresis, but the stabilization force is to high at the loaded vehicle and 11c shows an optimal stabilization force characteristic and is without hysteresis.

Industrial applicability

[0014] The wheelset guidance is applicable at all railway vehicles bogies, especially at the freight car bogies.

Claims

1. A wheelset guiding in a railway bogie, particularly in bogie for a freight car, comprising a bogie frame (1) and at least two wheelsets (2) with wheels (2a) coupled to the bogie frame (1) by swing arms (6), which are assembled to the wheelsets (2) by bearings (3) and bearing adapters (4) with flexible parts (5) arranged in an oblique position on interface (4b) and swing arms (6) are coupled by joint (9) and by at least one bogie suspension spring (10) with bogie frame (1) **characterized in that** in the wheelset guiding assembly is on the swing arm (6) at least one bracket (6d) fitted for the swing arm (6) mounting on the obliquely arranged flexible part (5) and there is

arranged at least one internal guiding bracket (6a) on the swing arm (6) for the stabilization of the position of the bearing adapter (4) by the surface (4c) and internal guiding bracket (6a) on the swing arm (6).

2. The wheelset guiding system according to claim 1 **characterized in that** flexible part (5) arranged between bearing adapter (4) and swing arm (6) is compact or segmented.

3. The wheelset guiding system according to claim 1 **characterized in that** flexible part (5) is flat shaped, or "V" shaped or "U" shaped.

4. The wheelset guiding system according to claim 1 to 3 **characterized in that** flexible part (5) is made from rubber.

5. The wheelset guiding system according to any claims 1 to 4 **characterized in that** the brackets (4a) and the lateral stop (6c) for limitation of wheelset (2) lateral movement are orientated in the direction from wheelset (2) axis to joint (9) of the swing arm (6).

6. The wheelset guiding system according to any claims 1 to 5 **characterized in that** the bogie spring (10) can be orientated lateral, or vertical, or obliquely related to the top of rail.

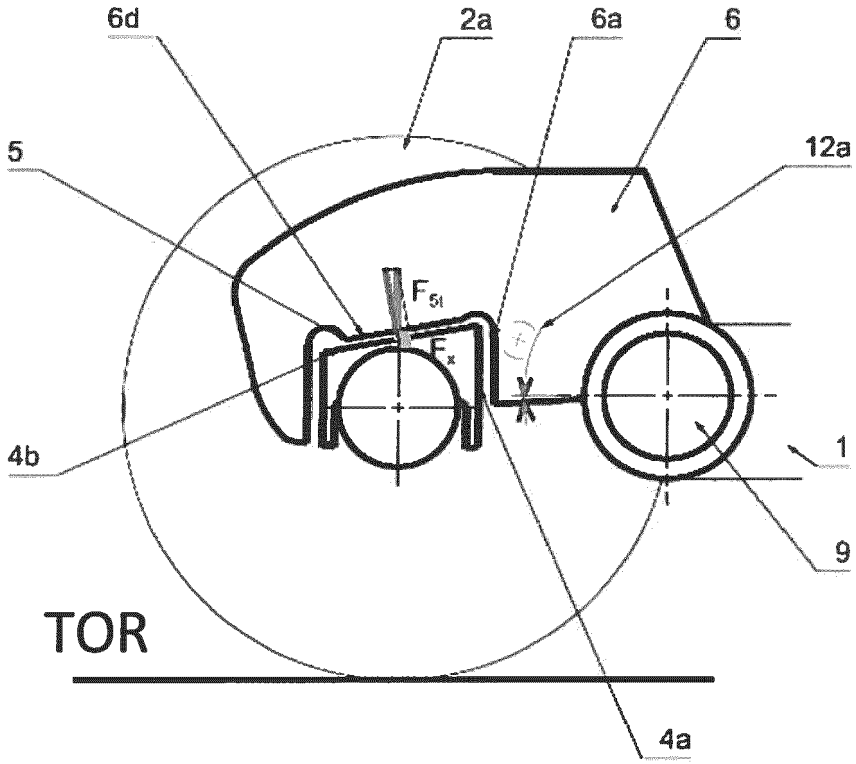
6d
2a
6a
6
12a
5
F_{5t}
F_x
4b
1
9
TOR
4a

Fig. 1a

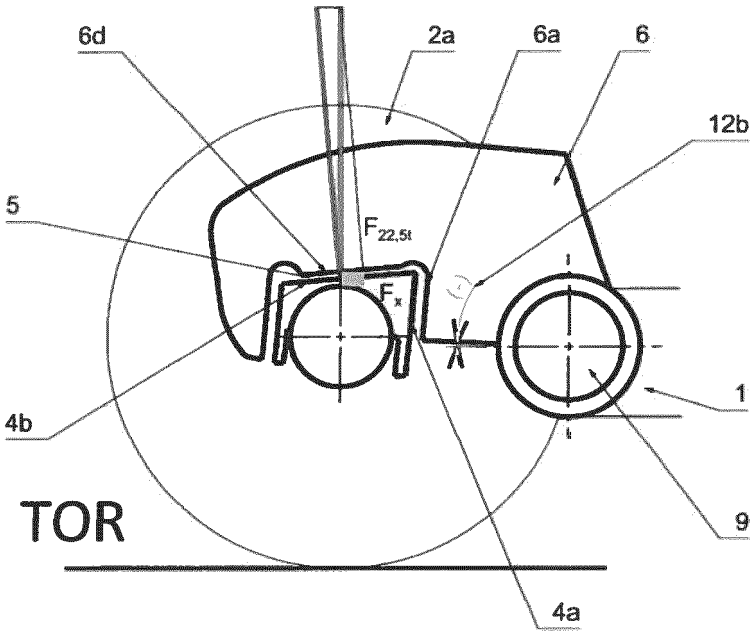
6d
2a
6a
6
12b
5
$F_{22,5t}$
F_x
4b
1
9
TOR
4a

Fig. 1b

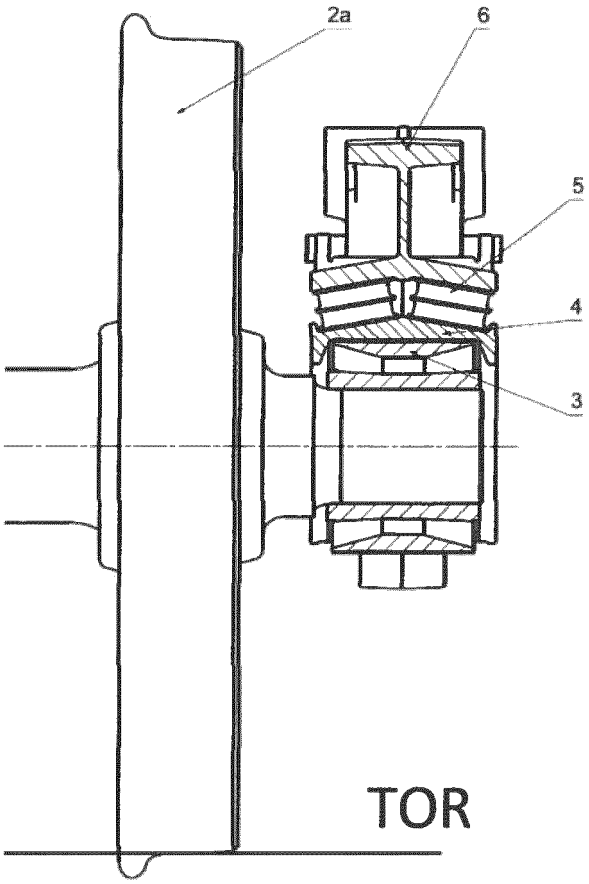
2a
6
5
4
3
TOR

Fig. 2

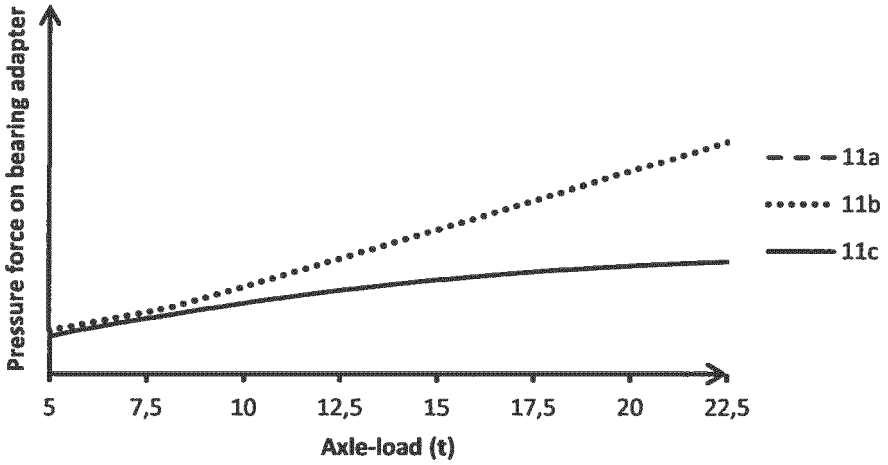
Pressure force on bearing adapter
11a
11b
11c
5
7,5
10
12,5
15
17,5
20
22,5
Axle-load (t)

Fig. 3

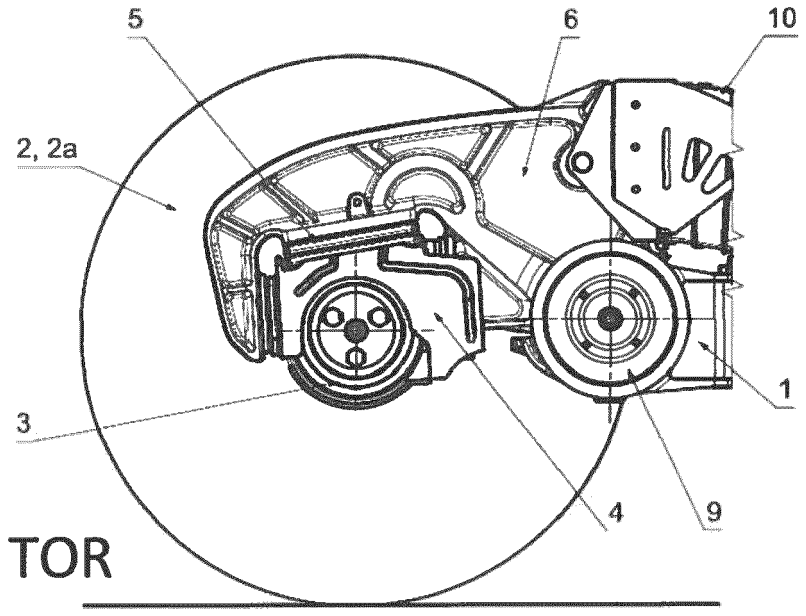

Fig. 4

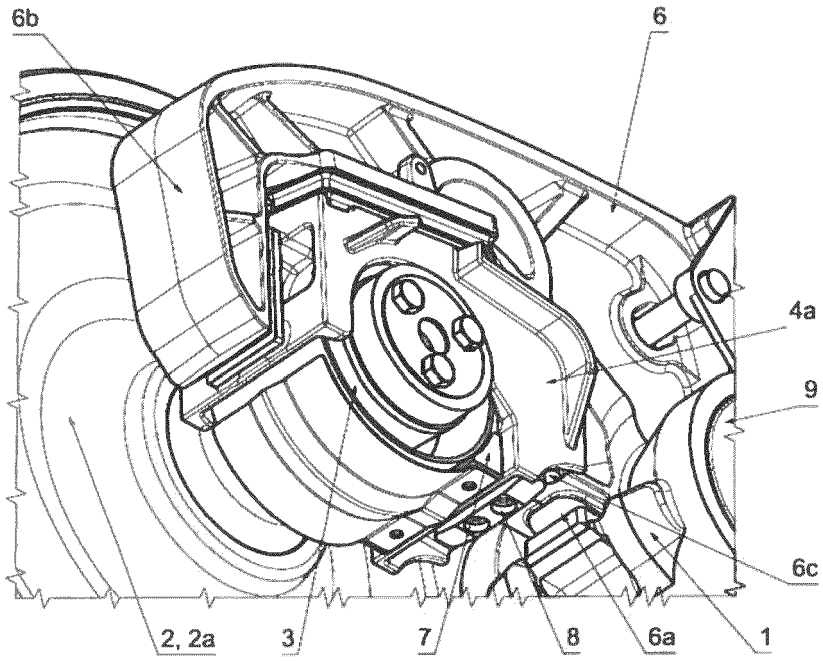

Fig. 5

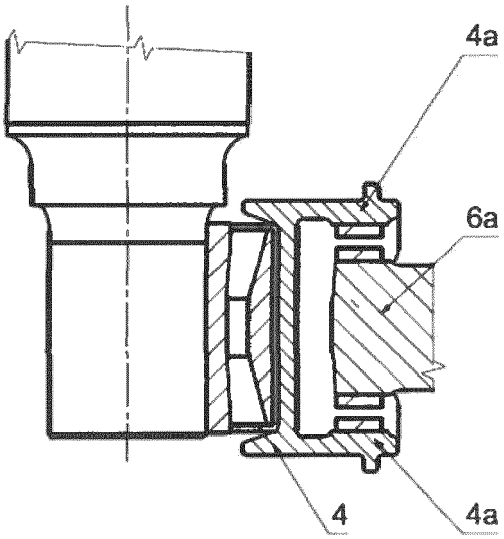

Fig. 6

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 46 6003

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 3 299 247 A1 (VÚKV A S [CZ]) 28 March 2018 (2018-03-28) * paragraph [0005]; figures 1, 2 *	1-6	INV. B61F5/30 B61F5/32
Y	US 2018/257681 A1 (WIKE PAUL STEVEN [US]) 13 September 2018 (2018-09-13) * figures 1-5B *	1-6	
A	US 3 211 112 A (BAKER ARTHUR F) 12 October 1965 (1965-10-12) * column 2, lines 7-8; figures 1, 3, 4 *	1	
A	US 5 509 358 A (HAWTHORNE V TERREY [US] ET AL) 23 April 1996 (1996-04-23) * figures 4, 5, 7 *	1	
A	US 5 562 045 A (RUDIBAUGH JOHN W [US] ET AL) 8 October 1996 (1996-10-08) * figures 1, 12 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
B61F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 December 2020	Denis, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 46 6003

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

08-12-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3299247 A1	28-03-2018	NONE	
US 2018257681 A1	13-09-2018	AU 2018201620 A1	27-09-2018
		BR 102018004554 A2	02-01-2019
		CA 2995813 A1	09-09-2018
		CN 108569308 A	25-09-2018
		RU 2675337 C1	19-12-2018
		US 2018257681 A1	13-09-2018
		ZA 201801242 B	19-12-2018
US 3211112 A	12-10-1965	NONE	
US 5509358 A	23-04-1996	CA 2156547 A1	09-06-1996
		MX PA95003730 A	13-10-2005
		US 5509358 A	23-04-1996
US 5562045 A	08-10-1996	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- FR 1340882 A **[0003] [0004] [0005] [0012]**
- EP 1484228 A1 **[0004]**
- US 3211112 A **[0005] [0012]**
- CZ PV2018298 **[0008]**