



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.03.2020 Bulletin 2020/13

(51) Int Cl.:
B61G 7/10 (2006.01) **B61G 11/16 (2006.01)**
B61G 5/02 (2006.01)

(21) Application number: **18196006.3**

(22) Date of filing: **21.09.2018**

(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

(72) Inventors:
• **LAIB, Ahmed**
59510 Hem (FR)
• **FRAIKIN, Bruno**
59700 Marcq-En-Baroeul (FR)
• **ZBOROWSKI, Christian**
59410 Anzin (FR)

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

(74) Representative: **Alatis**
109 Bd Haussmann
75008 Paris (FR)

(54) **STRUCTURAL LINK BETWEEN TWO RAIL VEHICLE SUBASSEMBLIES AND ASSOCIATED RAIL VEHICLE ASSEMBLY**

(57) A permanent structural link (18) for permanently linking a first subassembly of a rail vehicle assembly with a second subassembly of the rail vehicle assembly, comprises: an energy absorption unit (20) comprising a permanently deformable cylinder (28), which defines a reference axis (100) and a widened portion (30), which has an inner cross-sectional area greater than the permanently deformable cylinder (28), a piston (24) comprising an end portion (44) provided with a non-deformable piston head (52), wherein the piston head (52) in a service position is received in the widened portion (30) of the energy absorption unit (20), wherein the piston head (52) is such as to effect a radial expansion of the permanently deformable cylinder (28) while moving within the perma-

nently deformable cylinder (28) in a stroke direction (200) parallel to the reference axis (100), and an annular guide (58) for guiding a relative translation motion between the piston (24) and the permanently deformable cylinder (28) in the stroke direction (200). The piston (24) comprises a piston rod (42) protruding from the end portion (44) in a direction parallel to the reference axis (100) and opposed to the stroke direction (200). The piston rod (42) is provided with an outer cylindrical sliding surface (74), and the annular guide (58) is fixed relative to the widened portion (30) of the energy absorption unit (20) and has an inner diameter such as to be in sliding contact with the outer cylindrical sliding surface (74) of the piston rod (42).

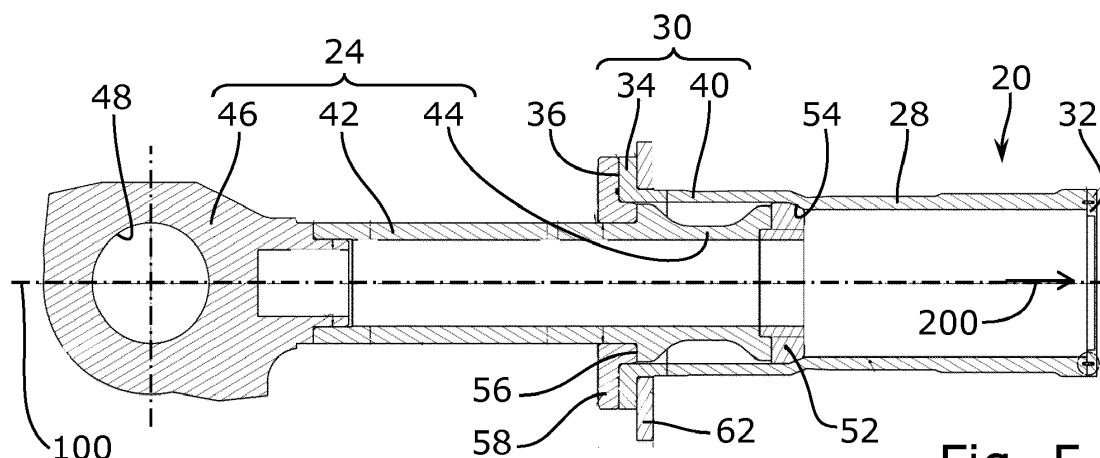


Fig. 5

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a structural link for permanently connecting two subassemblies of a rail vehicle assembly, such as two adjacent vehicle bodies or a vehicle body and a running gear.

BACKGROUND ART

[0002] A structural link for permanently connecting two subassemblies of a rail vehicle assembly is disclosed in US 2009/0008963 A1. This structural link comprises an energy absorption unit comprising a widened portion and a permanently deformable cylinder, which defines a reference axis. It further comprises a piston comprising an end portion provided with a non-deformable piston head, which is such as to effect a radial expansion of the permanently deformable cylinder while moving parallel to the reference axis within the permanently deformable cylinder in a stroke direction from an service position towards an end position. The piston is further provided with a guide for guiding a relative translation motion between the piston and the permanently deformable cylinder from the service position to the end position of the piston head. The guide protrudes from the piston head in the stroke direction and slides into the permanently deformable cylinder ahead of the piston head. The length of the permanently deformable cylinder is therefore greater than the stroke of the piston head from the service position to the end position to accommodate the guide in the end position. The piston is further provided with a bushing for receiving a pivot pin for articulating an end section of a coupling rod. The bushing defines a pivot axis perpendicular to the reference axis of the permanently deformable cylinder. The piston does not have a piston rod linking the bushing to the piston head. Hence, in the service position, the bushing protrudes outside the widened portion of the energy-absorption unit, but is very close to the widened portion. This may hinder the stroke motion of the piston head into the permanently deformable cylinder if the coupling rod is at angle with the reference axis of the permanently deformable cylinder during a collision.

SUMMARY OF THE INVENTION

[0003] The invention aims to provide an improved structural link for permanently connecting two subassemblies of a rail vehicle assembly.

[0004] According to a first aspect of the invention, there is provided a permanent structural link for permanently linking a first subassembly of a rail vehicle assembly with a second subassembly of the rail vehicle assembly, wherein the first subassembly and the second subassembly consist either of a first vehicle body and a second vehicle body or of a vehicle body and a running gear, wherein the structural link comprises:

- an energy absorption unit comprising a permanently deformable cylinder, which defines a reference axis and a widened portion, which has an inner cross-sectional area greater than the permanently deformable cylinder,
- a piston comprising an end portion provided with a non-deformable piston head, wherein the piston head in a service position is received in the widened portion of the energy absorption unit, wherein the piston head is such as to effect a radial expansion of the permanently deformable cylinder while moving within the permanently deformable cylinder in a stroke direction parallel to the reference axis, and
- an annular guide for guiding a relative translation motion between the piston and the permanently deformable cylinder in the stroke direction,

[0005] More specifically, the piston comprises a piston rod protruding from the end portion in a direction parallel to the reference axis and opposed to the stroke direction, the piston rod is provided with an outer cylindrical sliding surface, and the annular guide is fixed relative to the widened portion of the energy absorption unit and has an inner diameter such as to be in sliding contact with the outer cylindrical sliding surface of the piston rod at least when the piston head, after leaving the service position, moves towards the end position.

[0006] The permanently deformable cylinder does not need to have a length greater than the stroke of the piston head between the service position and the end position, since it does not have to accommodate the guide.

[0007] The piston rod and the annular guide cooperate to ensure that the piston head does not deviate from the stroke direction. During the stroke, the distance between the piston head and the annular guide increases while the distance between annular guide and the opposite end of the piston rod is reduced.

[0008] In practice, it is possible to define a predetermined collision threshold and a predetermined service limit lower than or equal to said collision threshold such that upon application of any collision load above said predetermined collision threshold in an axial direction parallel to the reference axis the piston head effects said radial expansion of the permanently deformable cylinder while moving parallel to the reference axis within the permanently deformable cylinder from the service position towards the end position, whereas upon application of any proof load or fatigue load below the predetermined service limit in the axial direction the piston head remains in the service position.

[0009] According to a preferred embodiment, the annular guide in the service position is press-fitted onto a cylindrical seat of the piston rod. The press-fitted connection defines a force threshold below which axial forces are transmitted between the piston and the annular guide without deformation of the energy absorption unit. Above

said threshold, the piston rod separates from the annular guide and the piston starts moving in the stroke direction while the piston rod slides within the annular guide.

[0010] According to a preferred embodiment, the annular guide in the service position bears axially against a shoulder of a collar of the widened portion of the energy-absorption unit and the shoulder of the collar of the widened portion of the energy-absorption unit faces a direction that has an axial component opposite to the stroke direction. The shoulder of the widened portion of the energy-absorption unit ensures that the annular guide does not move in the stroke direction relative to the energy-absorption unit.

[0011] Preferably, the annular guide is secured to the collar of the widened portion of the energy-absorption unit by means of fixing elements such as screws, bolts or rivets. The fixing elements ensure that the annular guide does not move relative to the energy-absorption unit in the axial direction opposite to the stroke direction. Preferably, the permanent structural link further comprises a mounting plate, wherein the collar of the widened portion of the energy-absorption unit is sandwiched between the mounting plate and the annular guide and the fixing elements secure the annular guide to the mounting plate through holes provided in the collar of the widened portion of the energy-absorption unit.

[0012] According to one embodiment, the collar of the widened portion of the energy-absorption unit is welded, preferably butt welded with an end of the permanently deformable cylinder. Alternatively, the energy absorption unit can be formed in one piece.

[0013] According to a preferred embodiment, the annular guide in the service position bears axially against a shoulder of the end portion of the piston, wherein the shoulder of the end portion of the piston faces a direction that has an axial component opposite to the stroke direction. The shoulder of the end portion of the piston ensures that the structural link can withstand traction forces in the reference direction, i.e. forces that tend to pull the piston in the direction opposite to the stroke direction.

[0014] To avoid any undesired play and wear during the lifetime of the structural link, the annular guide preferably bears axially against the shoulder of the end portion of the piston with a predetermined axial preload and the piston head in the service position bears axially against a shoulder of the widened portion of the energy-absorption unit with a predetermined axial preload, equal in magnitude to the axial preload between the annular guide and the shoulder of the end portion of the piston.

[0015] According to one embodiment, the annular guide is made of a material having a Vickers hardness greater than 600 HV, preferably greater than 630 HV. The hardness of the annular guide contributes to the absence of deformation or play of the permanent structural link during its lifetime in the service position.

[0016] According to one embodiment, the piston head in the service position is press-fitted into the widened portion of the energy-absorption unit. Preferably, the pis-

ton head has a tapered end face and the shoulder of the widened portion of the energy-absorption unit is tapered.

[0017] The piston head is preferably annular.

[0018] According to one embodiment, the end portion of the piston is made in one piece. Alternatively, the end portion of the piston can be made of several parts including a piston head body and the non-deformable piston head. The piston head is preferably press-fitted or otherwise affixed to a body of the end portion. According to a preferred embodiment, the piston head is press-fitted to the body of the body of the end portion and the connection is secured by means of fixing elements such as screws, preferably locked with glue.

[0019] According to a preferred embodiment, the non-deformable piston head is preferably made of a material having a Vickers hardness greater than 650 HV, preferably greater than 700HV. The high hardness of the piston head ensures a controlled expansion of the permanently deformable cylinder.

[0020] According to one embodiment, the piston rod is tubular.

[0021] According to one embodiment, the end portion of the piston and the piston rod are made in a single piece, preferably a tubular piece.

[0022] Advantageously, the permanent structural link further comprises a coupling eye integral with an end of the piston opposed to the end portion. The coupling eye is part of a hinge connection or of a ball joint.

[0023] According to another aspect of the invention, the hinge connection or ball joint is part of the structural link.

[0024] According to another aspect of the invention, there is provided a rail vehicle assembly comprising a first subassembly and a second subassembly of a rail vehicle assembly, wherein the first subassembly and the second subassembly consist either of a first vehicle body and a second vehicle body or of a vehicle body and a running gear, characterised in that the rail vehicle assembly further comprises a permanent structural link according to any one of the preceding claims for linking the first subassembly with the second subassembly. Preferably, the reference axis of the permanent structural link is parallel to a median vertical longitudinal plane of the rail vehicle assembly, and preferably parallel to a longitudinal axis of the rail vehicle assembly.

[0025] As stated above, it is possible to define a predetermined collision threshold and a predetermined service limit below said collision threshold such that upon application of any collision load above said predetermined collision threshold in an axial direction parallel to the reference axis the piston head effects said radial expansion of the permanently deformable cylinder while moving parallel to the reference axis within the permanently deformable cylinder from the service position towards the end position, whereas upon application of any proof load or fatigue load below the predetermined service limit in the axial direction the piston head remains in the service position.

[0026] The predetermined service limit is more than a standard proof load and a standard fatigue load of the rail vehicle according to the applicable standard load cases.

[0027] The predetermined service limit is more than a standard proof load and a standard fatigue load of the rail vehicle according to the applicable standard.

BRIEF DESCRIPTION OF THE FIGURES

[0028] Other advantages and features of the invention will then become more clearly apparent from the following description of a specific embodiment of the invention given as non-restrictive examples only and represented in the accompanying drawings in which:

- figure 1 is a side view of a region of a train set comprising two adjacent car bodies and a running gear;
- figure 2 is a longitudinal cross-section of a detail of figure 1;
- figure 3 is an isometric view from below of some parts of the region of a the train set illustrated in figure 1;
- figure 4 is an isometric view of a structural link between the running gear and one of the adjacent car bodies shown in figure 1;
- figure 5 is an axial section of the structural link of figure 4, along section plane V-V of figure 8;
- figure 6 is an axial section of the structural link of figure 4, along section plane VI-VI of figure 8;
- figure 7 is an axial section of a detail of the structural link of figure 4, along section plane VII-VII of figure 8;
- figure 8 is a front view of the structural link of figure 4.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0029] With reference to Figures 1 to 3, a train set 10 comprises a first car body 12, a second car body 14 and a running gear 16 located below adjacent ends of the first and second car bodies, 12, 14. A structural link 18 forms a permanent connection between the end of the first car body 12 and the second car body 18. The structural link comprises an energy absorption unit 20 fixed to the end of the first car body 12, a ball joint housing 22 fixed to the second car body 18 and a piston 24 for connecting the energy absorption unit 20 to the ball joint housing 22. The ball joint housing 22 has a vertical extension that protrudes through an aperture in a frame 26 of the running gear 16 and is linked to the frame 26 by longitudinal resilient members 27, which transfer longitudinal forces between the frame 26 of the running gear

16 and the ball joint housing 22.

[0030] The energy absorption unit 20 illustrated in figures 4 to 8 comprises a permanently deformable cylinder 28, which defines a reference axis 100, and an annular widened portion 30 at an open end of the permanently deformable cylinder 28. The opposite end of the permanently deformable cylinder 28 is closed with a cap 32. The axial direction 200 parallel to the reference axis 100 and directed from the open end towards the cap 32 is called stroke direction. The reference axis 100 is located in a median longitudinal vertical plane of the first car body 12. The reference axis 100 is preferably horizontal.

[0031] The widened portion 30 is coaxial with the permanently deformable cylinder 28 and has a slightly larger inner diameter than the permanently deformable cylinder 28. The widened portion 30 comprises a collar 34 that protrudes radially so as to form an annular planar shoulder 36 that faces in a direction opposite to the stroke direction 200. The collar 34 of the widened portion 30 is provided with a set of axial through holes 38. The collar 34 is welded, preferably butt welded with a widened extension 40 of the permanently deformable cylinder 30.

[0032] The piston 24 comprises a piston rod 42 and two opposite end portions, namely first end portion 44 which, in the service position depicted in the figures, is received in the widened portion 30 of the energy absorption unit 20, and a second end portion 46 opposed to the first end portion and provided with a coupling eye 48 for receiving the ball joint 49 fixed to the ball joint housing 22. The piston rod 42 protrudes from the first end portion 44 in a direction parallel to the reference axis 100 and opposed to the stroke direction 200. The piston rod 42 is tubular, as well as the first end portion 44.

[0033] The first end portion 44 of the piston 24 comprises a piston head body 50 integral with the piston rod 42 and a non-deformable tapered annular piston head 52 protruding at the free end of the first end portion 44 in the stroke direction 200. The piston head 52 is press-fitted onto the piston head body 50. The material of the piston head 52 has a greater hardness than the material of the permanently deformable cylinder 28. The hardness of the piston head body 50 is preferably greater than 650 HV, preferably greater than 700 HV. The piston head 52 in the service position bears axially against a tapered shoulder 54 of the widened portion of the energy-absorption unit 30, which marks the transition between the widened extension 40 of the widened portion 30 and the permanently deformable cylinder 28.

[0034] The first end portion 44 of the piston 24 is further provided with an annular planar shoulder 56, which faces the direction opposite to the stroke direction 200.

[0035] The energy absorption unit 20 further comprises an annular guide 58 for maintaining the piston 24 in the service position and guiding the piston 24 in translation parallel to the reference axis 100 in the stroke direction 200 relative to the permanently deformable cylinder.

[0036] The annular guide 58 bears axially against the shoulder 36 of the collar 34 of the widened portion 30 of

the energy-absorption unit **20** and is provided with through holes **60** coaxial with the through holes **38** of the collar **34**. The annular guide **58** has a hardness, which is preferably greater than 600 HV, preferably greater than 630 HV.

[0037] The structural link **18** further comprises a mounting plate **62** for securing the structural link **18** to the end of the first car body **12**. The mounting plate **62** is provided with threaded holes **64** that are coaxial with the through holes **60** of the annular guide **58** and the through holes **38** of the collar **34**. The collar **34** is sandwiched between the annular guide **58** and the mounting plate **62**. Fixing elements such as screws **66** engaged in the through holes **60**, **38** and threaded holes **66** are used to secure the annular guide **58** and the collar **34** to the mounting plate **62**.

[0038] When the screws **66** are tightened with a predetermined torque, the annular guide **58** bears axially against the shoulder **56** of the end portion **44** of the piston **24** with a predetermined axial preload and the piston head **52** bears axially against the tapered shoulder **54** of the widened portion **40** of the energy-absorption unit **30** with a predetermined axial preload, equal in magnitude to the axial preload between the annular guide **58** and the shoulder **56** of the end portion **44** of the piston **24**.

[0039] The mounting plate **62** is further provided with a set of through holes **68** for fixing the mounting plate **62** to the end of the first car body **12**, by means of fixing elements **70**.

[0040] The annular guide **58** in the service position is press-fitted onto a cylindrical seat **72** of the piston rod **42**. The piston rod **42** is provided with a smooth outer cylindrical sliding surface **74**, which has a diameter slightly smaller than the cylindrical seat **72**.

[0041] The structural link **18** operates as follows.

[0042] The tight sandwiched connection between the end portion **44**, the tapered shoulder **54** of the energy-absorption unit **20** and the annular guide **58** is such as to remain without play and without plastic deformation upon application of any proof load or fatigue load below a predetermined service limit in the axial direction the piston **24**. To this end, the axial preload of the annular guide **36** against the shoulder **56** of the end portion **44** of the piston **24** in the absence of external force is preferably greater than the predetermined service limit.

[0043] However, whenever a collision load above a predetermined collision threshold in an axial direction parallel to the reference axis **100** is applied, the press fit connection between annular guide **58** and the seat **72** is overcome and the piston head **54** effects a radial expansion of the permanently deformable cylinder **28** while moving parallel to the reference axis **100** in the stroke direction **200** within the permanently deformable cylinder **28** from the service position towards an end position closer to the cap **100**. The annular guide **58** has an inner diameter such as to be in sliding contact with the outer cylindrical sliding surface **74** of the piston rod **42** when the piston head **54**, after leaving the service position,

moves towards the end position.

[0044] The predetermined service limit is more than a standard proof load and a standard fatigue load of the rail vehicle according to the applicable standard load cases and less than the predetermined collision threshold.

[0045] In practice, the axial preload of the annular guide against the shoulder of the piston head in the absence of external force is greater than the predetermined service limit and smaller than the predetermined collision threshold.

[0046] The invention is not limited to this embodiment. As a variant, the end portion **44** of the piston is made in one piece, i.e. the piston head **54** and piston head body **50** are made in one piece. The energy absorption unit **20** can also be formed in one piece, i.e. the collar **64** can be made in one piece with the permanently deformable cylinder **28**. The cap **32** is optional. The mounting plate **62** can be integral with the collar **64**. The piston rod can **42** be a solid cylinder rather than a tubular cylinder.

[0047] The structural link **18** can be used in other train configurations, e.g. between two vehicle bodies **12**, **14**, or between a vehicle body **12** and a running gear **16** that is not a Jacob-type bogie.

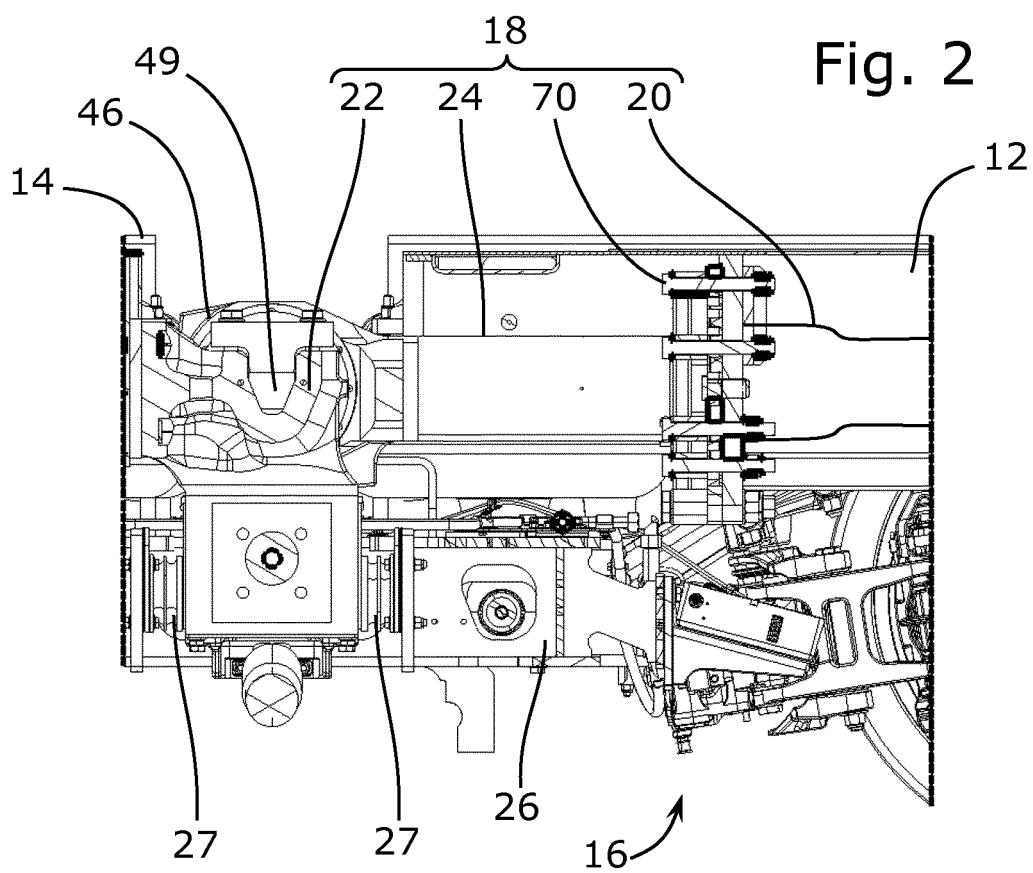
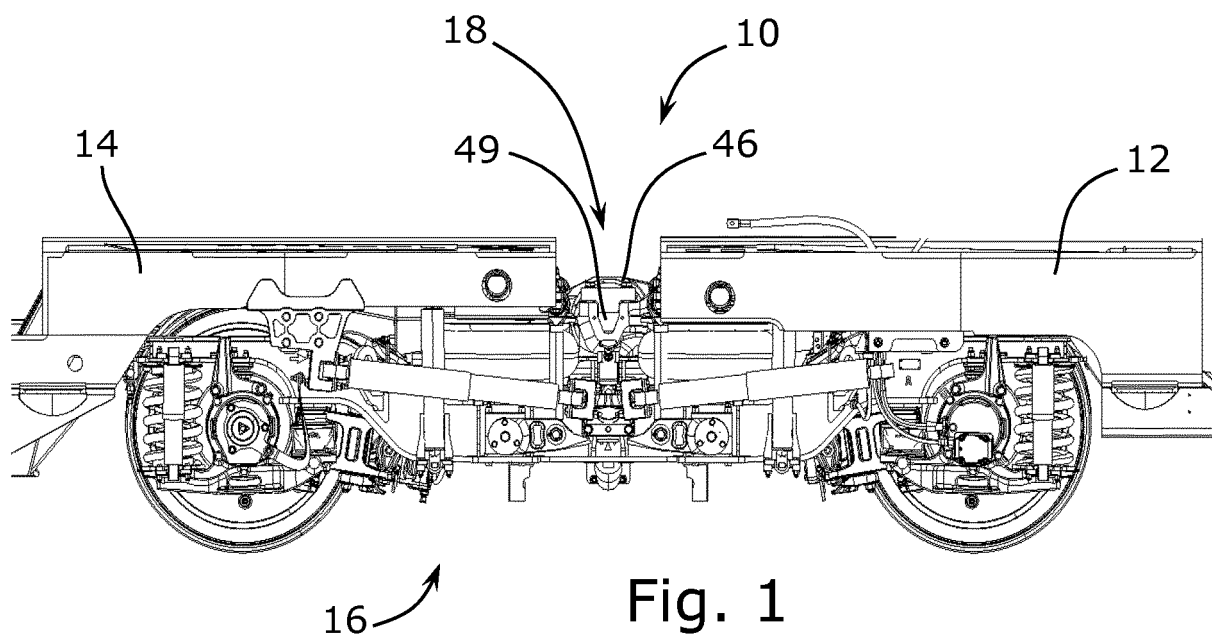
Claims

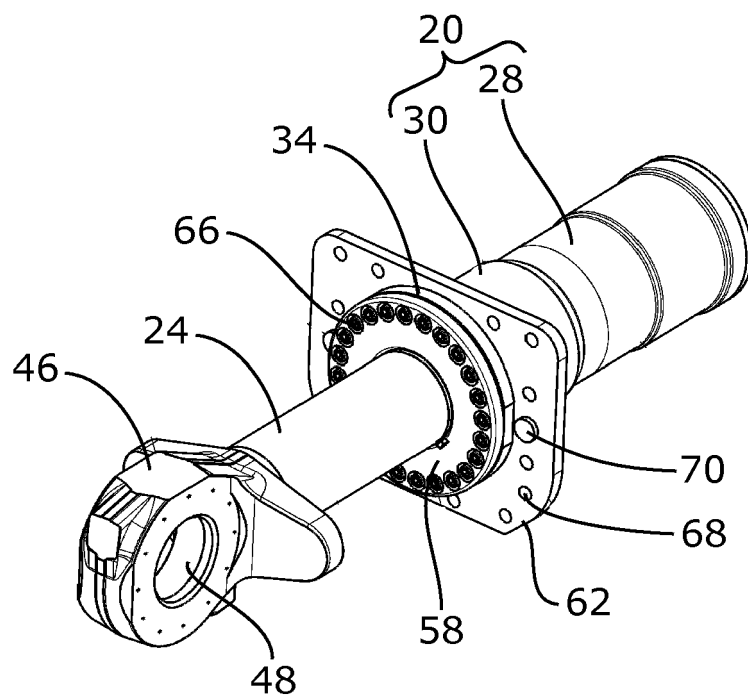
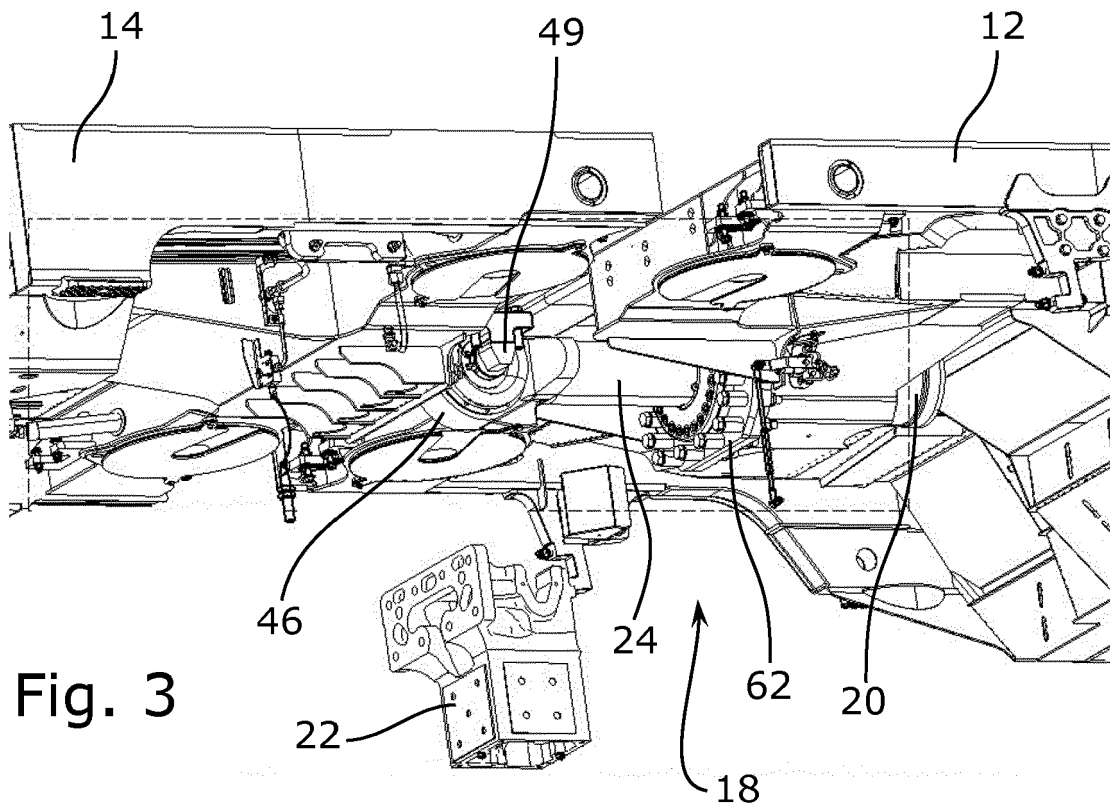
1. A permanent structural link (18) for permanently linking a first subassembly of a rail vehicle assembly with a second subassembly of the rail vehicle assembly, wherein the first subassembly and the second subassembly consist either of a first vehicle body (12) and a second vehicle body (14) or of a vehicle body (12) and a running gear (16), wherein the structural link (18) comprises:

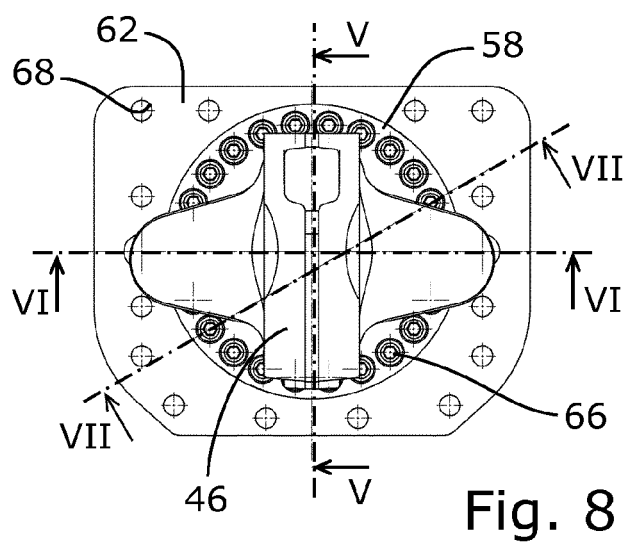
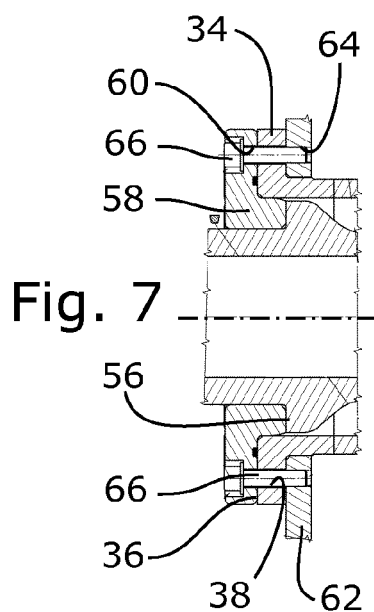
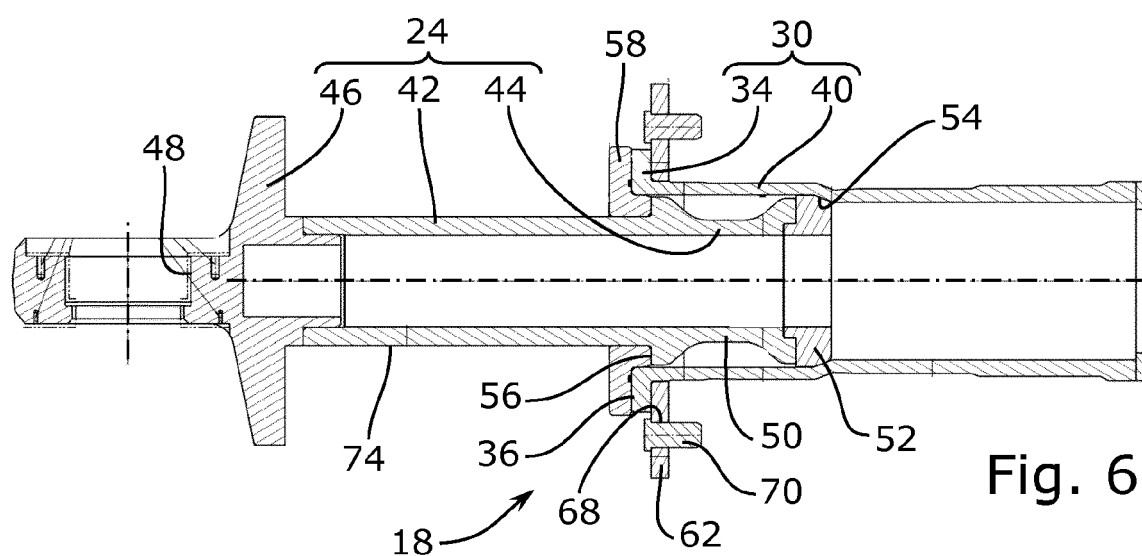
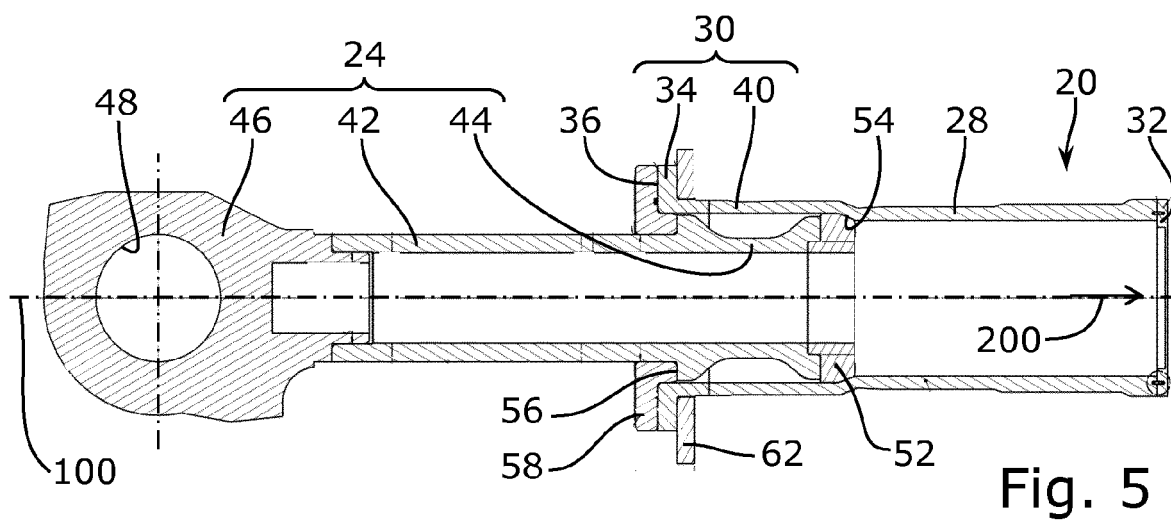
- an energy absorption unit (20) comprising a permanently deformable cylinder (28), which defines a reference axis (100) and a widened portion (30), which has an inner cross-sectional area greater than the permanently deformable cylinder (28),
- a piston (24) comprising an end portion (44) provided with a non-deformable piston head (52), wherein the piston head (52) in a service position is received in the widened portion (30) of the energy absorption unit (20), wherein the piston head (52) is such as to effect a radial expansion of the permanently deformable cylinder (28) while moving within the permanently deformable cylinder (28) in a stroke direction (200) parallel to the reference axis (100), and
- an annular guide (58) for guiding a relative translation motion between the piston (24) and the permanently deformable cylinder (28) in the stroke direction (200),

characterised in that the piston (24) comprises a

- piston rod (42) protruding from the end portion (44) in a direction parallel to the reference axis (100) and opposed to the stroke direction (200), the piston rod (42) is provided with an outer cylindrical sliding surface (74), and the annular guide (58) is fixed relative to the widened portion (30) of the energy absorption unit (20) and has an inner diameter such as to be in sliding contact with the outer cylindrical sliding surface (74) of the piston rod (42) at least when the piston head (52), after leaving the service position, moves towards the end position.
2. The permanent structural link (18) of claim 1, wherein the annular guide (58) in the service position is press-fitted onto a cylindrical seat (72) of the piston rod (42).
 3. The permanent structural link (18) of any one of the preceding claims, wherein the annular guide (58) in the service position bears axially against a shoulder (36) of a collar (34) of the widened portion (30) of the energy-absorption unit (20) and the shoulder (36) of the collar (34) of the widened portion (30) of the energy-absorption unit (20) faces a direction that has an axial component opposite to the stroke direction (200).
 4. The permanent structural link of claim 3, wherein the annular guide (58) is secured to the collar (34) of the widened portion (30) of the energy-absorption unit (20) by means of fixing elements (66).
 5. The permanent structural link of claim 4, further comprising a mounting plate (62), wherein the collar (34) of the widened portion (30) of the energy-absorption unit (20) is sandwiched between the mounting plate (62) and the annular guide (58) and the fixing elements (66) secure the annular guide (58) to the mounting plate (62) through holes (38) provided in the collar (34) of the widened portion (30) of the energy-absorption unit (20).
 6. The permanent structural link (18) of any one of claims 3 to 5, wherein the collar (34) of the widened portion (30) of the energy-absorption unit (20) is welded, preferably butt welded with an end of the permanently deformable cylinder (20).
 7. The permanent structural link (18) of any one of claims 1 to 5, wherein the energy absorption unit (20) is formed in one piece.
 8. The permanent structural link (18) of any one of the preceding claims, wherein the annular guide (58) in the service position bears axially against a shoulder (56) of the end portion (44) of the piston (24), wherein the shoulder (56) of the end portion (44) of the piston (24) faces a direction that has an axial component opposite to the stroke direction (200).
 9. The permanent structural link (18) of any one of claims 3 to 6 in combination with claim 8, wherein the annular guide (58) bears axially against the shoulder (56) of the end portion (44) of the piston (24) with a predetermined axial preload and the piston head (52) in the service position bears axially against a shoulder (54) of the widened portion of the energy-absorption unit with a predetermined axial preload, equal in magnitude to the axial preload between the annular guide (58) and the shoulder (56) of the end portion (44) of the piston (24).
 10. The permanent structural link (18) of the preceding claims, wherein the annular guide (58) is made of a material having a Vickers hardness greater than 600 HV, preferably greater than 630 HV.
 11. The permanent structural link (18) of any one of the preceding claims, wherein the piston head (52) in the service position is press-fitted into the widened portion (30) of the energy-absorption unit (20).
 12. The permanent structural link (18) of any one of the preceding claims, wherein the non-deformable piston head (52) is preferably made of a material having a Vickers hardness greater than 650 HV, preferably greater than 700HV.
 13. The permanent structural link (18) of any one of the preceding claims, further comprising a coupling eye (48) integral with an end (46) of the piston (24) opposed to the end portion (44).
 14. A rail vehicle assembly (10) comprising a first sub-assembly and a second subassembly of a rail vehicle assembly, wherein the first subassembly and the second subassembly consist either of a first vehicle body (12) and a second vehicle body (14) or of a vehicle body (12) and a running gear (16), **characterised in that** the rail vehicle assembly (10) further comprises a permanent structural link (18) according to any one of the preceding claims for linking the first subassembly with the second subassembly.
 15. The rail vehicle assembly of claim 14, wherein the reference axis (100) of the permanent structural link (18) is parallel to a median vertical longitudinal plane of the rail vehicle assembly (10), and preferably parallel to a longitudinal axis of the rail vehicle assembly (10).









EUROPEAN SEARCH REPORT

Application Number
EP 18 19 6006

5

10

15

20

25

30

35

40

45

1

50

55

EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 990 251 A1 (VOITH PATENT GMBH [DE]) 12 November 2008 (2008-11-12) * column 12, paragraph 0038 - column 16, paragraph 0052; figures 1-3c *	1-15	INV. B61G7/10 B61G11/16 B61G5/02
A	EP 1 857 342 A1 (VOITH TURBO SCHARFENBERG GMBH [DE]) 21 November 2007 (2007-11-21) * page 8, paragraph 0064 - page 10, paragraph 0083; figures 1-6 *	1-15	
A	EP 1 955 918 A1 (VOITH AG [DE]) 13 August 2008 (2008-08-13) * column 10, paragraph 0037 - column 14, paragraph 0056; figures 1-7 *	1-15	
A	EP 2 851 260 A1 (T A SAVERY & CO LTD [GB]) 25 March 2015 (2015-03-25) * column 9, paragraph 0063 - column 14, paragraph 0111; figures 1-5 *	1-15	
A	WO 2012/111300 A1 (JAPAN STEEL WORKS LTD [JP]; OKIMOTO TASUKU [JP]; TOGO HIROYUKI [JP]) 23 August 2012 (2012-08-23) * abstract; figures 1-3 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) B61G
A	EP 2 949 539 A1 (DELLNER COUPLERS AB [SE]) 2 December 2015 (2015-12-02) * column 7, paragraph 0023 - column 9, paragraph 0030; figures 1, 2 *	1-15	
A	CH 452 586 A (SCHWEIZ WAGONS AUFZUEGEFAB [CH]) 15 March 1968 (1968-03-15) * column 3, line 13 - column 3, line 59; figures 1-4 *	1-15	
A	JP H11 20695 A (JAPAN STEEL WORKS LTD) 26 January 1999 (1999-01-26) * abstract; figures 1-9 *	1-15	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 March 2019	Examiner Lendfers, Paul
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			

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 18 19 6006

5

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.

20-03-2019

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1990251 A1	12-11-2008	AU 2008248723 A1	13-11-2008
		BR PI0810242 A2	29-10-2014
		CN 101674969 A	17-03-2010
		DK 1990251 T3	12-10-2009
		EP 1990251 A1	12-11-2008
		ES 2328527 T3	13-11-2009
		HK 1123779 A1	06-11-2009
		JP 5273405 B2	28-08-2013
		JP 2010526702 A	05-08-2010
		KR 20100004106 A	12-01-2010
		SI 1990251 T1	31-10-2009
		TW 200920636 A	16-05-2009
		US 2009008963 A1	08-01-2009
		WO 2008135414 A2	13-11-2008
EP 1857342 A1	21-11-2007	AT 416961 T	15-12-2008
		DK 1857342 T3	16-03-2009
		EP 1857342 A1	21-11-2007
		ES 2318683 T3	01-05-2009
EP 1955918 A1	13-08-2008	AT 429368 T	15-05-2009
		AU 2007242929 A1	28-08-2008
		DK 1955918 T3	17-08-2009
		EP 1955918 A1	13-08-2008
		ES 2324686 T3	12-08-2009
		KR 20080074704 A	13-08-2008
		NO 333865 B1	07-10-2013
		PT 1955918 E	16-07-2009
		US 2008277366 A1	13-11-2008
EP 2851260 A1	25-03-2015	BR 102014022316 A2	31-05-2016
		CN 104512432 A	15-04-2015
		EP 2851260 A1	25-03-2015
		GB 2517986 A	11-03-2015
		JP 2015051760 A	19-03-2015
		RU 2014136525 A	27-03-2016
		US 2015069002 A1	12-03-2015
WO 2012111300 A1	23-08-2012	JP 5222965 B2	26-06-2013
		JP 2012166726 A	06-09-2012
		WO 2012111300 A1	23-08-2012
EP 2949539 A1	02-12-2015	CN 106458233 A	22-02-2017
		EP 2949539 A1	02-12-2015
		US 2017197641 A1	13-07-2017
		WO 2015180839 A1	03-12-2015

EPO FORM P0459

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

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 18 19 6006

5

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.

20-03-2019

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CH 452586	A	15-03-1968	NONE
JP H1120695	A	26-01-1999	JP 3335882 B2 21-10-2002
			JP H1120695 A 26-01-1999

15

20

25

30

35

40

45

50

EPO FORM P0459

55

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- US 20090008963 A1 [0002]