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

STRUKTURELLE VERBINDUNG ZWISCHEN ZWEI SCHIENENFAHRZEUGUNTERBAUGRUPPEN UND ZUGEHÖRIGE SCHIENENFAHRZEUGBAUGRUPPE

LIAISON STRUCTURELLE ENTRE DEUX SOUS-ENSEMBLES DE VÉHICULE FERROVIAIRE ET ENSEMBLE DE VÉHICULE FERROVIAIRE ASSOCIÉ

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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 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] wherein 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 a preferred 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 a preferred 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 a preferred embodiment, the piston head in the service position is press-fitted into the widened portion of the energy-absorption unit. Preferably, the piston 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 a preferred 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 a preferred embodiment, the piston rod is tubular.

[0021] According to a preferred 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 a preferred embodiment of the invention, the hinge connection or ball joint is part of the structural link.

[0024] According to a preferred embodiment of the invention, there is provided a 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 though 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 though 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 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 (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).

Patentansprüche

1. Permanente strukturelle Verbindung (18) zum permanenten Verbinden einer ersten Teilbaugruppe einer Schienenfahrzeugbaugruppe mit einer zweiten Teilbaugruppe der Schienenfahrzeugbaugruppe,

wobei die erste Teilbaugruppe und die zweite Teilbaugruppe entweder aus einer ersten Fahrzeugkarosserie (12) und einer zweiten Fahrzeugkarosserie (14) oder aus einer Fahrzeugkarosserie (12) und einem Fahrgestell (16) bestehen, wobei die strukturelle Verbindung (18) Folgendes umfasst:

- eine Energieabsorptionseinheit (20), die einen permanent verformbaren Zylinder (28) umfasst, der eine Bezugsachse (100) und einen erweiterten Abschnitt (30) definiert, der eine innere Querschnittsfläche aufweist, die größer als der permanent verformbare Zylinder (28) ist,
- einen Kolben (24), der einen Endabschnitt (44) umfasst, der mit einem nicht verformbaren Kolbenkopf (52) versehen ist, wobei der Kolbenkopf (52) in einer Betriebsposition in dem erweiterten Abschnitt (30) der Energieabsorptionseinheit (20) aufgenommen wird, wobei der Kolbenkopf (52) derart beschaffen ist, dass er eine radiale Expansion des permanent verformbaren Zylinders (28) bewirkt, während er sich innerhalb des permanent verformbaren Zylinders (28) in einer Hubrichtung (200) parallel zu der Bezugsachse (100) bewegt, und
- eine ringförmige Führung (58) zum Führen einer relativen Translationsbewegung zwischen dem Kolben (24) und dem permanent verformbaren Zylinder (28) in der Hubrichtung (200),

dadurch gekennzeichnet, dass der Kolben (24) eine Kolbenstange (42) umfasst, die von dem Endabschnitt (44) in einer Richtung parallel zu der Bezugsachse (100) und entgegen der Hubrichtung (200) vorsteht, wobei die Kolbenstange (42) mit einer äußeren zylindrischen Gleitoberfläche (74) versehen ist und die ringförmige Führung (58) relativ zu dem erweiterten Abschnitt (30) der Energieabsorptionseinheit (20) befestigt ist und einen Innendurchmesser aufweist, dass sie wenigstens dann in Gleitberührung mit der äußeren zylindrischen Gleitoberfläche (74) der Kolbenstange (42) steht, wenn sich der Kolbenkopf (52) nach Verlassen der Betriebsposition in Richtung der Endposition bewegt.

2. Permanente strukturelle Verbindung (18) nach Anspruch 1, wobei die ringförmige Führung (58) in der Betriebsposition auf einen zylindrischen Sitz (72) der Kolbenstange (42) aufgepresst ist.

3. Permanente strukturelle Verbindung (18) nach einem der vorhergehenden Ansprüche, wobei die ringförmige Führung (58) in der Betriebsposition an einem Vorsprung (36) einer Manschette (34) des erweiterten Abschnitts (30) der Energieabsorptionseinheit (20) axial anliegt und der Vorsprung (36) der Manschette (34) des erweiterten Abschnitts (30) der Energieabsorptionseinheit (20) in eine Richtung weist, die eine axiale Komponente entgegengesetzt der Hubrichtung (200) aufweist.

4. Permanente strukturelle Verbindung nach Anspruch 3, wobei die ringförmige Führung (58) an der Manschette (34) des erweiterten Abschnitts (30) der Energieabsorptionseinheit (20) mittels Befestigungselementen (66) gesichert ist.

5. Permanente strukturelle Verbindung nach Anspruch 4, die ferner eine Montageplatte (62) umfasst, wobei die Manschette (34) des erweiterten Abschnitts (30) der Energieabsorptionseinheit (20) zwischen der Montageplatte (62) und der ringförmigen Führung (58) eingelegt ist und die Befestigungselemente (66) die ringförmige Führung (58) an der Montageplatte (62) durch Löcher (38) sichern, die in der Manschette (34) des erweiterten Abschnitts (30) der Energieabsorptionseinheit (20) bereitgestellt sind.

6. Permanente strukturelle Verbindung (18) nach einem der Ansprüche 3 bis 5, wobei die Manschette (34) des erweiterten Abschnitts (30) der Energieabsorptionseinheit (20) geschweißt, vorzugsweise mit einem Ende des permanent verformbaren Zylinders (20) stumpfgeschweißt ist.

7. Permanente strukturelle Verbindung (18) nach einem der Ansprüche 1 bis 5, wobei die Energieabsorptionseinheit (20) einstückig ausgebildet ist.

8. Permanente strukturelle Verbindung (18) nach einem der vorhergehenden Ansprüche, wobei die ringförmige Führung (58) in der Betriebsposition an einem Vorsprung (56) des Endabschnitts (44) des Kolbens (24) axial anliegt, wobei der Vorsprung (56) des Endabschnitts (44) des Kolbens (24) in eine Richtung weist, die eine axiale Komponente entgegengesetzt der Hubrichtung (200) aufweist.

9. Permanente strukturelle Verbindung (18) nach einem der Ansprüche 3 bis 6 in Kombination mit Anspruch 8, wobei die ringförmige Führung (58) an dem Vorsprung (56) des Endabschnitts (44) des Kolbens (24) mit einer vorgegebenen axialen Vorspannung axial anliegt und der Kolbenkopf (52) in der Betriebsposition an einem Vorsprung (54) des erweiterten Abschnitts der Energieabsorptionseinheit mit einer vorgegebenen axialen Vorspannung axial anliegt, die in einer Stärke der axialen Vorspannung zwischen der ringförmigen Führung (58) und dem Vorsprung (56) des Endabschnitts (44) des Kolbens (24) gleicht.

10. Permanente strukturelle Verbindung (18) nach den vorhergehenden Ansprüchen, wobei die ringförmige Führung (58) aus einem Material hergestellt ist, das eine Vickershärte über 600 HV, vorzugsweise über

630 HV aufweist.

11. Permanente strukturelle Verbindung (18) nach einem der vorhergehenden Ansprüche, wobei der Kolbenkopf (52) in der Betriebsposition in den erweiterten Abschnitt (30) der Energieabsorptionseinheit (20) eingepresst ist.

12. Permanente strukturelle Verbindung (18) nach einem der vorhergehenden Ansprüche, wobei der nicht verformbare Kolbenkopf (52) vorzugsweise aus einem Material hergestellt ist, das eine Vickershärte über 650 HV, vorzugsweise über 700 HV aufweist.

13. Permanente strukturelle Verbindung (18) nach einem der vorhergehenden Ansprüche, die ferner eine Kupplungsöse (48) umfasst, die mit einem Ende (46) des Kolbens (24) gegenüber dem Endabschnitt (44) einstückig ist.

14. Schienenfahrzeugbaugruppe (10), die eine erste Teilbaugruppe und eine zweite Teilbaugruppe einer Schienenfahrzeugbaugruppe umfasst, wobei die erste Teilbaugruppe und die zweite Teilbaugruppe entweder aus einer ersten Fahrzeugkarosserie (12) und einer zweiten Fahrzeugkarosserie (14) oder aus einer Fahrzeugkarosserie (12) und einem Fahrgestell (16) bestehen, **dadurch gekennzeichnet, dass** die Schienenfahrzeugbaugruppe (10) ferner eine permanente strukturelle Verbindung (18) nach einem der vorhergehenden Ansprüche zum Verbinden der ersten Teilbaugruppe mit der zweiten Teilbaugruppe umfasst.

15. Schienenfahrzeugbaugruppe nach Anspruch 14, wobei die Bezugsachse (100) der permanenten strukturellen Verbindung (18) parallel zu einer vertikalen Mittellängsebene der Schienenfahrzeugbaugruppe (10) und vorzugsweise parallel zu einer Längsachse der Schienenfahrzeugbaugruppe (10) ist.

Revendications

1. Liaison structurelle permanente (18) destinée à relier de façon permanente un premier sous-ensemble d'un ensemble de véhicule ferroviaire avec un second sous-ensemble de l'ensemble de véhicule ferroviaire, dans lequel le premier sous-ensemble et le second sous-ensemble sont constitués soit d'une première carrosserie (12) et d'une seconde carrosserie (14) soit d'une carrosserie (12) et d'un train roulant (16), la liaison structurelle (18) comprenant :

- une unité d'absorption d'énergie (20) comprenant un cylindre déformable de façon permanente (28), qui définit un axe de référence (100) et une partie élargie (30), qui présente une section transversale intérieure supérieure à celle du cylindre déformable de façon permanente (28),
- un piston (24) comprenant une partie d'extrémité (44) pourvue d'une tête de piston non déformable (52), la tête de piston (52) en position de service étant reçue dans la partie élargie (30) de l'unité d'absorption d'énergie (20), la tête de piston (52) étant telle qu'elle effectue une expansion radiale du cylindre déformable de façon permanente (28) lorsqu'elle se déplace à l'intérieur du cylindre déformable de façon permanente (28) dans une direction de course (200) parallèle à l'axe de référence (100), et
- un guidage annulaire (58) permettant de guider un mouvement de translation relatif entre le piston (24) et le cylindre (28) déformable de façon permanente dans la direction de course (200),

caractérisée en ce que le piston (24) comprend une tige de piston (42) dépassant de la portion d'extrémité (44) dans une direction parallèle à l'axe de référence (100) et opposée à la direction de course (200), la tige de piston (42) est pourvue d'une surface de glissement cylindrique extérieure (74), et le guidage annulaire (58) est fixe par rapport à la partie élargie (30) de l'unité d'absorption d'énergie (20) et présente un diamètre intérieur tel qu'il est en contact coulissant avec la surface de glissement cylindrique extérieure (74) de la tige de piston (42) au moins lorsque la tête de piston (52), après avoir quitté la position de service, se déplace vers la position finale.

2. Liaison structurelle permanente (18) selon la revendication 1, dans laquelle le guidage annulaire (58) en position de service est fretté sur un siège cylindrique (72) de la tige de piston (42).

3. Liaison structurelle permanente (18) selon l'une quelconque des revendications précédentes, dans laquelle le guidage annulaire (58) en position de service est en appui axial contre un épaulement (36) d'une collerette (34) de la partie élargie (30) de l'unité d'absorption d'énergie (20) et l'épaulement (36) de la collerette (34) de la partie élargie (30) de l'unité d'absorption d'énergie (20) fait face à une direction qui a une composante axiale opposée à la direction de course (200).

4. Liaison structurelle permanente selon la revendication 3, dans laquelle le guidage annulaire (58) est fixé à la collerette (34) de la partie élargie (30) de l'unité d'absorption d'énergie (20) au moyen d'éléments de fixation (66).

5. Liaison structurelle permanente selon la revendica-

tion 4, comprenant en outre une plaque de montage (62), dans laquelle la collerette (34) de la partie élargie (30) de l'unité d'absorption d'énergie (20) est prise en sandwich entre la plaque de montage (62) et le guidage annulaire (58) et les éléments de fixation (66) fixent le guidage annulaire (58) à la plaque de montage (62) à travers des trous (38) pourvus dans la collerette (34) de la partie élargie (30) de l'unité d'absorption d'énergie (20).

6. Liaison structurelle permanente (18) selon l'une quelconque des revendications 3 à 5, dans laquelle la collerette (34) de la partie élargie (30) de l'unité d'absorption d'énergie (20) est soudée, de préférence bout à bout, avec une extrémité du cylindre déformable de façon permanente (20).

7. Liaison structurelle permanente (18) selon l'une quelconque des revendications 1 à 5, dans laquelle l'unité d'absorption d'énergie (20) est formée d'une seule pièce.

8. Liaison structurelle permanente (18) selon l'une quelconque des revendications précédentes, dans laquelle le guidage annulaire (58) en position de service est en appui axial contre un épaulement (56) de la partie d'extrémité (44) du piston (24), dans laquelle l'épaulement (56) de la partie d'extrémité (44) du piston (24) fait face à une direction qui a une composante axiale opposée à la direction de course (200).

9. Liaison structurelle permanente (18) selon l'une quelconque des revendications 3 à 6 en combinaison avec la revendication 8, dans laquelle le guidage annulaire (58) est en appui axial contre l'épaulement (56) de la partie d'extrémité (44) du piston (24) avec une précharge axiale prédéterminée et la tête de piston (52) en position de service est en appui axial contre un épaulement (54) de la partie élargie de l'unité d'absorption d'énergie avec une précharge axiale prédéterminée, égale en module à la précharge axiale entre le guidage annulaire (58) et l'épaulement (56) de la partie d'extrémité (44) du piston (24).

10. Liaison structurelle permanente (18) selon les revendications précédentes, dans laquelle le guidage annulaire (58) est réalisé en un matériau ayant une dureté Vickers supérieure à 600 HV, de préférence supérieure à 630 HV.

11. Liaison structurelle permanente (18) selon l'une quelconque des revendications précédentes, dans laquelle la tête de piston (52) en position de service est emmanchée à force dans la partie élargie (30) de l'unité d'absorption d'énergie (20).

12. Liaison structurelle permanente (18) selon l'une quelconque des revendications précédentes, dans laquelle la tête de piston non déformable (52) est de préférence réalisée en un matériau ayant une dureté Vickers supérieure à 650 HV, de préférence supérieure à 700HV.

13. Liaison structurelle permanente (18) selon l'une quelconque des revendications précédentes, comprenant en outre un oeil d'accouplement (48) solidaire d'une extrémité (46) du piston (24) opposée à la partie d'extrémité (44).

14. Ensemble de véhicule ferroviaire (10) comprenant un premier sous-ensemble et un second sous-ensemble d'un ensemble de véhicule ferroviaire, dans lequel le premier sous-ensemble et le second sous-ensemble sont constitués soit d'une première carrosserie (12) et d'une seconde carrosserie (14), soit d'une carrosserie (12) et d'un train roulant (16), **caractérisé en ce que** l'ensemble de véhicule ferroviaire (10) comprend en outre une liaison structurelle permanente (18) selon l'une quelconque des revendications précédentes pour relier le premier sous-ensemble au second sous-ensemble.

15. Ensemble de véhicule ferroviaire selon la revendication 14, dans lequel l'axe de référence (100) de la liaison structurelle permanente (18) est parallèle à un plan longitudinal vertical médian de l'ensemble de véhicule ferroviaire (10), et de préférence parallèle à un axe longitudinal de l'ensemble de véhicule ferroviaire (10).

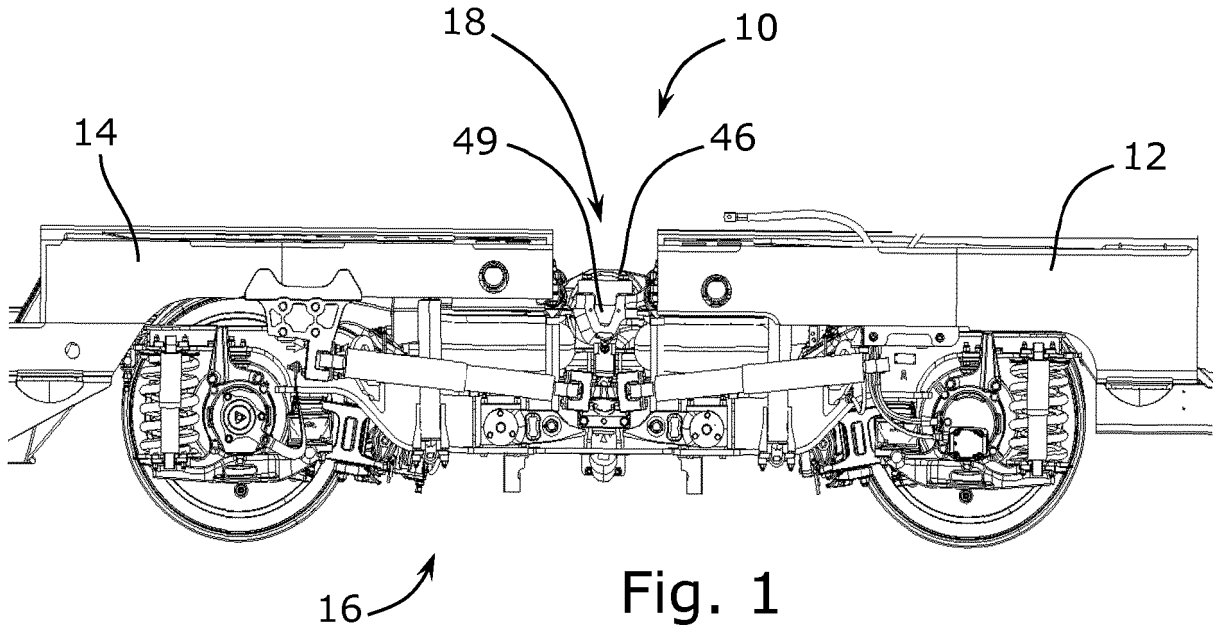

Fig. 1

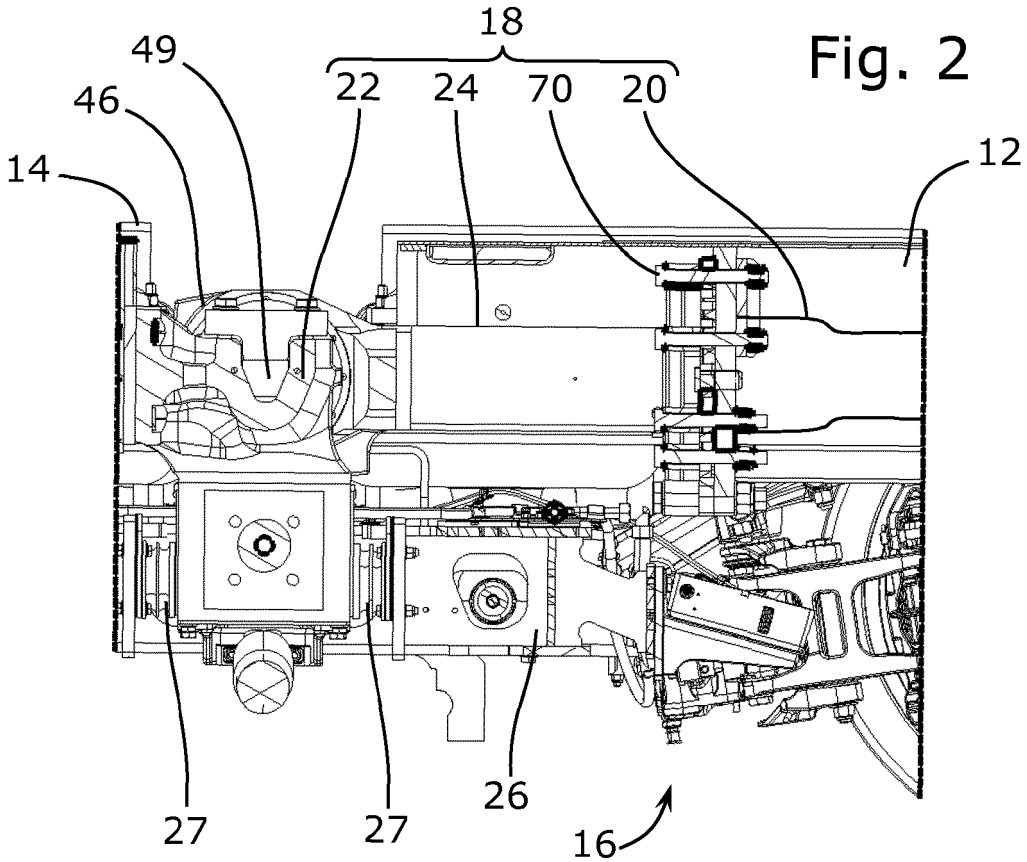

Fig. 2

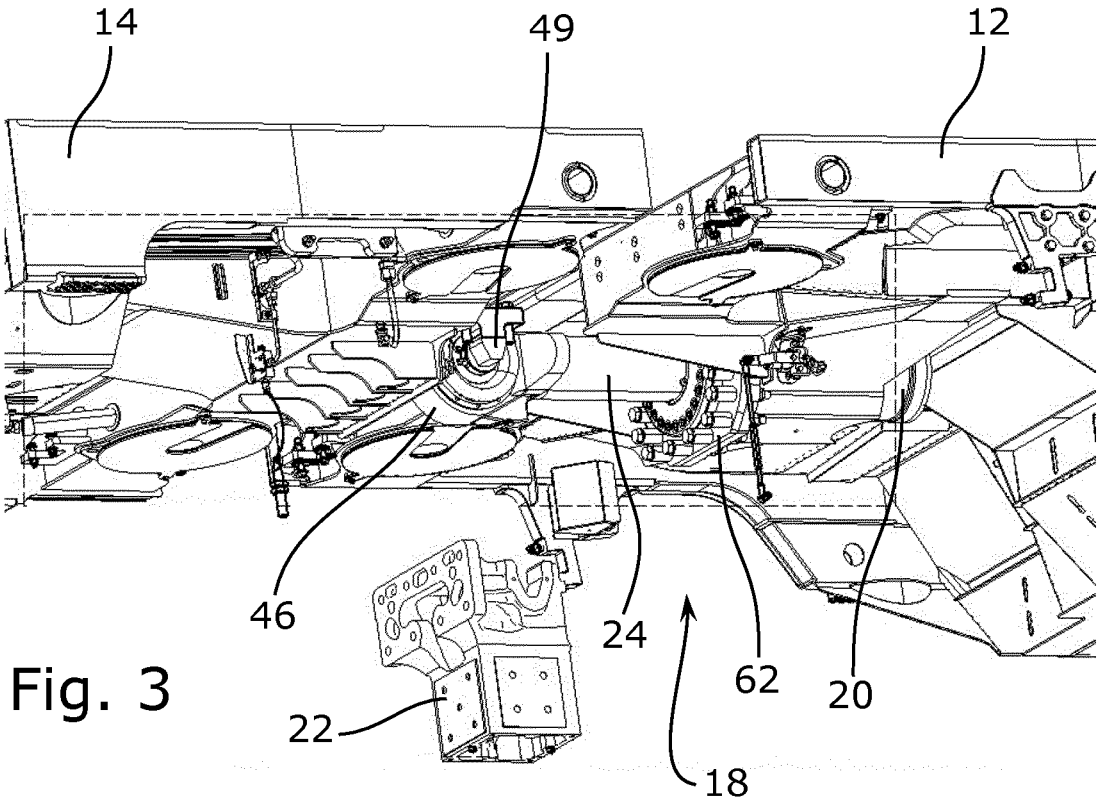

Fig. 3

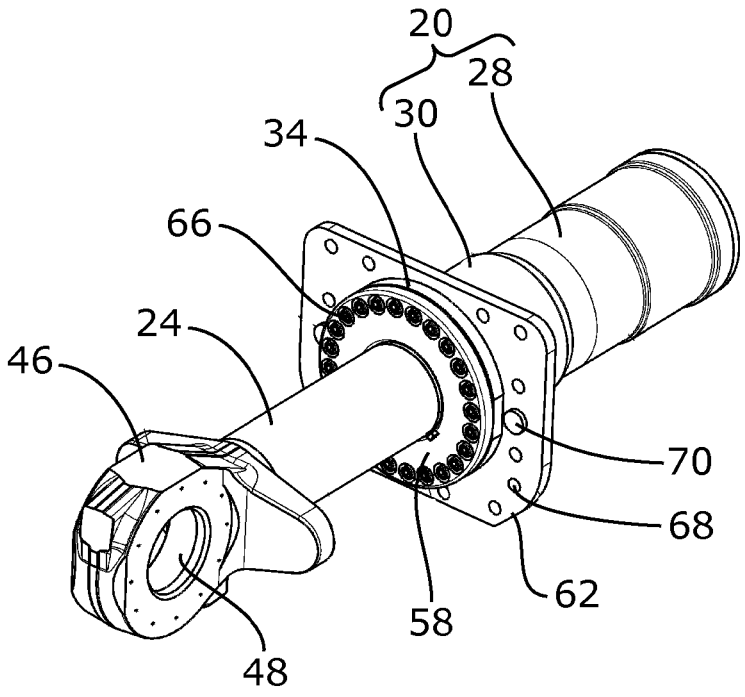

Fig. 4

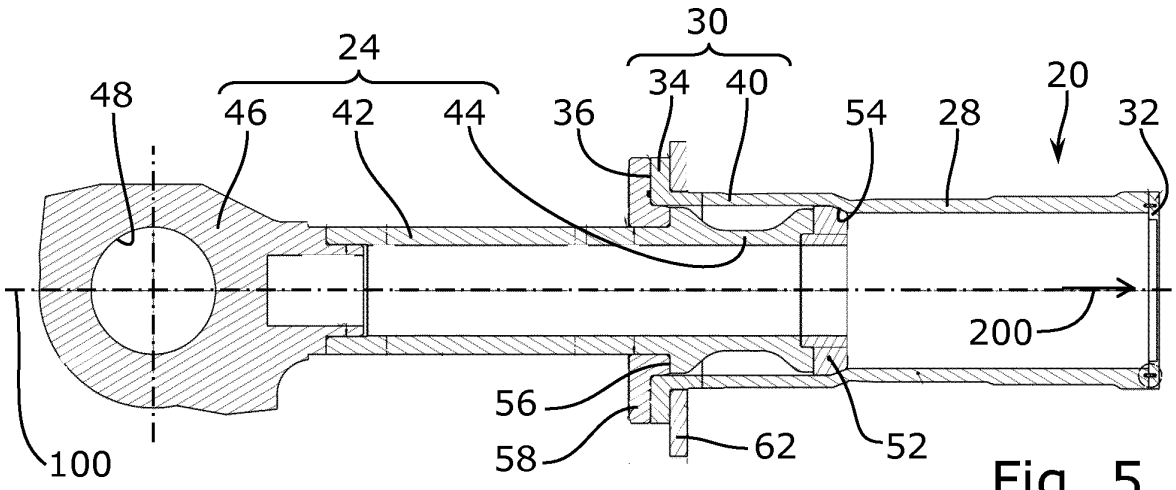

Fig. 5

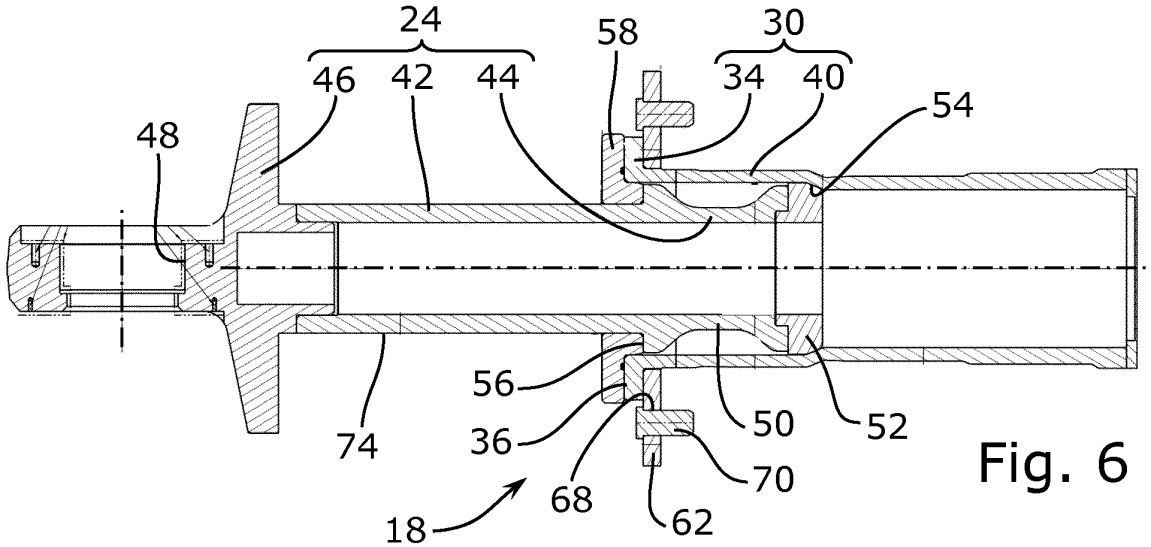

Fig. 6

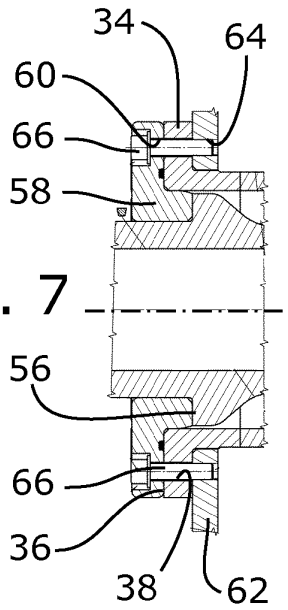

Fig. 7

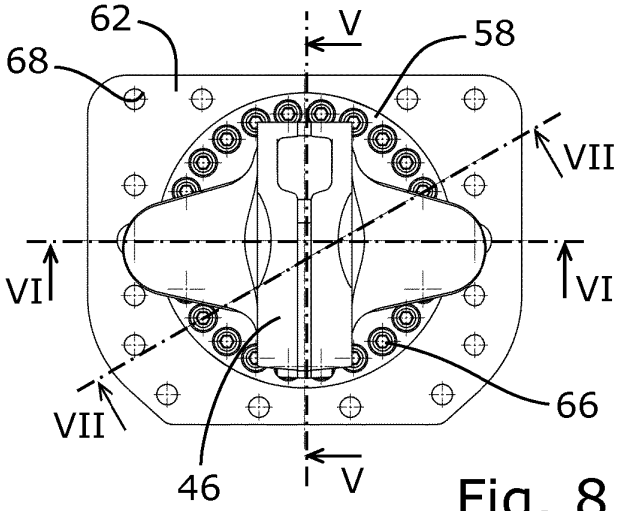

Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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