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(54) **ENERGY DISSIPATING DEVICE, CONNECTION DEVICE SUITABLE TO CONNECT A FIRST CAR OF A MULTI-CAR VEHICLE WITH A SECOND CAR OF THE MULTI-CAR VEHICLE AND METHOD FOR BUILDING A CONNECTION DEVICE**

ENERGIEABLEITENDE VORRICHTUNG, VERBINDUNGSVORRICHTUNG ZUM VERBINDEN EINES ERSTEN WAGENS EINES FAHRZEUGS MIT MEHREREN WAGEN MIT EINEM ZWEITEN WAGEN DES FAHRZEUGS MIT MEHREREN WAGEN UND VERFAHREN ZUR HERSTELLUNG EINER VERBINDUNGSVORRICHTUNG

DISPOSITIF DE DISSIPATION D'ÉNERGIE, DISPOSITIF DE CONNEXION CONÇU POUR RELIER UNE PREMIÈRE CABINE D'UN VÉHICULE À PLUSIEURS CABINES À UNE SECONDE CABINE DE VÉHICULE À PLUSIEURS CABINES ET PROCÉDÉ DE CONSTRUCTION D'UN DISPOSITIF DE CONNEXION

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Description

[0001] The invention relates to an energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle. The invention also relates to a connection device suitable to connect a first car of a multi-car vehicle with a second car of the multi-car vehicle. The invention also relates to a method for building such a connection device.

[0002] Multi-car vehicles are known in different designs and in different forms of adaptation for uses. Multi-car vehicles, for example, railway-bound trains (street cars and subway-trains also being considered as such trains) are known and are known for the purpose of transporting passengers as well as transporting goods. Further types of multi-car vehicles can be magnetic railway trains or can be buses (road buses as well as buses travelling on fixed tracks). A car of a multi-car vehicle can be a self-supporting cars, whereby the car has sufficient wheels that are placed at sufficient locations such that the car can stand by itself without being supported by other cars, for example a three-wheeled car, a four wheeled car or a car with even more wheels placed suitable locations. A car of a multi-car vehicle can also be of the non-self-supporting type, whereby the car has no wheels or only wheels provided in such number or arranged at such a place that the car cannot stand by itself, but is vertically supported by at least one neighbouring car.

[0003] To form the multi-car vehicles, the individual cars of the vehicle are connected to one another by means of a connecting device. The connecting devices can be provided for different types of purposes. In multi-car vehicles where only one or only several of the total of cars is driven, the connecting devices are provided so that a driven car can drive a non-driven car and thus ensure that the complete vehicle travels with the same speed. Connecting devices are also distinguished between those connecting devices that allow for an easy decoupling of the cars, whereby easy decoupling is understood to be accomplished within a couple of minutes, or for what is called "semi-permanent" coupling of the cars, for which decoupling of the cars takes efforts and usually involves the vehicle to have been transported to a specific work shop. Trains, for example, can have coupler-heads as part of their connecting devices. These coupler-heads can, for example, be so called "automatic couplers" that allow decoupling within minutes.

[0004] It is known to provide connection devices that are suitable to connect a first car of a multi-car vehicle with a second car of a multi-car vehicle with energy dissipating devices. From EP 1 312 527 A1 an energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle is known. The connection device in this embodiment is designed as an articulated joint. The energy dissipating device arranged as part of the connection device has an energy dissipating member in the form of a deformation tube that dissipates energy when it is deformed. The deformation tube has a first end and a second end, the first end and the second end being spaced apart from each other in a compression stroke direction, which is in line with the longitudinal axis of the articulated joint when it is in the straightened-out mode of operation. The energy dissipating device has a stopper in the form of a pressure plate. The pressure plate has a stopping surface and the first end of the energy deformation tube is in contact with the stopping surface, the stopping surface preventing that the first end moves in the compression stroke direction, because the pressure plate is screwed to flange parts surrounding the deformation tube. The energy dissipating device furthermore has a deformer, which is called guiding profile (Führungsprofil) in EP 1 312 527 A1. At one end of the guiding profile a mandrel is provided that is in contact with the second end of the deformation tube and that is held apart from the pressure plate by the deformation tube, whereby the guiding profile can be moved towards the pressure plate by application of a linear force pointing in the compression stroke direction that is larger than a predetermined threshold value and thereby the guiding profile deforms the deformation tube when moving towards the pressure plate. The mandrel moves into the deformation tube and deforms it outwardly. The guiding profile is guided on straight-line rails provided at either end of the deformation tube in the flange parts that surround the deformation tube and to which the pressure plate is fastened by screws.

[0005] From WO 2005/075272 A1 an energy dissipating device of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle is known. The energy dissipating device has an energy dissipating member in the form of a deformation tube that dissipates energy when it is deformed. The deformation tube has a flange arranged at a first end of the deformation tube, which is intended to rest against a panel of the first car. Arranged inside the deformation tube at the first end of the deformation tube is a deformer that has a mandrel arranged at its end that rests against a waist of the deformation tube whereby the diameter of the deformation tube is reduced at this waist.

[0006] An energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle is also known from EP 2 949 539 A1.

[0007] The deformation tubes used as energy dissipating members in EP 1 312 527 A1, WO 2005/075272 A1 and EP 2 949 539 A1 are deformed fully with regard to their cross section. The respective mandrel deforms the complete cross section of the respective deformation tube such that in the cases of WO 2005/075272 A1 and EP 1 312 527 A1, where the mandrel is placed inside the deformation tube, the outer diameter of the deformation tube after deformation is larger than the outer diameter of the deformation tube before deformation, while at the

same time the inner diameter of the deformation tube after deformation is larger than the inner diameter before the deformation. In the design known from EP 2 949 539 A1, where the mandrel is placed outside the deformation tube and the deformation tube is pushed into the opening of the mandrel, the outer diameter of the deformation tube after deformation is smaller than the outer diameter of the deformation tube before deformation, while at the same time the inner diameter of the deformation tube after deformation is smaller than the inner diameter of the deformation tube before deformation. The experience has shown, that these deformation tubes are usually designed to be very heavy adding substantial weight to the connection device. Additionally the invention offers the possibility to implement energy dissipation where previously energy dissipation had not been thought of. The invention allows small energy dissipation sections to be provided for at many parts that are present in a connection device anyways. For example gas hydraulic dampers: In many embodiments, gas hydraulic dampers are implemented in the coupler rod of a connection device. These gas hydraulic dampers take up some of the small forces that occur during normal travel of the vehicle and smoothen the ride. Gas hydraulic dampers often have a piston that moves inside a tubular member. These parts can be used to implement the energy dissipating device according to the invention, for example by using the piston as plug according to the invention and implement the mandrel on the tubular member that surrounds the piston. The advantages of the invention can be taken so far as to implement the energy dissipation solely on elements already present in a coupling device without the need to implement an additional energy dissipating device like a deformation tube in the connection device. This will save built-length of the complete connection device and will save weight. DE 101 45 446 A1 discloses an energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle. The energy dissipating device comprises a plug (Rohr 1) that has a longitudinal axis. Furthermore by way of the ring type element (ringartiges Element) a mandrel is disclosed that has an opening, whereby the plug is arranged to be moved at least partially through the opening, if a force pointing in the direction of or parallel to the direction of the longitudinal axis is applied to the plug. As can be best seen in figure 2 of DE 101 45 446 A1 at least a part of the plug, namely protruding ribs that are arranged on the outer surface of the plug are severed of the plug, when the plug is at least partially moved through the opening.

[0008] From WO 2009/072843 A2 an energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle is known. The energy dissipating device is described to comprise a plug (die 501) that has a longitudinal axis. Furthermore by way of a tearing tube 504 a mandrel that has an opening is disclosed, whereby the plug is arranged to be moved at least partially through the opening, if a force pointing in the direction of the longitudinal axis is applied to the plug. As can best be seen in figure 10 at least a part of the mandrel is cut, when the plug is at least partially moved through the opening. For this purpose, the plug is provided with blades 502 that each have the shape of a knife edge.

[0009] Given this background, the problem to be solved by the invention is to provide an energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle that can be built in a more lightweight manner. It is also an object of the invention to suggest a connection device having such an energy dissipating device and a method for building such a connection device.

[0010] This problem is solved by the subject matter of claims 1, 3 and 4. Preferred embodiments are described in the subordinate claims and in the description following hereafter

[0011] The general concept of the invention is to provide one protruding rib or a plurality of protruding ribs on at least one of two objects that are moved relative to each other, if a force is applied to one of the two objects, and to have a protruding rib being at least partially deformed when the one object is moved relative to the other object. When deforming the ribs, preferably the effect of smearing the material of the object to be deformed is used. Providing protruding ribs leaves space next to the ribs, into which the material can be smeared. To achieve the energy dissipating effect, it is therefore also not necessary, to cut into material, i.e. to sever material from the object.

[0012] The energy dissipating device has a plug that has a longitudinal axis as will be described further below. In the context of a preferred embodiment, the plug can be a tubular object, preferably a deformation tube. Since the invention is based, however, on the cooperation of two objects and only necessitates one of the two objects to be an energy dissipating object, the plug also can be a rigid object, if it is made to cooperate with a second object, namely the mandrel, if the mandrel is designed to be energy dissipating. The plug is described to have a longitudinal axis in order to allow a relative movement between the plug and the mandrel to be described. The use of the term "longitudinal axis" does, however, not mean that the maximum extent of the plug is in direction of the longitudinal axis. Embodiments of the invention can be thought of, where the plug has a larger extent in a direction perpendicular to the longitudinal axis than in the direction of the longitudinal axis. However, in a preferred embodiment, the maximum extent of the plug is in the direction of the longitudinal axis. In a preferred embodiment, the plug is an object with rotational symmetry with respect to the longitudinal axis. That is in a preferred embodiment there is at least one sectional plane perpendicular to the longitudinal axis in which plane the section of the plug is an object with rotational symmetry about the longitudinal axis. In a preferred embodiment, in the

plurality of sectional planes perpendicular to the longitudinal axis, the respective section of the plug in that respective sectional plane is an object with rotational symmetry about the longitudinal axis. In a preferred embodiment, the longitudinal axis of the plug points in the direction of or parallel to the direction of the maximum extend of the plug. In a preferred embodiment, the longitudinal axis is co-axial or parallel to the central axis of the hole in the mandrel.

[0013] The energy dissipating device according to the invention has a mandrel that has an opening, whereby the plug is arranged to be moved at least partially through the opening if a force pointing in the direction of or parallel to the direction of the longitudinal axis is applied to the plug and whereby at least a part of the plug and/or at least a part of the mandrel is deformed, when the plug is at least partially moved through the opening. In a preferred embodiment, the plug is already partially, even if it is minimally, inserted into the opening of the mandrel in the normal mode of operation of the energy dissipating device, i.e. the mode of operation where the energy dissipation has not taken place yet. Arranging the plug to be partially inserted into the opening of the mandrel allows for the relative movement of the plug relative to the mandrel to be coordinated in a better manner. However, designs can be thought of, where the plug is held distanced from the opening and whereby the plug first needs to be moved to engage into the opening of the mandrel, if a force pointing in the longitudinal axis is applied to the plug, before deformation can begin.

[0014] The surface of the mandrel that surrounds the opening has at least one protruding rib that extends in the direction of or parallel to the direction of the longitudinal direction, said rib being at least partially deformed when the plug is at least partially moved through the opening.

[0015] In a preferred embodiment, the maximum diameter of the plug in a plane perpendicular to the longitudinal axis is larger than the minimum diameter of the opening of the mandrel. The term "maximum diameter" is understood to be the length of that line of all lines that in a plane perpendicular to the longitudinal axis connects one point on the outer surface of the plug with a second point on the outer surface of the plug, while crossing the longitudinal axis which has the maximum length. Given that according to the invention the surface of the mandrel that surrounds the opening is described to have at least one protruding rib and given that the opening therefore need not be constant in diameter in a plane perpendicular to the longitudinal axis, the term "minimum diameter" is understood to be the length of that line of all lines that in a plane perpendicular to the longitudinal axis connects one point on the surface of the mandrel that surrounds the opening with a second point on the surface of the mandrel that surrounds the opening, while crossing the longitudinal axis, which has the minimum length.

[0016] The rib is claimed to extend in the direction of or parallel to the direction of the longitudinal axis. This leads to the effect that as the plug is moved into the opening in the direction of its longitudinal axis, further parts of the rib are made to engage with parts of the plug and are thus being deformed. This enhances the total amount of energy being dissipated as the plug is moved into the opening of the mandrel. The term "one protruding rib that extends along the longitudinal axis" also includes "one protruding rib that extends along a direction parallel to the longitudinal axis". This depends on what is considered to be the longitudinal axis of the plug. If the plug is designed to be an object that has rotational symmetry about an axis and if this axis is called the longitudinal axis, then the one protruding rib arranged at the outer surface of the plug extends along a direction parallel to the longitudinal axis of a such defined longitudinal axis of the plug. The term "one protruding rib that extends along the longitudinal axis" also includes the term "one protruding rib that extends in a direction, which direction can be fragmented into two vectors that are perpendicular to one another, whereby one of the two vectors points in the direction of the longitudinal axis or in a direction parallel to the direction of the longitudinal axis". The advantages of the invention can already be achieved, if the rib is not perfectly extending along the longitudinal axis. For example, arrangements of protruding rib can be thought of, that progresses along the plug in a helical manner. The same applies for the at least one protruding rib that is provided on the surface of the mandrel in the second alternative of the invention.

[0017] In a preferred embodiment, at least one protruding rib in a plane perpendicular to the longitudinal axis of the plug has a square cross section or a triangular cross section or a trapezoid cross section or the cross section of a segment of a circle. In a preferred embodiment, the geometric shape of the cross section of the protruding rib stays the same along its extent along the longitudinal axis. In a preferred embodiment, the surface area that the section of the protruding rib in a section perpendicular to the longitudinal axis takes up, stays the same along the extent of the protruding rib along the longitudinal axis. Embodiments can, however, be thought of, where the surface area that a section of a protruding rib takes up in a plane perpendicular to the longitudinal axis decreases when compared to the surface area that a section of a protruding rib takes up in a plane perpendicular to the longitudinal axis when take at a different position along the longitudinal axis of the plug. This can be achieved by reducing the height that the rib extends into the opening of the mandrel

In a preferred embodiment, the protruding rib terminates at its radially most outward end in an end surface that has a circumferential extent and an extent in a direction perpendicular to the longitudinal axis of the plug. In a preferred embodiment, this end surface has the shape of a section of an outer surface of a cylinder.

[0018] In a preferred embodiment the surface of the mandrel that surrounds the opening has a plurality of protruding ribs that extends in the direction of or parallel

to the direction of the longitudinal axis, said ribs being at least partially deformed, when the plug is at least partially moved through the opening. Providing a plurality of protruding ribs increases the material that is deformed during energy dissipation and hence allows the amount of energy dissipated during energy dissipation to be increased.

[0019] In a preferred embodiment, all of the plurality of protruding ribs extend in the same direction and keep the same distance to their neighbouring ribs as they extend along the longitudinal direction.

[0020] In a preferred embodiment, the opening has a circular or elliptical cross section, whereby in the embodiments of the invention, where the mandrel has at least one protruding rib, this one protruding rib of the mandrel protrudes inwards into such a circular or elliptical opening In a preferred embodiment of the preferred embodiment where a plurality of protruding ribs is provided, valleys are provided between the protruding ribs.

[0021] The surface of the mandrel that surrounds the opening has the plurality of protruding ribs that extends in the direction of or parallel to the direction of the longitudinal axis, whereby the plug has an inclined surface facing the ribs wherein said inclined surface inclines away from the longitudinal axis and/or the ribs each have an inclined front surface facing the plug said inclined front inclines towards the longitudinal axis. Providing such an inclined surface of inclined front or inclined surface facilitates the deformation of the ribs as the plug is moved further into the opening of the mandrel. In a preferred embodiment, the outside angle between the inclined surface on the mandrel and the longitudinal axis of the plug is less than 90°, preferably less than 80°, even more preferred less than 70°, and even more preferred less than 60°, and even more preferred less than 50°, and even more preferred less than 45°, and even more preferred less than 40°. In a preferred embodiment, the inside angle between the inclined front and the longitudinal axis of the plug is less than 90°, preferably less than 80°, even more preferred less than 70°, and even more preferred less than 60°, and even more preferred less than 50°, and even more preferred less than 45°, and even more preferred less than 40°.

[0022] In a preferred embodiment, the plug is a deformation tube. Designs can be thought of, where a first energy dissipation takes place as ribs are deformed as the plug is moved further into the opening of a mandrel and where a further opening is provided behind the opening of the mandrel, which forces the deformation tube to be further deformed, namely in a manner similar to the deformation of the deformation tubes in the prior art. This leads to a staggered dissipation of energy. In a preferred embodiment, the plug is made of a medium/high strength steel with good elongation properties.

[0023] In a preferred embodiment, the mandrel is made of a ultra-high strength steel with high yield stress and hardness.

[0024] The connection device suitable to connect a first car of a multi-car vehicle with a second car of the multi-car vehicle according to the invention, comprises an energy dissipating device according to the invention.

[0025] The method for building a connection device according to the invention provides for the plug to be arranged in front of the mandrel so as to allow the plug to be moved at least partially through the opening, if a force pointing in the longitudinal axis is applied to the plug.

[0026] Below, the invention will be explained in conjunction with Fig. that only show embodiments of the invention. In the Fig.

- Fig. 1 a perspective view onto one quarter of the plug and one quarter of the mandrel of an embodiment of an energy dissipating device,
- Fig. 2 a front view onto the one quarter of the plug and the one quarter of the mandrel of Fig. 1,
- Fig. 3 a perspective view taken from a different viewpoint onto the one quarter of the plug and the one quarter of the mandrel of Fig. 1
- Fig. 4 a perspective view onto one quarter of the plug and one quarter of the mandrel of an embodiment of an energy dissipating device according to the invention,
- Fig. 5 a front view onto the one quarter of the plug and the one quarter of the mandrel of Fig. 4,
- Fig. 6 a front view onto the one quarter of the plug and the one quarter of the mandrel of Fig. 4 in a different operational state than shown in Fig. 5,
- Fig. 7 a schematic front view onto a protruding rib arranged to surround the opening of the mandrel just before it comes into contact with the plug,
- Fig. 8 the view of Fig. 7 showing how the rib smears away the material of the plug,
- Fig. 9 a schematic front view onto a rib protruding from a plug just before it comes into contact with the mandrel and
- Fig. 10 the view of Fig. 9 showing how the rib is smeared way by the mandrel.

[0027] For ease of reference, the Fig. 1 to 6 only show one quarter 1, 101 of a plug and one quarter 2, 102 of a mandrel of embodiments of the invention. The plug and the mandrel each are completed by further three quarters (not shown in the Fig 1 to 6) that look identical to the quarters shown and are arranged around the longitudinal axis A of the plug to complete the plug and the mandrel.

[0028] The plug and the mandrel are part of an energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle. The Devices comprises the plug that has a longitudinal axis A and the mandrel that has an opening 3, 103. The plug is arranged to be moved at least partially through the opening 3, 103, if a force pointing in the direction of or parallel

to the direction of the longitudinal axis A is applied to the plug.

[0029] In the embodiment shown in Fig. 1 to 3, the outer surface of the plug has a plurality of protruding ribs 4 that extend in the direction of or parallel to the direction of the longitudinal axis A. In this embodiment, the mandrel has an inclined surface 5 facing the ribs 4 wherein said inclined surface 5 inclines towards the longitudinal axis A. The outside angle between the inclined surface 5 on the mandrel and the longitudinal axis A is less than 90° and about 25-30°.

[0030] As can be best seen from Fig. 3, the maximum diameter of the plug in a plane perpendicular to the longitudinal axis is larger than the minimum diameter of the opening of the mandrel. Therefore the ribs 4 will be partially deformed, when the plug is at least partially moved through the opening 3. Because valleys 6 are arranged between the ribs 4, the deformation of the ribs 4 will lead to material from the ribs 4 to be smeared into these valleys 6.

[0031] The embodiment according to the invention shown in Fig. 4 to 6 differs from the one shown in Fig. 1 to 3 in that the ribs 104 are arranged to surround the opening 105 of the mandrel. The surface of the mandrel that surrounds the opening has a plurality of protruding ribs 104 that extend parallel to the direction of the longitudinal axis A, said ribs 104 being at least partially deformed, when the plug is at least partially moved through the opening as can best be seen when comparing Fig. 5 (deformed ribs 104) to Fig. 6 (ribs 104 just before deformation). As can be best seen from Fig. 4, the plug has an inclined surface 107 facing the ribs 104 wherein said inclined surface inclines away from the longitudinal axis A and the ribs 104 each have an inclined front surface108 facing the plug said inclined front 108 inclines towards the longitudinal axis A. Valleys 106 are provided between the ribs 104.

[0032] Fig. 7 shows schematic front view onto a protruding rib 204 arranged to surround the opening 205 of the mandrel just before it comes into contact with the inclined surface 207 of the plug. Fig. 8 shows the view of Fig. 7, but how the rib 204 smears away the material of the plug. A bulk 210 of material is made during this smearing, which enters into the gap between adjacent ribs 204.

[0033] Fig. 9 shows a schematic front view onto rib 304 protruding from a plug just before it comes into contact with the inclined surface 305 of the mandrel. Fig. 10 shows the view of Fig. 9, but how the material of rib 304 is smeared away by the mandrel. A bulk 310 of material is made during this smearing, which enters into the gap between adjacent ribs 304.

Claims

1. Energy dissipating device suitable to be used as part of a connection device that connects a first car of a multi-car vehicle with a second car of the multi-car vehicle, comprising

   - a plug that has a longitudinal axis (A) and
   - a mandrel that has an opening (103), whereby the plug is arranged to be moved at least partially through the opening (103), if a force pointing in the direction of or parallel to the direction of the longitudinal axis (A) is applied to the plug, and whereby at least a part of the plug and/or at least a part of the mandrel is deformed, when the plug is at least partially moved through the opening (103),

   characterized in that
   the surface of the mandrel that surrounds the opening (103) has one protruding rib (104) that extends in the direction of or parallel to the direction of the longitudinal axis (A), either said rib (104) being at least partially deformed and/or said rib (104) at least partially deforming a part of the plug, when the plug is at least partially moved through the opening (103), or
   the surface of the mandrel that surrounds the opening (103) has a plurality of protruding ribs (104) that extends in the direction of or parallel to the direction of the longitudinal axis (A), said ribs (104) being at least partially deformed, when the plug is at least partially moved through the opening (103), whereby the plug has an inclined surface (107) facing the rib or the plurality of ribs (104) wherein said inclined surface inclines away from the longitudinal axis (A) and/or the rib or the plurality of ribs ribs (104) each have an inclined front surface (108) facing the plug wherein said inclined front surface (108) inclines towards the longitudinal axis.

2. Energy dissipating device according to claim 1, **characterized in that** the plug is a deformation tube.

3. Connection device suitable to connect a first car of a multi-car vehicle with a second car of the multi-car vehicle, comprising an energy dissipating device according to any one of claims 1 or 2.

4. Method for building a connection device according to claim 3, **characterized in that** the plug is arranged in front of the mandrel so as to be moved at least partially through the opening (3, 103), if a force pointing in the longitudinal axis (A) is applied to the plug.

Patentansprüche

1. Energie ableitende Vorrichtung, die sich zur Verwendung als Teil einer Verbindungsvorrichtung eignet, welche einen ersten Wagen eines Fahrzeugs mit mehreren Wagen mit einem zweiten Wagen des

Fahrzeugs mit mehreren Wagen verbindet, umfassend:

- einen Zapfen, der eine Längsachse (A) aufweist; und
- einen Dorn, der eine Öffnung (103) aufweist, wobei der Zapfen für eine Bewegung wenigstens teilweise durch die Öffnung (103) angeordnet ist, wenn eine Kraft auf den Zapfen ausgeübt wird, die in Richtung der oder parallel zu der Richtung der Längsachse (A) gerichtet ist, und wobei wenigstens ein Teil des Zapfens und/oder wenigstens ein Teil des Dorns verformt wird, wenn der Zapfen wenigstens teilweise durch die Öffnung (103) bewegt wird;

dadurch gekennzeichnet, dass
die Oberfläche des Dorns, welche die Öffnung (103) umgibt, eine vorstehende Rippe (104) aufweist, die sich in die Richtung der oder parallel zu der Richtung der Längsachse (A) erstreckt, wobei die Rippe (104) entweder teilweise verformt wird und/oder wobei die Rippe (104) wenigstens einen Teil des Zapfens verformt, wenn der Zapfen wenigstens teilweise durch die Öffnung (103) bewegt wird; oder
wobei die Oberfläche des Dorns, welche die Öffnung (103) umgibt, eine Mehrzahl vorstehender Rippen (104) aufweist, die sich in die Richtung der oder parallel zu der Richtung der Längsachse (A) erstrecken, wobei die Rippen (104) wenigstens teilweise verformt werden, wenn der Zapfen wenigstens teilweise durch die Öffnung (103) bewegt wird, wobei der Zapfen eine geneigte Oberfläche (107) aufweist, die zu der Rippe oder der Mehrzahl von Rippen (104) gerichtet ist, wobei die geneigte Oberfläche von der Längsachse (A) weggehend geneigt ist, und/oder wobei die Rippe oder die Mehrzahl von Rippen (104) jeweils eine geneigte vordere Oberfläche (108) aufweisen, die zu dem Zapfen gerichtet ist, wobei die geneigte vordere Oberfläche (108) zu der Längsachse geneigt ist.

2. Energie ableitende Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Zapfen ein Verformungsrohr ist.

3. Verbindungsvorrichtung, die sich zur Verbindung eines ersten Wagens eines Fahrzeugs mit mehreren Wagen mit einem zweiten Wagen des Fahrzeugs mit mehreren Wagen eignet, wobei die Vorrichtung eine Energie ableitende Vorrichtung nach Anspruch 1 oder 2 umfasst.

4. Verfahren für den Bau einer Verbindungsvorrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** der Zapfen vor dem Dorn angeordnet ist, für eine Bewegung wenigstens teilweise durch die Öffnung (3, 103), wenn eine in die Längsrichtung (A) gerichtete Kraft auf den Zapfen ausgeübt wird.

Revendications

1. Dispositif de dissipation d'énergie pouvant être utilisé comme partie d'un dispositif de connexion qui relie une première cabine d'un véhicule à plusieurs cabines à une seconde cabine du véhicule à plusieurs cabines, comprenant

- une fiche qui a un axe longitudinal (A) et
- un mandrin qui a une ouverture (103), la fiche étant conçue pour être déplacée au moins partiellement à travers l'ouverture (103), si une force dirigée dans la direction de ou parallèle à la direction de l'axe longitudinal (A) est appliquée à la fiche, et au moins une partie de la fiche et/ou au moins une partie du mandrin étant déformée, lorsque la fiche est au moins partiellement déplacée à travers l'ouverture (103),

caractérisé en ce que
la surface du mandrin qui entoure l'ouverture (103) a une nervure (104) saillante qui s'étend dans la direction de ou parallèle à la direction de l'axe longitudinal (A), soit ladite nervure (104) étant au moins partiellement déformée et/ou ladite nervure (104) déformant au moins partiellement une partie de la fiche, lorsque la fiche étant au moins partiellement déplacé à travers l'ouverture (103), ou
la surface du mandrin qui entoure l'ouverture (103) a une pluralité de nervures (104) saillantes qui s'étendent dans la direction de ou parallèles à la direction de l'axe longitudinal (A), lesdites nervures (104) étant au moins partiellement déformées, lorsque la fiche est au moins partiellement déplacée à travers l'ouverture (103), la fiche ayant une surface inclinée (107) tournée vers la nervure ou la pluralité de nervures (104), ladite surface inclinée s'éloignant de l'axe longitudinal (A) et/ou la nervure de la pluralité de nervures (104) ayant chacune une surface frontale inclinée (108) tournée vers la fiche, ladite surface frontale inclinée (108) s'inclinant vers l'axe longitudinal.

2. Dispositif de dissipation d'énergie selon la revendication 1, **caractérisé en ce que** la fiche est un tube de déformation.

3. Dispositif de connexion pouvant relier une première cabine d'un véhicule à plusieurs cabines à une seconde cabine du véhicule à plusieurs cabines, comprenant un dispositif de dissipation d'énergie selon la revendication 1 ou 2.

4. Procédé de construction d'un dispositif de connexion selon la revendication 3, **caractérisé en ce que** la

fiche est disposée devant le mandrin de sorte à être déplacée au moins partiellement à travers l'ouverture (3, 103), si une force dirigée dans l'axe longitudinal (A) est appliquée à la fiche.

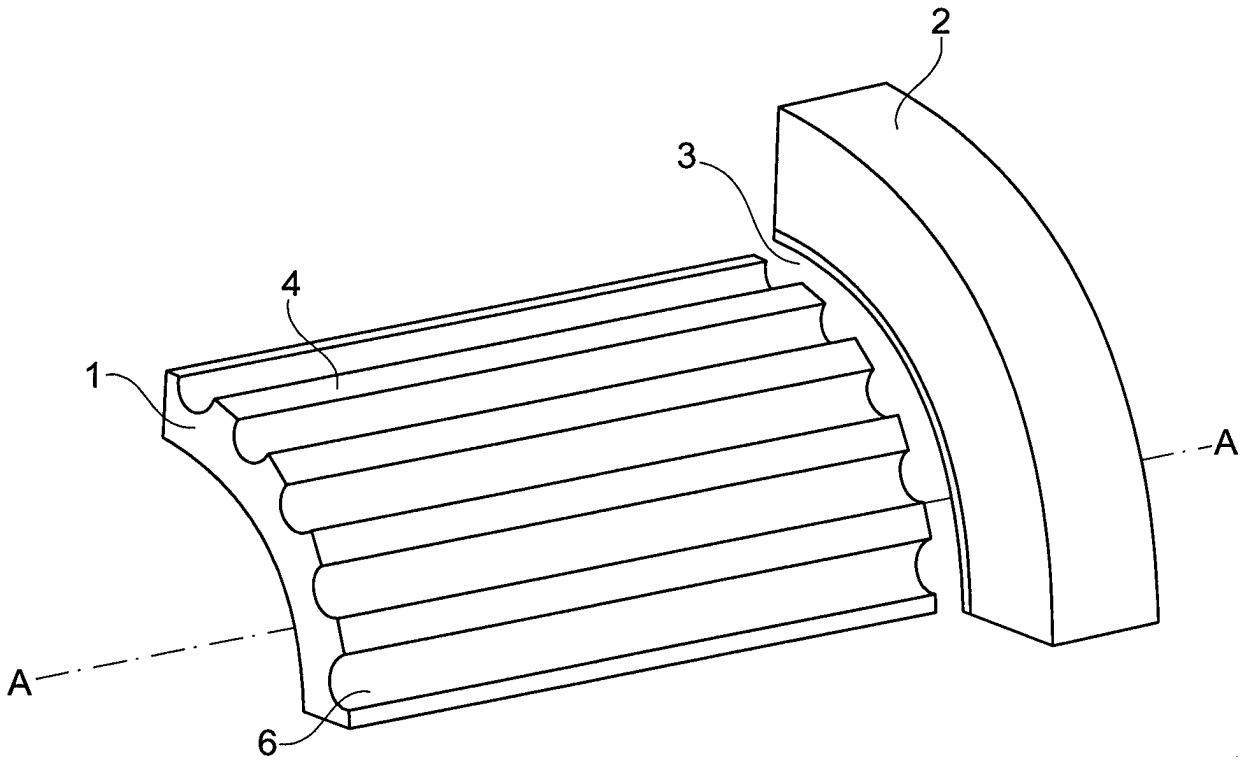

Fig. 1

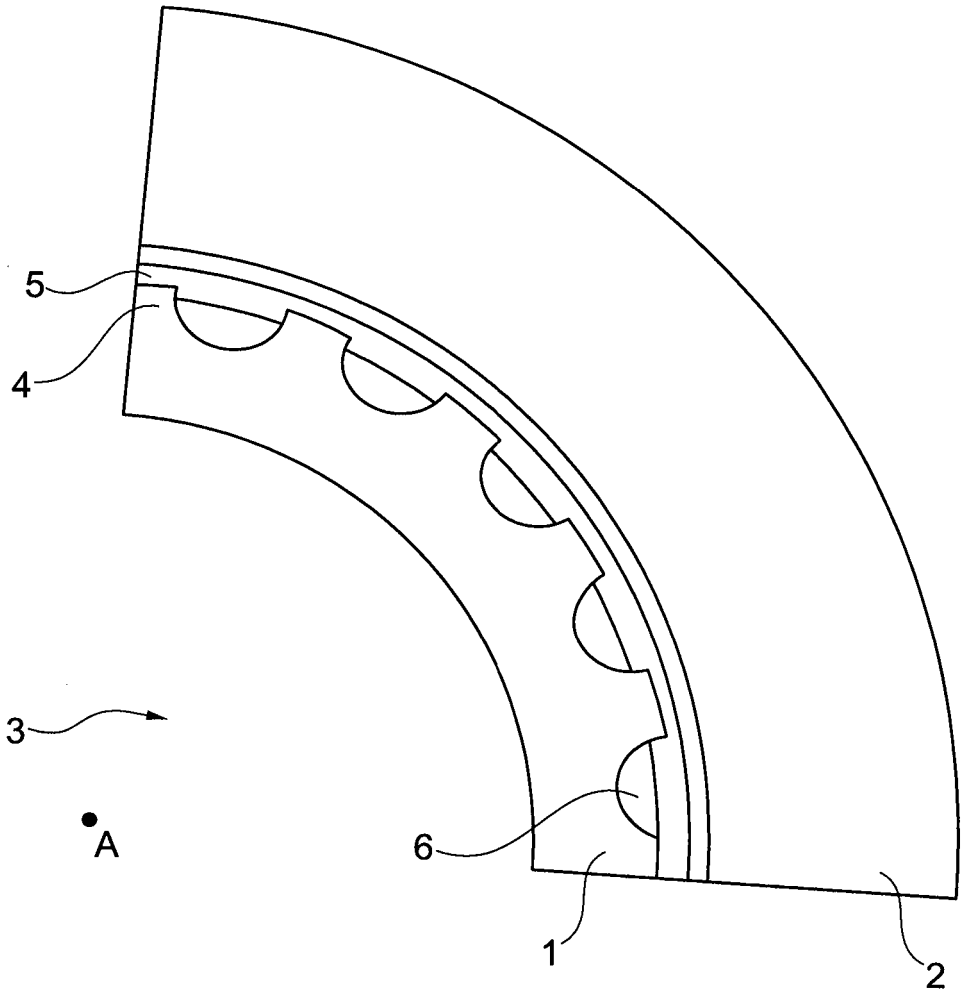

Fig. 2

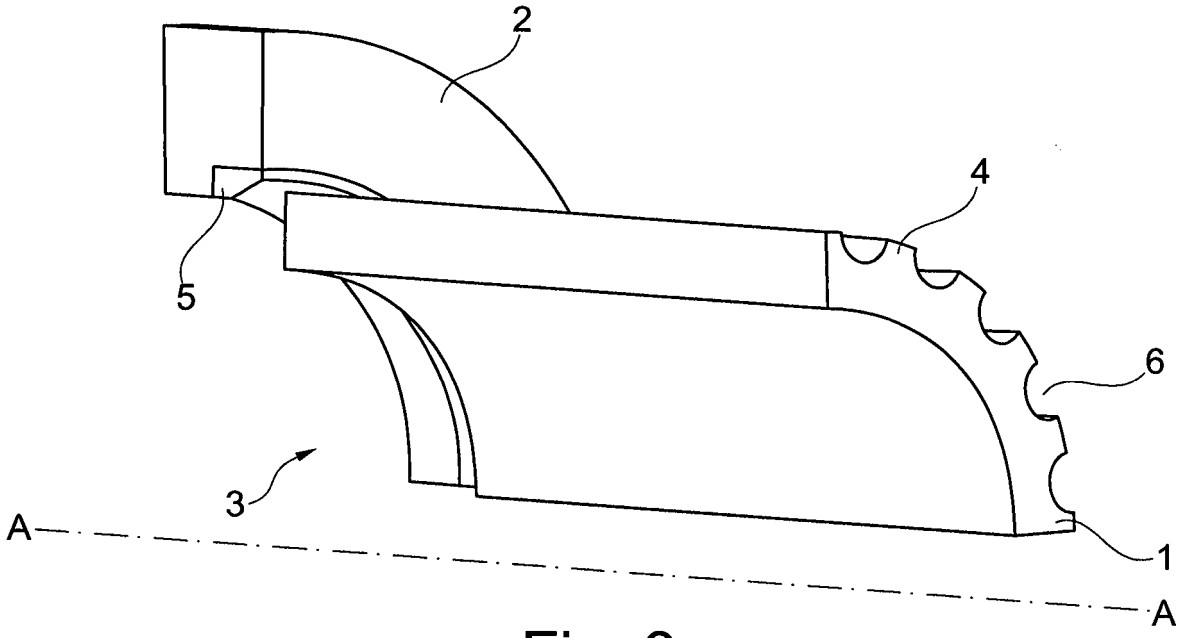

Fig. 3

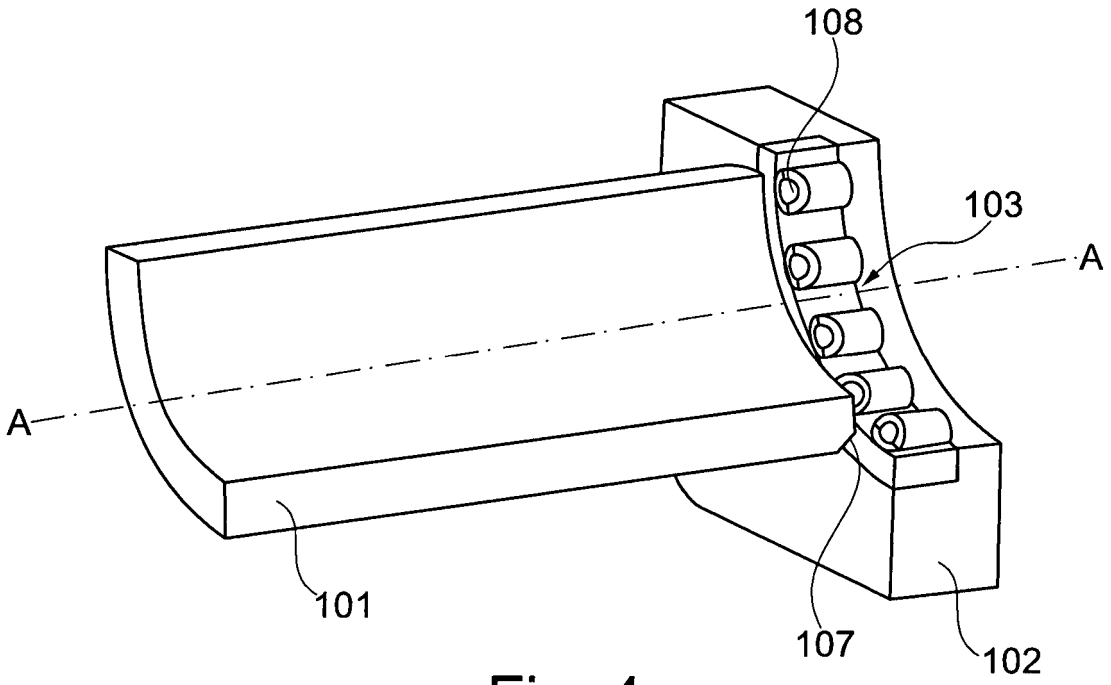

Fig. 4

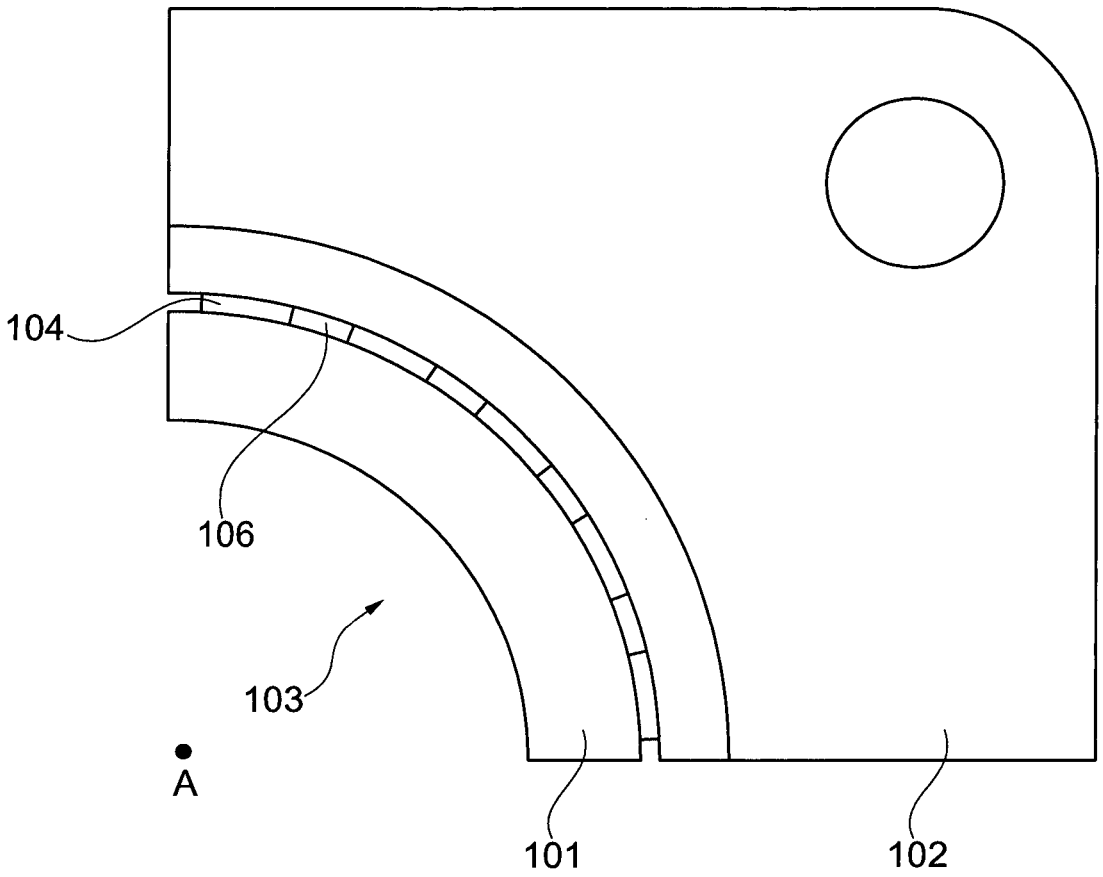

Fig. 5

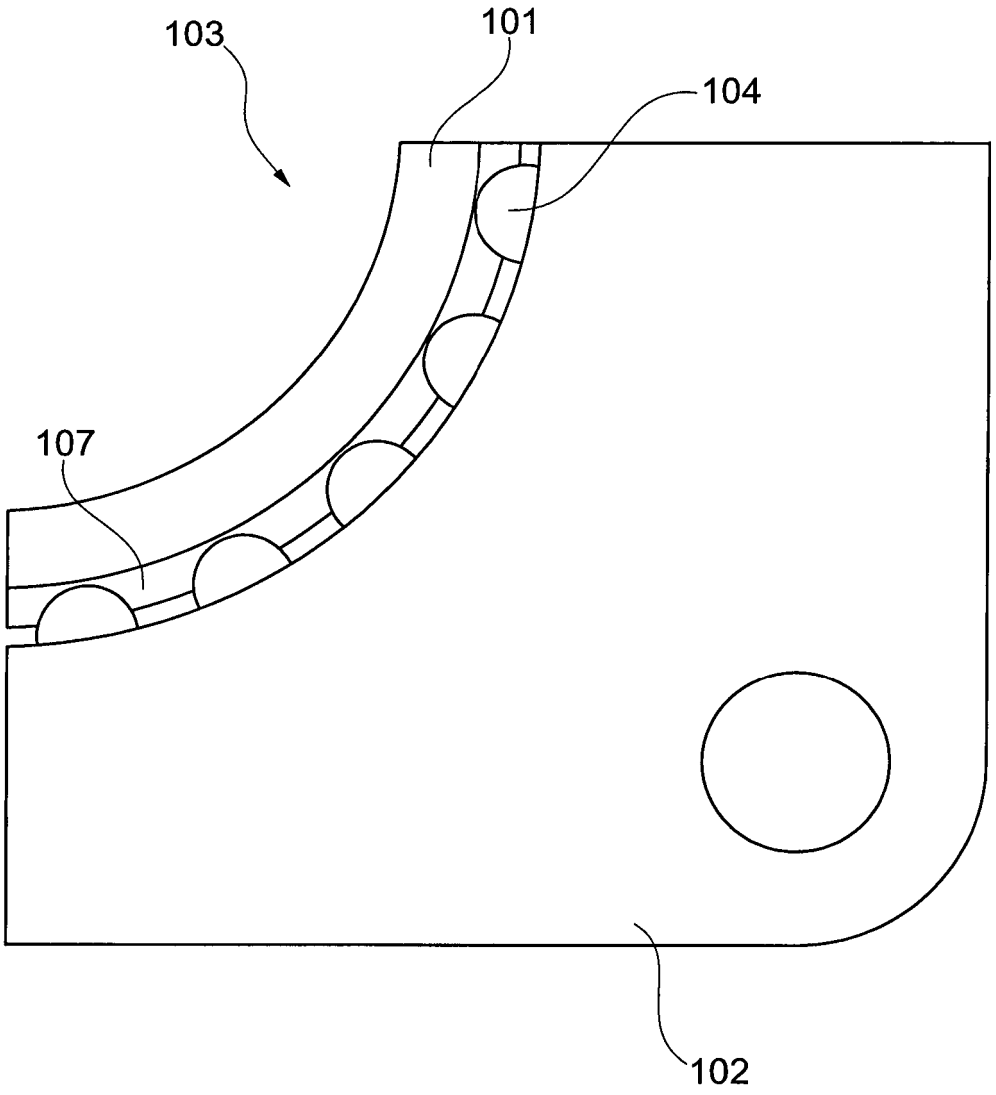

Fig. 6

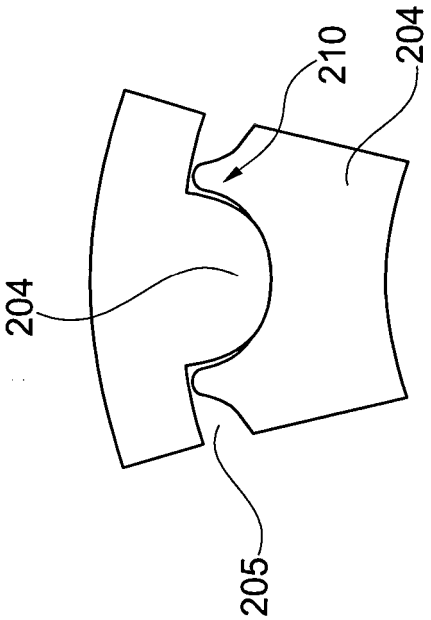

Fig. 8

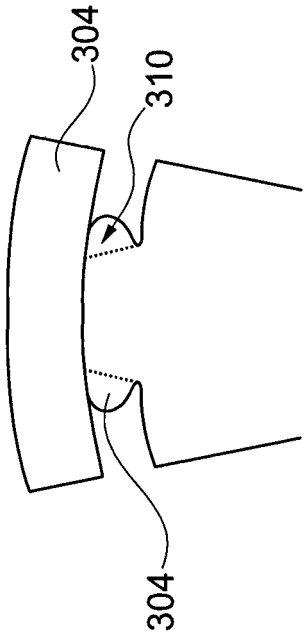

Fig. 10

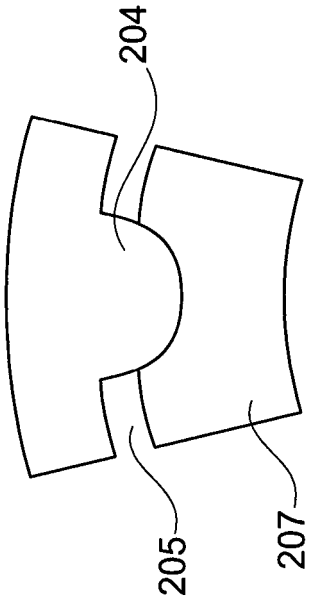

Fig. 7

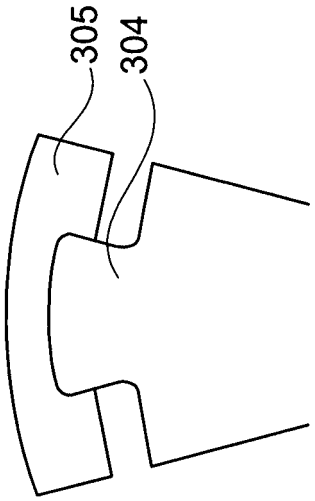

Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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