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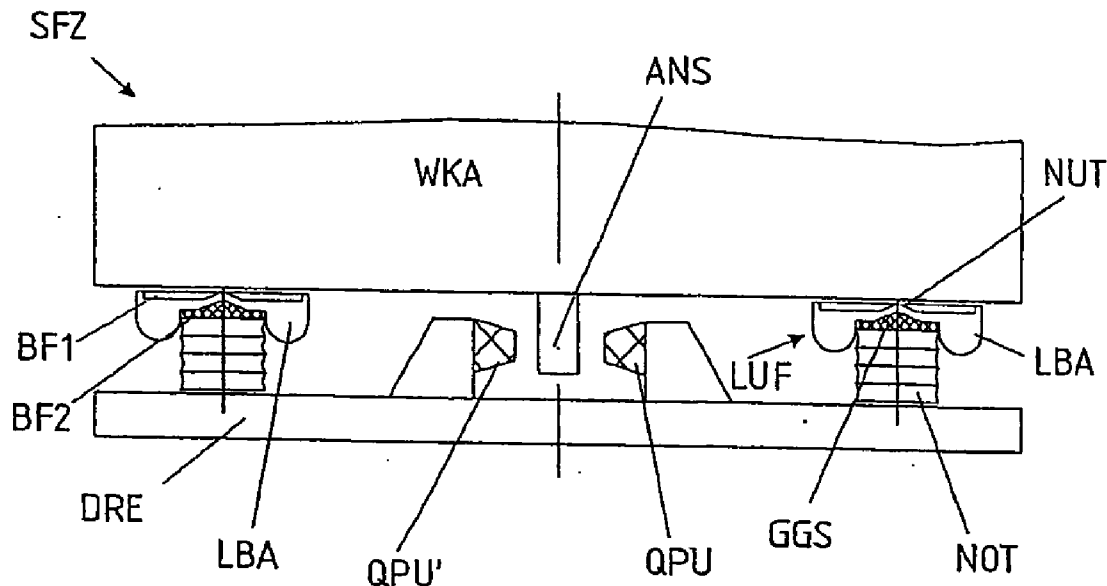
(19) **United States**(12) **Patent Application Publication****Teichman et al.**(10) **Pub. No.: US 2006/0180048 A1**(43) **Pub. Date: Aug. 17, 2006**(54) **EMERGENCY PNEUMATIC SPRING WITH CENTERING ACTION**(75) Inventors: **Martin Teichman**, Graz (AT); **Herwig Waltensdorfer**, Graz (AT); **Andreas Kienberger**, Graz (AT); **Herbert Haas**, Graz (AT); **Johannes Hirtenlechner**, Graz (AT); **Christian Kuter**, Graz (AT)Correspondence Address:
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SKIPPACK, PA 19474 (US)(73) Assignee: **Siemens Transportation systems GmbH & Co. KG**, Vienna (AT)(21) Appl. No.: **11/329,611**(22) Filed: **Jan. 11, 2006**(30) **Foreign Application Priority Data**

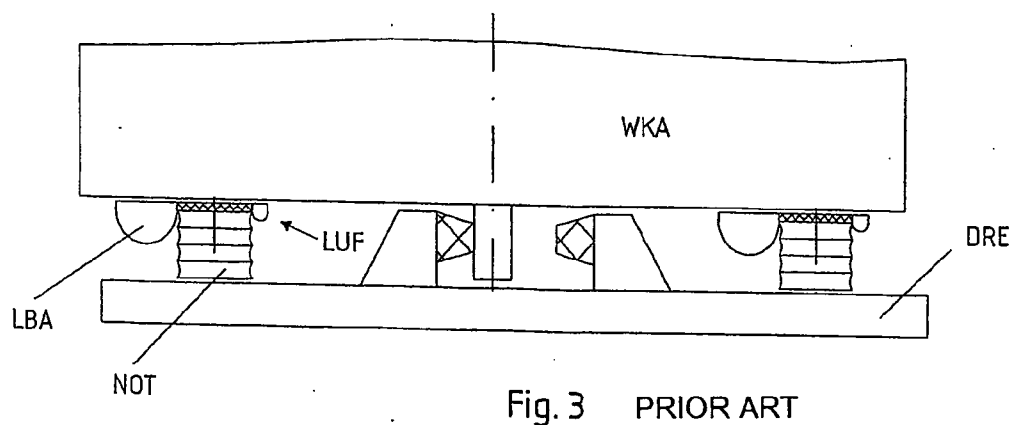
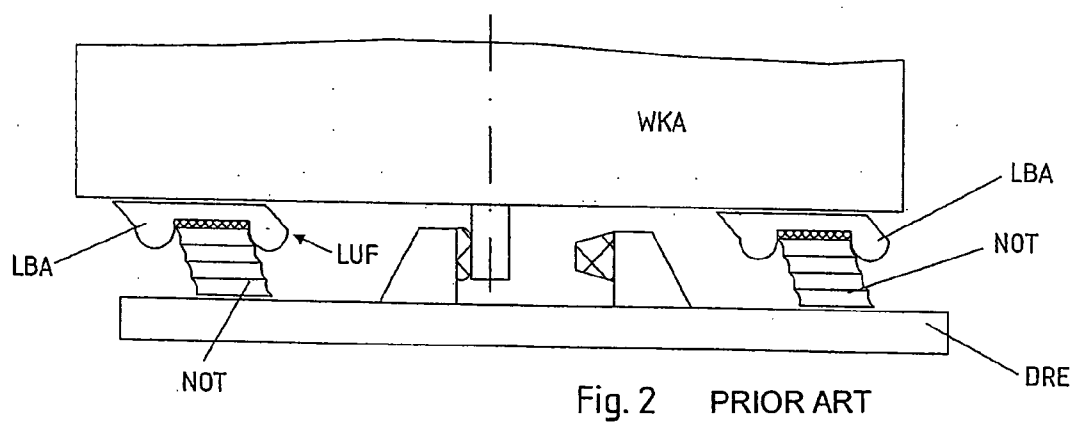
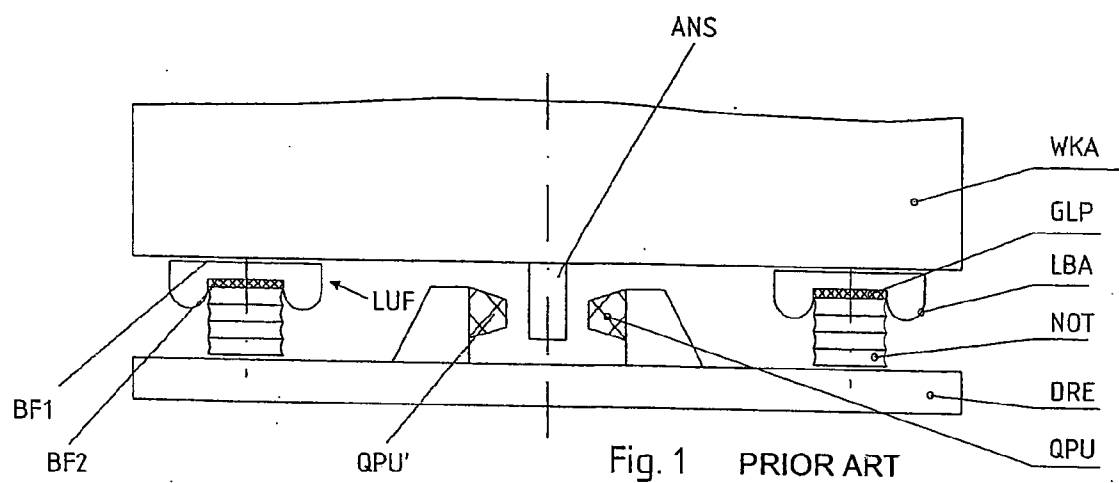
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Jul. 15, 2003 (AT)..... A 1084/2003

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B61F 3/00 (2006.01)(52) **U.S. Cl.** **105/198.1**(57) **ABSTRACT**

A pneumatic spring (LUF) for a rail vehicle (SFZ), comprising two bellow rims (BF1, BF2) mounted one above the other and interconnected by pneumatic-suspension bellow (LBA). One of the bellow rims (BF1) comprises a groove (NUT) and the other rim (BF2) comprises a counterpart (GGG) for the groove (NUT), which permit an automatic centering of the two bellow rims (BF1, BF2) in relation to one another in the transversal direction (Q) of the vehicle, if the pneumatic spring (LUF) fails.





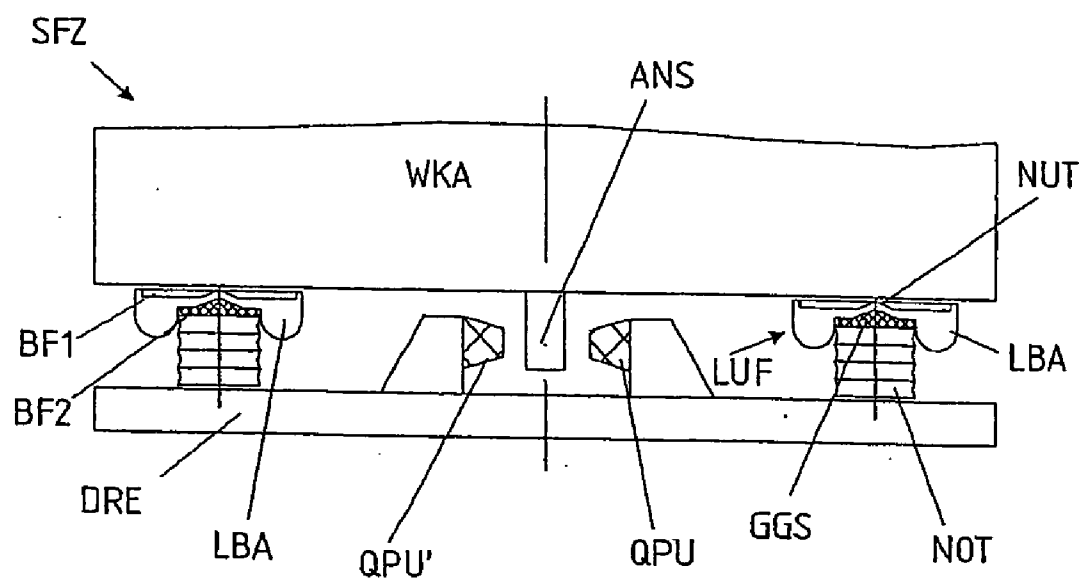


Fig. 4

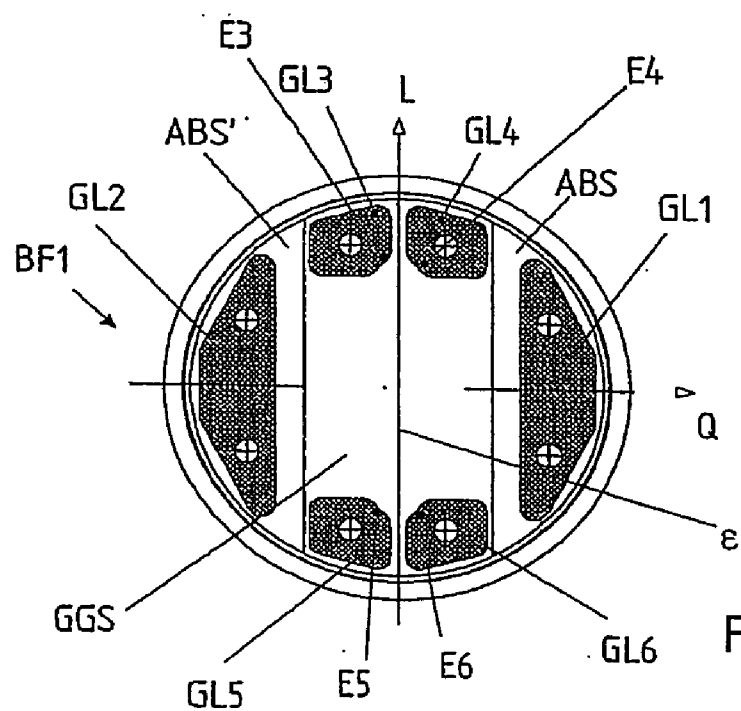


Fig. 5

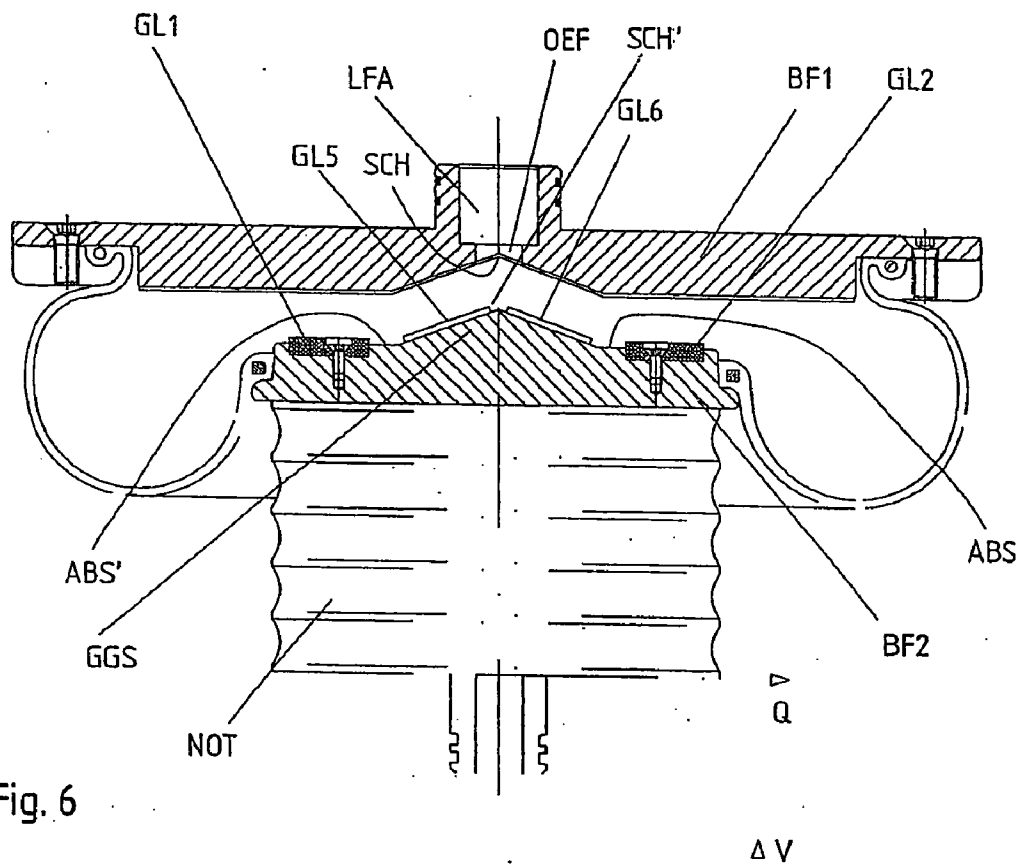


Fig. 6

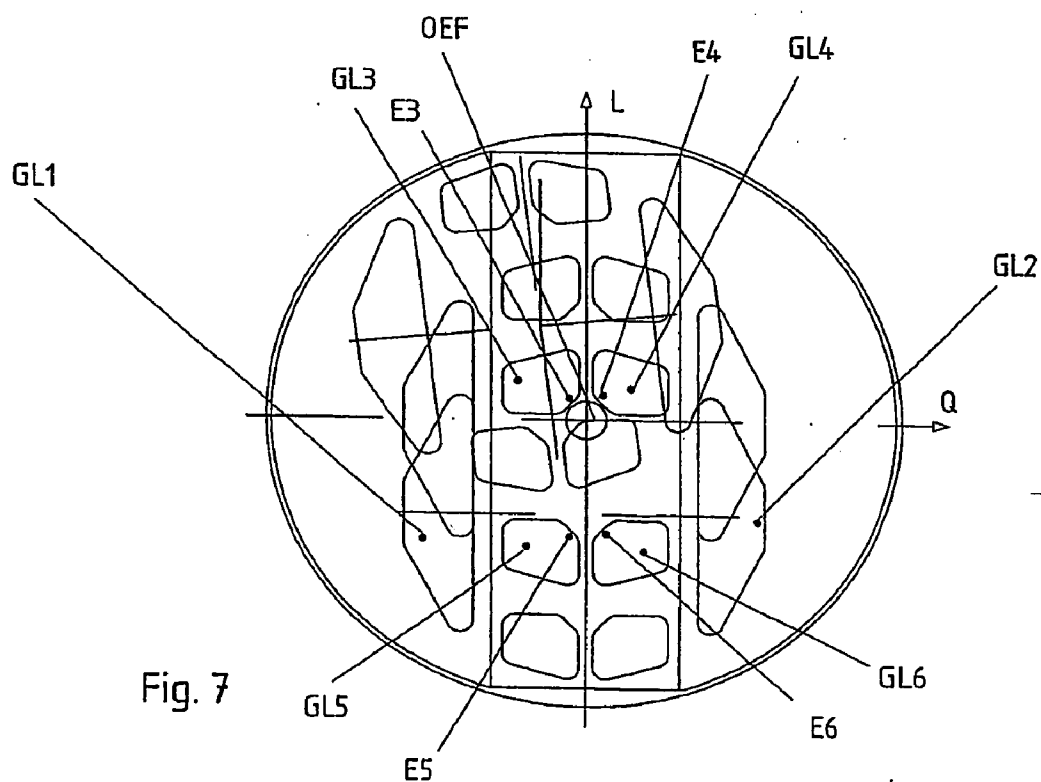


Fig. 7

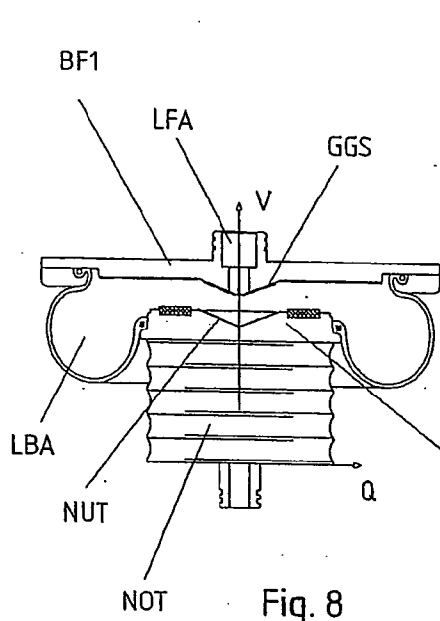


Fig. 8

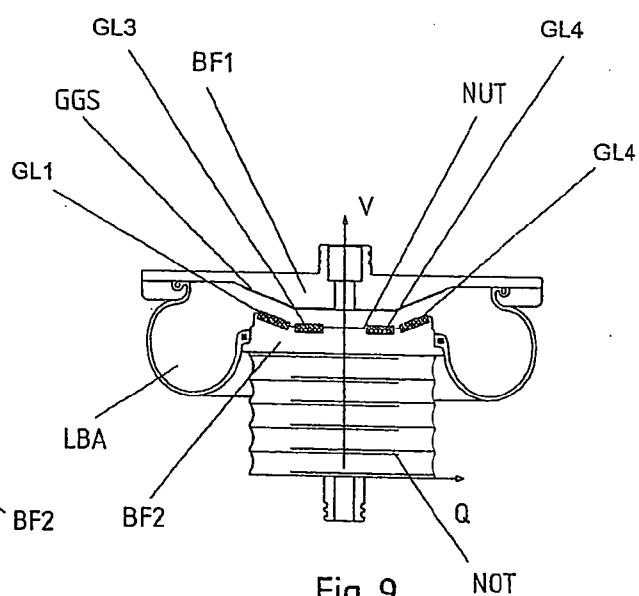


Fig. 9

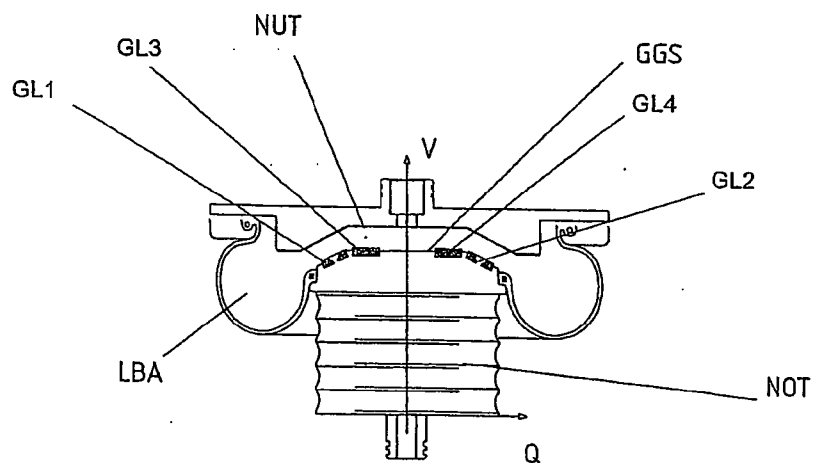


Fig. 10

EMERGENCY PNEUMATIC SPRING WITH CENTERING ACTION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from PCT Patent Application No. PCT/AT2004/000249 filed Jul. 12, 2004, which in turn claims priority from Austrian Patent Application No. A 1084/2003 filed Jul. 15, 2003.

FIELD OF THE INVENTION

[0002] This invention relates to rail vehicles and more particularly to a pneumatic spring for a rail vehicle.

BACKGROUND OF THE INVENTION

[0003] Usually, pneumatic springs LUF are arranged between a bogie DRE and a freight car body WKA of a rail vehicle. Such an arrangement or execution of a pneumatic spring as it is known in the state of the art is illustrated by way of example in **FIG. 1**. Naturally, the spring LUF can also be filled with a gaseous medium other than air, which is why the term "pneumatic spring" in this document quite generally refers to a gas spring. The known pneumatic spring LUF displays an air bellow LBA arranged between two bellow rims BF1, BF2 usually made of steel. Pneumatic spring LUF is connected with the freight car body WKA or with the bogie DER via the bellow rims BF1, BF2. Usually, an emergency spring NOT is provided, for example, a rubber layer spring between pneumatic spring LUF and the bogie, where the two bellow rims BF1, BF2 are usually made in the shape of plates.

[0004] Transversal forces occurring during operation are absorbed by the pneumatic spring LUF and the emergency spring NOT, and a transversal movement of the freight car body WKA is usually limited by transversal buffers QPU, QPU' that cooperate with a stop ANS (**FIG. 2**). In known bogie designs, which employ pneumatic springs LUF with sliding plates GLP for emergency operation when the pneumatic spring LUF fails, its transversal rigidity is almost completely eliminated, as a result of which the transversal travel of the freight car body WKA in the hysteresis of sliding friction is undefined.

[0005] This means that the upper and lower bellow rims BF1, BF2 can, within the transversal sliding friction hysteresis, assume any undefined position with respect to each other (**FIG. 3**), as a result of which the running performance of the rail vehicle SFZ will deteriorate or the permissible limitation profile can be impaired.

[0006] It is therefore an object of the invention to minimize the transversal friction hysteresis as much as possible when the pneumatic spring fails.

BRIEF SUMMARY OF THE INVENTION

[0007] This problem is solved according to the invention with a pneumatic spring for a rail vehicle that comprises two bellow rims that are arranged above each other and that are connected with each other via an air bellow when in an assembled state. One of the bellow rims has a groove, while the other one of the bellow rims has a counterpiece for the groove for the purpose of the automatic centering in the

lateral direction of the vehicle of the two bellow rims with respect to each other in case the pneumatic spring has failed.

[0008] It is to the credit of the invention that it ensures a defined middle position of the two bellow rims with respect to each other even if the pneumatic spring fails because, in case of a failure of the pneumatic spring and the resultant settling or sinking of the upper bellow rim upon the lower bellow rim, the counterpiece and the groove can be made to engage each other. As a result of the cooperation of the groove with its counterpiece, one can greatly restrict the relative motion of the two bellow rims with respect to each other in the lateral direction of the vehicle. In the case of the invention-based solution, one can thus substantially eliminate the friction hysteresis by means of the self-centering groove and its counterpiece.

[0009] In a preferred variant of the invention, the groove is arranged on the bellow rim that, when in the assembled state, lies above the other bellow rim, whereby for certain pneumatic spring systems, the alignment of the groove downward can also be advantageous. Furthermore, at least one of the bellow rims can display at least one sliding element.

[0010] Advantageously, the groove displays an essentially triangular or trapezoidal cross-section. In particular, all sliding elements are made as level surfaces, as a result of which there can develop a relatively large-surface contact between the sliding surface and the countersurface, something that has a positive effect on the service life. Furthermore, the groove and the counterpiece can essentially be designed in a congruent fashion with respect to each other. Moreover, the groove can be bent, whereby the bend is advantageously adapted to the turnout movement. The counterpiece can basically have the shape of a cone, although it also can have some other shape.

[0011] Optimized centering of the two bellow rims in case of a failure of the pneumatic spring can be achieved in the following manner: The apex of the groove and the counterpiece will extend essentially along a longitudinal midplane of its particular associated bellow rim. If the groove has a triangular cross-section, then sliding elements are disposed on a central portion of the facing surfaces of the upper and lower bellow rims, or one thereof, for the purpose of centering the two bellow rims in case the pneumatic spring has failed, whereas other, like sliding elements disposed on lateral portions of the facing surfaces of the upper and lower bellow rims, or one thereof, are provided to absorb vertical stresses.

[0012] If the groove, on the other hand, has a trapezoidal cross-section, then there are provided sliding elements centrally on the upper and/or lower bellow rim for the purpose of absorbing vertical stresses in case the pneumatic spring has failed, whereas other sliding elements are provided laterally on the upper and/or lower bellow rim for the purpose of centering the two bellow rims. The functioning mode of the sliding plates is thus separated into a carrying row and a centering row. This separation of functions takes place as a result of the suitable choice of the tolerances and prevents the unnecessary jamming of the centering sliding plates.

[0013] The service life is extended because the sliding elements display level sliding surfaces. The optimized

design of the sliding plates facilitates a central air connection without which the sliding elements run over the air connection borehole, whereby the upper bellow rim, when in an assembled state, displays an air connection that is arranged centrally upon it, and the sliding elements, provided for the centering of the two bellow rims, can advantageously be made slanted on their corners that face toward the air connection, to prevent the opening from being covered up.

[0014] The abovementioned problem is solved according to the invention also with a rail vehicle of the kind mentioned initially in that at least one pneumatic spring is arranged between the bogie and the freight car body. The alignment of the groove in the longitudinal direction (i.e., the direction of movement) facilitates a sliding action due to the turnout motion of the bogie when moving along an arc with simultaneous maintenance of the groove centering action.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate the presently preferred embodiments of the invention, and, together with the general description given above and the detailed description given below, serve to explain the features of the invention. In the drawings:

[0016] FIGS. 1 to 3 are PRIOR ART elevation views of a rail vehicle representation showing a bogie and a freight car body of a rail vehicle with pneumatic springs;

[0017] FIG. 4 is a basic sketch of a rail vehicle having the present invention;

[0018] FIG. 5 is a partial top view of a bellow rim of the pneumatic spring of the present invention;

[0019] FIG. 6 is a cross-section of the pneumatic spring of FIG. 5;

[0020] FIG. 7 is a top view of the pneumatic spring of FIGS. 5 and 6 with an illustration of the possible operating states; and

[0021] FIGS. 8 to 10 each show alternate embodiments of the pneumatic spring of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] FIGS. 4 to 10 illustrate the pneumatic spring of the present invention. According to FIG. 4, an invention-based rail vehicle SFZ has a bogie DRE and a freight car body WAK arranged above it. An invention-based pneumatic spring LUF is arranged between freight car body WAK and the bogie, below which the pneumatic spring is an emergency spring NOT, for example, a rubber layer spring. In case the pneumatic spring LUF fails, emergency spring NOT provides for the spring suspension of the freight car body WKA in the vertical direction, while to limit the maximum lateral deflection, one can provide a centrally disposed stop ANS whose lateral deflection is limited by two transversal buffers QPU, QPU'.

[0023] Pneumatic spring LUF, as shown in FIG. 6, displays two mutually opposite bellow rims BF1, BF2 that are connected with each other via a pneumatic bellow LBA.

Such pneumatic springs LUF or pneumatic spring systems are known to the expert in many different forms and will therefore not be explained in any greater detail at this point. Furthermore, one of the two bellow rims BF1 has a groove NUT, which preferably has a triangular or trapezoidal cross-section—see also FIGS. 8-10. The other bellow rim BF2 displays a counterpiece GGS for the groove NUT, whereby the counterpiece GGS in a preferred embodiment of the invention is made congruent with the groove NUT. The counterpiece GGS is thus made as a wedge in case of a groove NUT with a triangular cross-section. Production can be simplified in the following manner: Bellow rim BF2 and counterpiece GGS are made in one piece, although separate production with subsequent assembly of the counterpiece GGS and its bellow rim BF2 would basically be possible.

[0024] Very good centering action of the two bellow rims BF1, BF2 and thus of pneumatic spring LUF in case of failure, can be achieved in the following manner: Groove NUT and counterpiece GGS are so arranged on their bellow rims BF1, BF2 that the apex SCH of the groove NUT and the apex SCH' of counterpiece GGS will extend essentially along a longitudinal midplane C of its particular associated bellow rim BF1, BF2. As a result, in case the pneumatic spring fails, one can ensure good engagement of the groove NUT with its counterpiece GGS.

[0025] When pneumatic spring LUF is assembled, groove NUT is so arranged that the apex SCH of the groove NUT will extend essentially parallel to the longitudinal vehicle direction L. As a result of this measure and the arrangement of groove NUT on the upper bellow rim BF1, in case the pneumatic spring fails, one can assure self-centering of the rims with respect to each other. Basically, however, other embodiments are also conceivable, where the groove NUT is defined on the lower bellow rim BF2 and the counterpiece GGS is defined on the upper bellow rim BF1. It is essentially the geometry of the pneumatic bellows and the bellow rims that will determine whether the groove is arranged on the upper or the lower bellow rim.

[0026] Longitudinal movement of the two bellow rims BF1, BF2 with respect to each other due to turnouts is facilitated by the sliding action of the counterpiece GGS in groove NUT. Any rotations occurring around the vertical axis V of the pneumatic spring LUF and the transversal shifts in the direction labeled Q, are absorbed by emergency spring NOT, while groove NUT will retain its transversally centered position (FIG. 7). This means that very similar conditions obtain for the restriction calculation, both for pneumatic spring operation and for emergency operation—failure of pneumatic spring—something that has a particularly favorable effect on the design (width) of the freight car body WKA.

[0027] Moreover, as a result of the wedge-shaped design of groove NUT and of counterpiece GGS, one can—in case of a lateral shift of the two bellow rims BF1, BF2 with respect to each other in case of damage—guarantee the engagement of groove NUT and counterpiece GGS because counterpiece GGS, in case of the settling of the upper bellow rim BF1, can be “caught” by the sidewalls of the groove NUT. In that way, one can ensure the automatic centering of bellow rims BF1, BF2 or of pneumatic spring LUF in the course of emergency operation. The transition phase from pneumatic operation to emergency operation, in particular,

represents a critical situation, where groove NUT is optimized as a result of the abovementioned wedge-shaped design for this transition. This means that the two bellow rims BF1, BF2 in case the pneumatic spring LUF has failed can automatically relatively center each other in all operating states (transversal travel, turnout, longitudinal travel and wobbling).

[0028] By restricting the mobility of the two bellow rims BF1, BF2 with respect to each other in the transversal direction Q, one can bring about an essential minimization of the lateral travel sliding hysteresis if the pneumatic bellow LBA should collapse.

[0029] Furthermore, sliding plates GL1, GL2, GL3, GL4 can be arranged on counterpiece GGS, while according to FIG. 5, two each of sliding plates GL1, GL2, GL3, GL4 can be arranged on each wedge flank, which plates cooperate with the sidewalls of groove NUT. The segments ABS, ABS' that adjoin the wedge flanks can also have sliding plates GL1, GL2, whereby the vertical stresses are introduced via these sliding plates GL1, GL2, while the sliding plates GL3, GL4, arranged on the wedge flanks, will serve primarily for the purpose of centering the two bellow rims BF1, BF2 with respect to each other. There is thus a functional separation of sliding plates GL1, GL2, GL3, GL4 into "carrying" and "centering."

[0030] If the groove has a trapezoidal cross-section, then sliding elements GL3, GL4, arranged in the middle segment, are provided to absorb vertical stresses in case pneumatic spring LUF should fail, while sliding elements GL1, GL2, arranged on a lateral segment ABS, ABS', are provided to center the two bellow rims BF1, BF2 (FIGS. 9, 10).

[0031] When the upper bellow rim BF1 is in an assembled state, then a compressed air supply LFA, arranged centrally upon it, can include an opening OEF. The pneumatic air supply LFA can be arranged centrally by means of an arrangement of the sliding plates GL3-GL6 upon counterpiece GGS, placed as far away from each other as possible, as a result of which, one can prevent a contact of the sliding plates GL3-GL6 with the opening OEF.

[0032] Moreover, the sliding elements GL3, GL4, GL5, GL6, provided for the centering of the two bellow rims BF1, BF2 at their corners E3, E4, E5, E6 facing toward opening OEF, can be advantageously slanted to prevent the opening OEF from being covered up (FIGS. 5 and 7).

[0033] Summarizing, one can say this: by virtue of the arrangement of groove NUT and counterpiece GGS on the upper or the lower bellow rim BF1 or BF2, in case pneumatic spring LUF has failed, one exerts a centering effect upon these two parts in all possible operating states and thus, in case of a failure, bring about a clearly defined laterally centered state of the pneumatic spring LUF.

[0034] It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A pneumatic spring for a rail vehicle that includes two bellow rims that, when in the assembled state, are arranged above each other and that are connected with each other via an air bellow, characterized in that one of the bellow rims displays a groove and the other of the bellow rims displays a counterpiece for the groove for the automatic centering in the transversal vehicle direction of the two bellow rims with respect to each other in case the pneumatic spring fails.

2. The pneumatic spring according to claim 1, characterized in that the groove is arranged on one of the bellow rims, which, when in the assembled state, lies above the other of the bellow rims.

3. The pneumatic spring according to claim 1, characterized in that the groove is arranged on one of the bellow rims, which, when in the assembled state, lies under the other of the bellow rims.

4. The pneumatic spring according to claim 1, characterized in that at least one of the bellow rims has at least one sliding element.

5. The pneumatic spring according to claim 4, characterized in that each of the at least one sliding elements has a level sliding surface.

6. The pneumatic spring according to claim 1, characterized in that the groove has an essentially triangular cross-section.

7. The pneumatic spring according to claim 6, characterized in that sliding elements are disposed on central portions of a facing surface of at least one of the upper and lower bellow rims, for centering the two bellow rims in case the pneumatic spring fails, and other sliding elements are provided on disposed on lateral portions of the facing surface of the at least one of the upper and lower bellow rims to absorb vertical stresses.

8. The pneumatic spring according to claim 7, characterized in that the sliding elements and the other sliding elements have level sliding surfaces.

9. The pneumatic spring according to claim 1, characterized in that the groove has an essentially trapezoidal cross-section.

10. The pneumatic spring according to claim 9, characterized in that sliding elements are disposed on central portions of a facing surface of at least one of the upper and lower bellow rims, for centering the two bellow rims in case the pneumatic spring fails, and other sliding elements are provided on disposed on lateral portions of the facing surface of the at least one of the upper and lower bellow rims to absorb vertical stresses.

11. The pneumatic spring according to claim 10, characterized in that the sliding elements and the other sliding elements have level sliding surfaces.

12. The pneumatic spring according to claim 1, characterized in that the groove and the counterpiece are made essentially congruent with respect to each other.

13. The pneumatic spring according to claim 1, characterized in that the groove has an apex, and the groove apex and the counterpiece each extend essentially along a longitudinal midplane of its particular associated bellow rim.

14. The pneumatic spring according to claim 1, characterized in that the groove is bent.

15. The pneumatic spring according to claim 14, characterized in that the bend of the groove is adapted to the turnout motion.

16. The pneumatic spring according to claim 1, characterized in that the counterpiece is made in the shape of a cone.

17. The pneumatic spring according to claim 1, characterized in that the upper bellow rim, when in the assembled state, displays a compressed air supply that is arranged centrally upon it.

18. The pneumatic spring according to claim 17, characterized in that the sliding elements are arranged for the centering of the two bellow rims and are made slanted at their corners that face toward the compressed air supply.

19. A rail vehicle with a bogie or a truck and a freight car body arranged above, characterized in that there is arranged at least one pneumatic spring according to claim 1 between the bogie and the freight car body.

20. The rail vehicle according to claim 19, characterized in that the apex of the groove extends essentially parallel to the longitudinal vehicle direction.

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