(54) Title: RAIL VEHICLE COMPRISING A COUPLING CONNECTION THAT IS ADAPTED TO A CRASH SITUATION

(57) Abstract:
A rail vehicle having a vehicle body (WKA) comprising on at least one vehicle end a compression zone (STA) located behind an end carrier (ETR) of the vehicle body, and having a central buffer coupling (KUP) extending from a substantially vertical pivot axis (SWA) to the vehicle end and connected to said vehicle body via a coupling carriage (KSL) wherein said coupling carriage (KSL) is attached to said end carrier (ETR) and extending from said end carrier (ETR), bridging said compression zone (STA), towards the vehicle centre, and which is guided longitudinally slidable on the vehicle body (WKA).
ABSTRACT

A rail vehicle having a vehicle body (WKA) comprising on at least one vehicle end a compression zone (STA) located behind an end carrier (ETR) of the vehicle body, and having a central buffer coupling (KUP) extending from a substantially vertical pivot axis (SWA) to the vehicle end and connected to said vehicle body via a coupling carriage (KSL) wherein said coupling carriage (KSL) is attached to said end carrier (ETR) and extending from said end carrier (ETR), bridging said compression zone (STA), towards the vehicle centre, and which is guided longitudinally slidable on the vehicle body (WKA).
RAIL VEHICLE COMPRISING A COUPLING CONNECTION THAT IS ADAPTED TO A CRASH SITUATION

FIELD OF THE INVENTION

The invention relates to a rail vehicle having a vehicle body comprising on at least one vehicle end a compression zone located behind an end carrier and having a (central buffer) coupling protruding from a substantially vertical pivot axis beyond the vehicle end, and connected to carrier of the vehicle body.

BACKGROUND OF THE INVENTION

In rail vehicles of the representational type in case of frontal collision first there will be an abutment of the couplings. Usually the couplings contain shock absorbing and/or resilient members receiving at least a part the impact energy under shortening in longitudinal direction. If the lowering of energy in the coupling is not sufficient which is the case in higher speed collisions between vehicles, the compression zone present on each car located behind each end carrier subsequently has to receive the remainder of the impact energy and to prevent or limit damage on the remaining part of the vehicle and thus to protect people. Before engaging of the end sides of the vehicles, generally the respective anti-climbing protective devices, it is mostly intended to separate the coupling via a designed shear position from the vehicle body to avoid that the collision force is introduced via parallel load paths (coupling and compression zone of the vehicle body) into the vehicle bodies and that unacceptable high total forces occur in the vehicle bodies. Besides of the previously mentioned damages on the vehicles this would also lead to increased retardations of the vehicles and thus to an increased risk of injury for people.

The previously mentioned prior art solution is schematically represented in figures 1a through 1c. The vehicle body WKA of a not further shown rail vehicle holds on its end sides an end carrier ETR running transversely to the direction of travel terminating in an anti-climbing protection device AKS. Such an
arrangement is well known and arises for example from WO 2004/110 842 A1. Towards the vehicle centre a compression zone STA joins which in case of collision may deform in a controlled way. On a bearing block LAB of the central longitudinal beam MLT (or on a coupling cross beam, a perpendicular coupling mounting plate etc.) the coupling KUP pivotable about a substantially vertical pivot axis SWA is attached by means of shear bolts SBO. It terminates in a coupling end piece KES that is connectable with a same end piece of an adjacent vehicle. In the shown example the coupling arm KAM is telescopic when in case of collision the acting force exceeds a certain amount for which for example a deformation member DEF may be used, as indicated. Anyway, in most of the cases the coupling arm KAM contains shock absorbing and/or resilient members, as can be seen e.g. in US 3,149,731 A.

Figure 1b shows a first phase of a collision in which the force acting on the coupling end piece has become so large that the deformation member DEF has reacted and the coupling arm KAM has been pushed together. In this phase the anti-climbing protection devices AKS of the colliding vehicles start to engage each other and the introduction of force has to take place via the anti-climbing protection device so that the action of the compression zone may begin. To permit this the bolts SBO shear off and via the coupling KUP – as desired – no more introduction of force is possible, as shown in figure 1c. Thus the total force on the vehicle body is defined by the deformation taking place in the compression zone of the compression members provided there.

However, the shearing off of the coupling involves the risk of derailments since the coupling can get caught with the track bed, can collide with the bogie etc. It is possible to reduce this danger by special devices such as guide bars, retaining chains etc., but this generally requires that the coupling may shear off before the vehicle bodies engage each other, but this is not possible in all implementations and design requirements, respectively.
SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a rail vehicle having a vehicle body (WKA) comprising on at least one vehicle end a compression zone (STA) located behind an end carrier (ETR) of said vehicle body, and a central buffer coupling (KUP) extending from a substantially vertical pivot axis (SWA) to the vehicle end and connected to a carrier of said vehicle body (WKA), a coupling carriage (KSL) being attached to and extending from said end carrier (ETR), said coupling carriage (KSL) bridging said compression zone (STA), towards the vehicle centre, and being longitudinally and slidably guided on said vehicle body (WKA).

An objective of the invention is the creation of a coupling connection for a rail vehicle in which a shearing off of the coupling is not necessary to avoid in the
case of collision unwanted parallel load paths, namely on the one hand the
coupling and on the other hand the compression zone. Thus retardations in the
region of passengers are to be limited and the stability of this region has to be
ensured. Moreover the problems that may arise from a sheared off coupling are
supposed to be cancelled.

According to the invention this objective is solved by a rail vehicle of the above
mentioned type in that to the end carrier a coupling carriage is attached which is
extending from the end carrier, bridging the compression zone, towards the
vehicle centre, and which is guided longitudinally slidable on the vehicle body.

Figures 2a through 2c show in a similar view like figure 1 but for two vehicles
coupled to each other the invention in a simplified and schematic
representation. In these figures for the same parts the same reference
numerals are used as in figures 1a through 1c.

As can be seen the coupling KUP according to the invention is fixed to the lower
side of a coupling carriage KSL and here – in contrast to the prior art – no shear
bolts or the like are in use. The coupling carriage KSL is attached to an end
carrier ETR of the vehicle body WKA and runs from here, bridging the
compression zone STA, towards the vehicle centre. It is supported
longitudinally slidable behind the compression zone STA on a central
longitudinal beam MLT of the vehicle body WKA, as will be explained in more
detail below.

In contrast to a conventional coupling connection in which the coupling
longitudinal forces are directly introduced into the vehicle body WKA behind the
compression zone STA, according to the invention, these are introduced via the
coupling carriage KSL, the end carrier ETR, and the compression zone STA into
the vehicle body WKA.

In case of collision the two adjacent vehicles are pushed against one another,
and first the coupling arms KAM acting to each other are telescopically pushed
together with the overcoming of the deformation members DEF, until in the first
phase of a collision the anti-climbing protection devices AKS of both vehicles
engage each other, as shown in figure 2b. It is to be emphasized here that the coupling arms also can be formed according to other known constructions and may include e.g. integrated attenuation members etc.

With a continuing force effect a deformation of the compression zone will occur, as can be seen in figure 2c, and during this deformation the coupling carriage KSL will be displaced along the central longitudinal beam MLT towards the vehicle centre. It is clear that in this way a shearing off of the coupling is not required, and also the problems explained above with such a shearing off can not appear. Since all longitudinal forces are introduced via the end carrier, regardless whether or not the coupling continues to transmit forces, the total force on the vehicle body is always limited by the maximum compression force in the compression zone.

In an aspect, practical concerning the introduction of force, it is provided that the coupling carriage is guided on a central longitudinal beam of the vehicle body.

For the purpose of the invention it is also preferable when the coupling carriage is bolted to the end carrier and for the introduction of force there is provided a central bolt stub.

A guiding of the coupling carriage favourable in praxis is resulting when the coupling carriage comprises on its interior end two U-shaped guides protruding on both sides which comprise guiding webs located on the vehicle body.

A secured function of the invention, even after a long period of use, will be ensured if the coupling carriage is slidably supported on the vehicle body with the interposition of plastic insertions. Thereby e.g. it will be avoided to get rusty. But with the use of suitable plastics also the sliding friction forces can be minimized in a collision to ensure a longitudinal displacement with low force level.

The invention turns out to be very advantageous in a rail vehicle in which a coupling arm, running from an attachment location on the coupling carriage towards the end of the vehicle up to a coupling end piece, in the case of collision is able to be telescopically pushed together with the overcoming of a
deformation member, or after the shearing off of an interior overload protection etc.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, an example of the prior art is shown in figures 1a through 1c, and the invention together with further advantages is explained in greater detail from an exemplary aspect which is illustrated in figures 2a through 7, in which:

Figures 1a to 1c are schematic sectional views of an existing coupling connection for rail vehicle that is adapted to a crash situation.

Figures 2a to 2c are sectional views similar to figures 1a to 1c, showing an embodiment in accordance with the present invention of coupling connections of two rail vehicles coupled to each other in a simplified and schematic representation.

Figures 3 and 3b are perspective views oblique from the bottom and from the front of the vehicle body of a rail vehicle according to the invention together with a coupling carriage in its original condition and in a deformed condition after a collision in a 3-D-crash simulation, respectively, and for a better visibility the actual coupling is not shown.

Figure 4 is a plan view of a front portion of the vehicle body with coupling carriage and the coupling placed thereto.

Figure 5 is a sectional view of the line V-V of figure 4 in an enlarged representation.

Figure 6 is a sectional view of the line VI-VI of figure 4 also in an enlarged representation.

Figure 7 is a detail VII of figure 5 in an enlarged representation.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In figures 3a and 3b there is shown from a computer simulation of an actual aspect, the crash performance of a rail vehicle according to the invention. Figure 3a shows the condition of the end side of a vehicle before a crash. It can be seen that the coupling carriage KSL is attached with one end to an end carrier ETR of the vehicle. Also coupled to this end carrier or integrally formed is the anti-climbing protection device AKS. The coupling carriage KSL is extending towards the vehicle centre and is guided on its other end by means of two U-shaped guides UFU protruding on both sides in that these comprise guiding webs FST located on the vehicle WKA. In figures 3a and 3b the actual coupling together with its coupling rod is omitted to be able to better show the coupling carriage in this oblique bottom view.

According to the illustration of figure 3b following a collision the entire end carrier ETR is displaced towards the vehicle centre, and the compression zone STA is pushed together, accordingly. As can be seen, now the carriage KSL with its guides UFU has slipped along the guiding webs FST towards the vehicle centre.

Figures 4 through 7 now show details of an actual embodiment. In figure 4 – a plan view – on the left hand-side one can see the outline of the anti-climbing protection device AKS. The coupling is drawn in, as well.

Figure 5 shows in enlarged representation the guide of the coupling carriage KSL on the central longitudinal beam MLT of the vehicle body. It can be seen that the coupling carriage KSL has on its left and right side a U-shaped guide UFU each, and each guide UFU is encompassing an associated guiding web FST connected to the central longitudinal beam. In a still enlarged view of figure 7 this can be recognised better. Each guide UFU has an upper leg OBS and a lower leg UNS. Between the lower leg UNS and the guiding web FST of the vehicle body there is provided a wedge KEI adjustable in transverse direction which is adjustable by means of a bolt and nut assembly such that the compression, with which the guide UFU is encompassing the web FST, can be adjusted. Further the guiding web FST is encompassed with the interposition of
plastic insertions KUE whereby for example a jam because of rust is to be avoided and the sliding friction forces between the guiding web FST and the coupling carriage KSL can be minimized.

At this point it is to be mentioned that other ways of guiding the coupling carriage KSL on the vehicle body WKA can absolutely be useful. So it is possible to arrange a U-shaped guide on the vehicle body and to arrange guiding webs on the coupling carriage KSL etc.

Finally figure 6 shows that the coupling carriage KSL at the end carrier ETR is bolted by means of threaded bolts SCH, and for defined and reliable introduction of force a central bolt stub BST is provided.
CLAIMS

1. A rail vehicle having a vehicle body (WKA) comprising on at least one vehicle end a compression zone (STA) located behind an end carrier (ETR) of said vehicle body, and a central buffer coupling (KUP) extending from a substantially vertical pivot axis (SWA) to the vehicle end and connected to a carrier of said vehicle body (WKA), a coupling carriage (KSL) being attached to and extending from said end carrier (ETR), said coupling carriage (KSL) bridging said compression zone (STA), towards the vehicle centre, and being longitudinally and slidably guided on said vehicle body (WKA).

2. A rail vehicle as defined in claim 1, wherein said coupling carriage (KSL) is guided on a central longitudinal beam (MLT) of said vehicle body (WKA).

3. A rail vehicle as defined in claim 1 or 2, wherein said coupling carriage (KSL) is bolted to said end carrier (ETR), and a central bolt stub (BST) is provided for introduction of force.

4. A rail vehicle as defined in any one of claims 1 to 3, wherein said coupling carriage (KSL) includes on its interior end two U-shaped guides (UFU) protruding on both sides which comprise guiding webs (FST) located on said vehicle body (WKA).
5. A rail vehicle as defined in any one of claims 1 to 4, wherein within said U-shaped guides (UFU) an adjustable wedge (KEI) is arranged one surface of which is acting to said guiding web (FST).

6. A rail vehicle as defined in any one of claims 1 to 5, wherein said coupling carriage (KSL) is slidably supported at said vehicle body (WKA) with the interposition of plastic insertions (KUE).

7. A rail vehicle as defined in any one of claims 1 to 6, wherein a coupling arm (KAM) running from an attachment point on said coupling carriage (KSL) towards the vehicle centre up to a coupling end piece (KES), in case of collision, can telescopically be pushed together with the overcoming of a deformation member (DEF).