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(54) Benævnelse: **ENDETERMINAL TIL ET AUTOVÆRN**

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DESCRIPTION

[0001] The invention relates to an end terminal for a safety guardrail, said end terminal comprising an elongated beam which is on opposite ends connected to a ground anchor and to the safety guardrail, respectively, and further comprising a collision catcher which is slidably mounted on the beam, wherein the collision catcher connects to a sliding block with an aperture through which the beam is guided.

[0002] Such an end terminal for a safety guardrail is known from EP-B-2 646 624. This known end terminal for a safety guardrail comprises an energy absorbing device and a metallic, elongated draw element, one of which is connected to the collision catcher, and wherein the impact energy of a collision is absorbed due to a relative movement of the elongated draw element and the energy absorbing device.

[0003] WO 2017 / 125740 A1 also discloses an end terminal, wherein the end terminal is provided with shearing elements projecting into cut-outs to transfer the load from the impact post, as the first point of impact to the shearing elements. The shearing elements cut through the rail upon collision of a vehicle with the impact device.

[0004] US 2003 / 0034484 A1 describes an impact head of a box beam rail member that is provided to bend and deflect the rail member during a collision, allowing the rail member to be deflected away from the roadway and out of the path of an impacting vehicle. The impact head includes a striking face and a chute portion that receives the box beam rail member therewithin when it is telescopingly forced onto the rail member by the collision force.

[0005] US 2006 / 0054876 A1 discloses a vehicle crash cushion with a deformable attenuator member extending in the longitudinal direction and having a first end coupled to the front anchor and a second end coupled to the rear anchor. A support member is positioned adjacent the attenuator member and is moveable in the longitudinal direction relative thereto between an initial position and an impact position toward the rear anchor and away from the front anchor.

[0006] US 2003 / 0070894 A1 discloses a crash cushion system having an impact head and a three stage energy absorption mechanism.

[0007] WO 2016 / 033122 A1 discloses a guardrail terminal incorporating an impact head of open front configuration adapted with a rear portion as a funnel disposed with the narrow end of the funnel facing forward which will flatten the W beam guardrail as it moves down the beam when impacted by the vehicle.

[0008] Any end terminal for a safety guardrail is required to pass a series of ENV1317-4:2002 crash tests. The EN1317 European crash test standard is developed within the framework of the Construction Products Directive 89/106/EEC and EN1317-5 serves as a basis for the CE

marking of road safety systems such as safety barriers and guardrails, crash cushions, barrier extremities and transitions. One of these tests is a head on impact at 110km/h with a 1500kg car to get a classification in the energy absorbing class of EN1317. In order to achieve this, it is desirable for the vehicle to be decelerated in a smooth manner.

[0009] The current invention relates to several aspects of such an end terminal for a safety guardrail that can be applied independently from each other, but also cumulative wherein in the latter situation the best results may be achieved.

[0010] The invention concerns the feature that inside the aperture the sliding block is provided with at least two protruding deformation elements that engage the beam so as to arrange that upon movement of the sliding block towards the safety guardrail, the deformation elements provide a depressed portion in the beam that extends towards the safety guardrail. As the sliding block moves along the beam during vehicle impact, the deformation elements thus deform the beam, which takes energy and slows the car down.

[0011] For mounting the sliding block on the elongated beam the elongated beam has an initial depressed portion in which the two or more protruding deformation elements protrude.

[0012] The elongated beam has a substantially square or rectangular cross-section. At least two deformation elements are provided within the aperture on the sliding block, and project to opposite sides of the elongated beam reaching through the sliding block. The sliding block is then mounted in a more or less balanced way on the elongated beam, and the further depression of the elongated beam during impact can then take place on opposite sides of the elongated beam so as to secure the maintenance of a stable movement of the sliding block along the elongated beam during slowing down of the impacting car.

[0013] It is preferred that the sliding block is provided with at least one of upper wall portions inside the aperture that directly engage the elongated beam for support of the sliding block, and that in or between said at least one of upper and lower wall portions a slit or slits are provided providing room for passing of bolt heads or other fixtures extending from the elongated beam. Preferably the sliding block (5) is also provided with at least one of lower (5") wall portions inside the aperture (6) that directly engage the elongated beam (2) for support of the sliding block (5), and that in or between said at least one of lower (5") wall portions a slit (9) or slits are provided providing room for passing of bolt heads (10) or other fixtures extending from the elongated beam (2).

[0014] In a particular embodiment regarding the invention, the sidewalls of the sliding block are provided with indents protruding inwardly into the aperture through which the elongated beam is guided, wherein said indents directly engage the elongated beam for support of the sliding block whilst providing room for passing of bolt heads or other fixtures extending from the elongated beam.

[0015] With respect to the invention it is remarked that, with current state-of-the-art end

terminal designs, if a vehicle heavier or travelling at a higher speed than the above-mentioned 1500kg car traveling at 110km/h were to impact the end terminal, once the prescribed energy had been absorbed, the terminal would cease to function in its desired way and could be dangerous. The just mentioned two embodiments relating to the invention are embodied with features which secure that the end terminal will continue to absorb energy beyond the EN1317 requirement for as long as is needed to bring the vehicle to rest. To achieve this result it is instrumental that the sliding block will pass over bolted joints of the elongated beam allowing the end terminal to continue working along its entire length without getting caught up.

[0016] It is preferred that the collision catcher has a hook part, which is preferably upstanding and/or swivable, for catching behind a bumper of a colliding car. As mentioned above an end terminal for a safety guardrail is required to pass EN1317 crash tests. One of these tests in particular causes the car to spin out and away from the end terminal, which can lead to the vehicle rebounding into other road traffic. The EN1317 standard has criteria that must be met to gain successful accreditation. The problem is that the nature of this test is likely to cause the vehicle to spin out beyond limits set in the standard and therefore fail the test. According to the invention a hooked front end is provided on the collision catcher which is designed to 'capture' the front bumper of a vehicle and therefore reduce motion of the vehicle during impact and stay within the limits prescribed by the test standard EN1317. The hook part can also be embodied with a locking pin that breaks under impact. The hook part can also be embodied as an active feature which becomes operational upon impact of a car.

[0017] It is preferred that below the elongated beam a stander is provided with a U-shaped receptacle in which the elongated beam is received. The stander with the U-shaped receptacle only supports the elongated beam. This has the advantage that the connection between the stander and the beam is relatively strong in a lateral direction, but relatively weak in a longitudinal direction.

[0018] Preferably the stander is designed to collapse when the elongated beam is loaded during the impact of a colliding car.

[0019] It is preferred that the elongated beam is provided with at least one insert beam extending over a part of the length of the elongated beam to provide said elongated beam with portions of different impact resistance. This differentiates from prior art solutions that are equipped with a single mechanism for absorbing energy and therefore do not have any ability to tailor the resistive force level for different vehicle impacts. According to this particular aspect of the invention the at least one insert beam that extends over a part of the length of the elongated beam provides it with different levels of impact resistance, so that one thing and another can be tailored to the required properties of the end terminal.

[0020] The benefits of applying at least one insert beam in the elongated beam can be further promoted by arranging that the elongated beam is provided with a plurality of insert beams, preferably having mutually differing lengths, gauges and/or material properties.

[0021] It is preferable that the at least one insert beam is closer to the safety guardrail than to the ground anchor in order to provide that upon impact the elongated beam initially provides a lower impact resistance than at a final stage when the part of the elongated beam wherein the insert beam is provided becomes operational.

[0022] It is preferred that the end terminal is provided with a deflector, wherein the deflector extends below the elongated beam. This provides a solution for the problem in certain cases of vehicle impact from an opposite rather than from the regular impact side, that the vehicle can become wedged between the underside of the elongated beam and the rigid anchor to the ground. The deflector is arranged to deflect parts of the vehicle (mainly the wheel) back out away from the anchor to the ground, to prevent such parts from getting trapped.

[0023] The deflector can either be mounted on the elongated beam or another suitable part of the end terminal, or to the ground.

[0024] The invention will hereinafter be further elucidated with reference to the drawing of an exemplary embodiment of an apparatus operating according to a prior art method and according to the method of the invention that is not limiting as to the appended claims.

[0025] In the drawing:

- figure 1 shows a detail of an end terminal for a safety guardrail according to the invention with a view at the sliding block; and
- figure 2A and figure 2B show the sliding block after it has moved over a certain distance along the elongated beam of the end terminal;
- figures 3A - 3C show the sliding block according to a first embodiment after it has moved over a certain distance along the elongated beam of the end terminal, also showing the bolt heads on top of the elongated beam;
- figure 3D shows separately a sliding block according to a second embodiment;
- figure 4A and figure 4B show the end terminal for a safety guardrail, as provided with an upstanding hook for catching behind the bumper of a car;
- figure 5 shows the end terminal of the invention in a specific embodiment with an insert beam provided in the part of the elongated beam; and
- figure 6A and figure 6B respectively show the end terminal of the invention as provided with a deflector in rest, and after impact with a colliding car.

[0026] Whenever in the figures the same reference numerals are applied, these numerals refer to the same parts.

[0027] Making first reference to figure 6A, this figure most clearly shows the substance of a nominal configuration of an end terminal 1 for a safety guardrail. Such an end terminal 1 comprises an elongated beam 2 which is on opposite ends connected to a ground anchor 3

and to a safety guardrail, respectively. The safety guardrail is not shown in the figure, but its construction and its combination with an end terminal 1 as shown in figure 6A is abundantly clear to the skilled person and requires no further elucidation. The end terminal 1 comprises a collision catcher 4 which is slidably mounted on the beam 2, wherein the collision catcher 4 connects to a sliding block 5 with an aperture 6 through which the beam 2 is guided.

[0028] Turning now to figure 1, the invention is illustrated by a detailed view at the beam 2 and the sliding block 5 with its aperture 6. It is shown in figure 1 that inside the aperture 6 the sliding block 5 is provided with one or more protruding deformation elements 7. Figure 1 only provides a view of a single deformation element 7, but it is preferred that at least two deformation elements 7 are provided within the aperture 6 and on the sliding block 5, projecting to opposite sides of the elongated beam 2 reaching through the sliding block 5.

[0029] Figure 2A and figure 2B show from different perspectives how the beam 2 is deformed during a vehicle impact as the sliding block 5 is moved in the direction of arrow A, towards the safety guardrail, along beam 2. Beam 2 may be arranged as having an optional initial depressed portion 8 that the deformation elements 7 engage with. This is however not necessary as the beam 2 may also be arranged with a square or rectangular cross-section over its entire length.

[0030] There are no specific requirements as to the tensile strength of the elongated beam 2 and the tensile strength of the sliding block 5, as long as the beam 2 and the sliding block 5 are arranged such that upon movement of the sliding block 5 along the beam 2 towards the safety guardrail - that is in the direction of the arrow A - the deformation element or elements 7 provide a depressed portion 8 in the beam 2, or extend an initial depressed portion 8 of the beam 2 towards the safety guardrail. As the sliding block moves along the beam 2 during vehicle impact, the deformation elements 7 deform the beam 2, which takes energy and slows the car down. As the elongated beam 2 has a substantially square or rectangular cross-section before movement of the sliding block 5, after passing of the sliding block 5 this square or rectangular cross-section is converted by the operation of the deformation elements 7 into a non-square or non-rectangular cross-section with depressed portions 8.

[0031] Taking reference now to figures 3A - 3C it is shown that the sliding block 5 is provided with at least one of upper 5' wall portions inside the aperture 6. Preferably also at least one of lower wall portions 5" are provided. This means that not both upper 5' and lower 5" wall portions need to be present, but that it is preferred that at least one of the upper wall portions 5' and at least one of lower wall portions 5" are provided. Whatever wall portions are actually present, these wall portions are intended to directly engage the elongated beam 2 for support of the sliding block 5, and that in or between said at least one of upper 5' and lower 5" wall portions a slit 9 or slits are provided providing room for passing of bolt heads 10 or other fixtures on top of the elongated beam 2. Going from figure 3A to figure 3C the progressing movement of the sliding block 5 along the elongated beam 2 is shown, wherein the bolt heads 10 can pass through the upper slit 9 between the two adjacent upper wall portions 5'. A similar construction can be provided at the underside of the beam 2 wherein a lower slit 9 can be

provided between the optional lower wall portions 5". This is not visible in the figures 3A - 3C but entirely clear for the skilled person, so that a further elucidation is superfluous.

[0032] In an alternative embodiment shown in figure 3D an embodiment of a sliding block 5 is shown wherein the sidewalls 15', 15" of the sliding block 5 are provided with indents 16', 16" protruding inwardly into the aperture 6 through which the elongated beam (not shown) is guided, wherein said indents 16', 16" are designed to directly engage the elongated beam for support of the sliding block 5 whilst providing room for passing of bolt heads 10 or other fixtures extending from the elongated beam 2.

[0033] Turning now to figure 4A and figure 4B it shows that the collision catcher 4 has a hook part 11. Figure 4B shows its function for catching behind a bumper 12 of a colliding car.

[0034] Preferably the hook part 11 is upstanding, which has proven to be most effective. It can also be beneficial that the hook part 11 is swivable. Other options are to embody the hook part with a locking pin that breaks under impact. The hook part can also be embodied as an active feature which becomes operational upon impact of a car. The way this can be executed requires no further elucidation, and is therefore not further shown in the drawing.

[0035] In figure 5 it is indicated that the elongated beam 2 is provided with an insert beam extending over a part 13 of the length of the elongated beam 2 to provide said elongated beam with portions of different impact resistance. As will be clear from figure 5, the insert beam in part 13 of the elongated beam 2 is closer to the safety guardrail (which is not shown but which is present at the left of the figure), than to the ground anchor 3 in order to provide that upon impact the elongated beam 2 initially provides a lower impact resistance than at a final stage when the part 13 of the elongated beam 2, wherein the insert beam is provided, becomes operational. Although figure 5 only shows a single insert beam, it may be preferable to provide the elongated beam 2 with a plurality of insert beams, wherein the insert beams have mutually differing lengths, gauges and/or material properties. This increases the flexibility in the design to provide the elongated beam with portions of different impact resistance.

[0036] As another feature shown in figure 5, below the elongated beam 2 a stander 17 is provided with a U-shaped receptacle 18 in which the elongated beam 2 is received. Preferably the stander 17 is designed to collapse when the elongated beam 2 is loaded during the impact of a colliding car.

[0037] Turning back to figure 6A, it is shown near to the collision catcher 4 the end terminal is provided with a deflector 14, wherein the deflector 14 is mounted on and extends below the elongated beam 2. Alternatively the deflector 14 can also be mounted to the ground. Figure 6B shows the functionality of the deflector 14 to deflect parts of the vehicle (mainly the wheel 15) back out, away from the anchor 3 to the ground, to prevent such parts from getting wedged and trapped between the underside of the elongated beam 2 and the rigid anchor 3 to the ground.

[0038] Although the invention has been discussed in the foregoing with reference to exemplary embodiments of the end terminal for a safety guard of the invention, the invention is not restricted to these particular embodiments which can be varied in many ways without departing from the scope of the claims.

[0039] The discussed exemplary embodiments shall therefore not be used to construe the appended claims strictly in accordance therewith. On the contrary the embodiments are merely intended to explain the wording of the appended claims without intent to limit the claims to these exemplary embodiments. The scope of protection of the invention shall therefore be construed in accordance with the appended claims only, wherein a possible ambiguity in the wording of the claims shall be resolved using these exemplary embodiments.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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- US20060054876A1 **[0005]**
- US20030070894A1 **[0006]**
- WO2016033122A1 **[0007]**

PATENTKRAV

1. Endeterminal (1) til et autoværn, hvor endeterminalen (1) omfatter en aflang bjælke (2), der i hver ende er forbundet med henholdsvis et jordanker (3) og med autoværnet, og som yderligere omfatter en kollisionsfanger (4), der er monteret forskydeligt på bjælken (2), hvor kollisionsfangeren (4) er forbundet med en glideklods (5) med en åbning (6), som bjælken (2) føres gennem, hvor den aflange bjælke (2) har et hovedsageligt firkantet eller rektangulær tværsnit, og hvor mindst to deformationselementer (7) er tilvejebragt inden i åbningen (6) på glideklodsen (5), **kendetegnet ved, at** deformationselementerne (7) stikker frem i modstående sider af den aflange bjælke (2) og når gennem glideklodsen (5), og hvor den aflange bjælke (2) har en første nedtrykket del (8), ind i hvilken mindst de to fremstikkende deformationselementer (7) stikker, og hvor mindst de to deformationselementer går i indgreb med bjælken (2) for at arrangere, at efter bevægelse af glideklodsen (5) i retning af autoværnet, tilvejebringer deformationselementerne (7) en nedtrykket del (8) i bjælken (2), som strækker sig i retning af autoværnet.

2. Endeterminalen ifølge krav 1, som er **kendetegnet ved, at** glideklodsen (5) er forsynet med mindst en af øvre (5') vægdele inde i åbningen (6), som er i direkte kontakt med den aflange bjælke (2) til understøtning af glideklodsen (5), og at der i eller mellem den mindst ene af øvre (5') vægdele er tilvejebragt en spalte (9) eller spalter, som giver plads til at indføre bolthoveder (10) eller andre fastspændingsanordninger, der udgår fra den aflange bjælke (2).

3. Endeterminalen ifølge krav 2, som er **kendetegnet ved, at** glideklodsen (5) også er forsynet med mindst en af nedre (5'') vægdele inde i åbningen (6), som kommer i direkte kontakt med den aflange bjælke (2) til understøtning af glideklodsen (5), og at der i eller mellem den mindst ene af nedre (5'') vægdele er tilvejebragt en spalte (9) eller spalter, som giver plads til at indføre bolthoveder (10) eller andre fastspændingsanordninger, der udgår fra den aflange bjælke (2).

4. Endeterminalen ifølge ethvert af kravene 1-3, **kendetegnet ved, at** sidevæggene (15', 15'') på glideklodsen (5) er forsynet med indhak (16', 16''), der stikker ind i åbningen (6), hvorigennem den aflange bjælke (2) er ført, hvor nævnte indhak (16', 16'') går i direkte indgreb med den aflange bjælke (2) til

understøtning af glideklodsen (5), mens der samtidigt gives plads til at indføre bolthoveder (10) eller andre fastspændingsanordninger, der udgår fra den aflange bjælke (2).

5. Endeterminalen ifølge ethvert af kravene 1-4, **kendetegnet ved, at** kollisionsfangeren (4) har en krogdel (11) til at gribe fat bag en kofanger (12) på en kolliderende bil.

6. Endeterminalen ifølge krav 5, der er **kendetegnet ved, at** krogdelen (11) er en opretstående krogdel.

7. Endeterminalen ifølge ethvert af kravene 1-6, som er **kendetegnet ved, at** der under den aflange bjælke (2) er tilvejebragt et stativ (17) med en U-formet holder (18), hvor den aflange bjælke (2) modtages.

8. Endeterminalen ifølge krav 7, der er **kendetegnet ved, at** stativet (17) er udformet til at klappe sammen, når den aflange bjælke (2) belastes under påvirkning af en kolliderende bil.

9. Endeterminalen ifølge ethvert af kravene 1-8, som er **kendetegnet ved, at** den aflange bjælke (2) er forsynet med mindst én indsat bjælke, der strækker sig over en del (13) af længden af den aflange bjælke (2) til tilvejebringelse af den aflange bjælke (2) med dele med forskellig modstandsdygtighed over for slag.

10. Endeterminalen følge krav 9, som er **kendetegnet ved, at** de indsatte bjælker har indbyrdes varierende længder, størrelser og/eller materialeegenskaber.

11. Endeterminalen ifølge ethvert af kravene 9-10, som er **kendetegnet ved, at** den mindst ene indsatte bjælke er tættere på autoværnet end på jordankeret (3) for at tilvejebringe, at den aflange bjælke (2) ved kollision indledningsvis tilvejebringer en lavere modstandsdygtighed over for slag end ved en slutfase, når den del (13) af den aflange bjælke (2), hvor den mindst ene indsatte bjælke er tilvejebragt, træder i funktion.

12. Endeterminalen ifølge ethvert af kravene 1-11, som er **kendetegnet ved, at** endeterminalen (1) er forsynet med en deflektor (14), hvor deflektoren (14) strækker sig under den aflange bjælke (2).

13. Endeterminalen ifølge krav 12, som er **kendetegnet ved, at** deflektoren (14) er monteret i jorden.

DRAWINGS

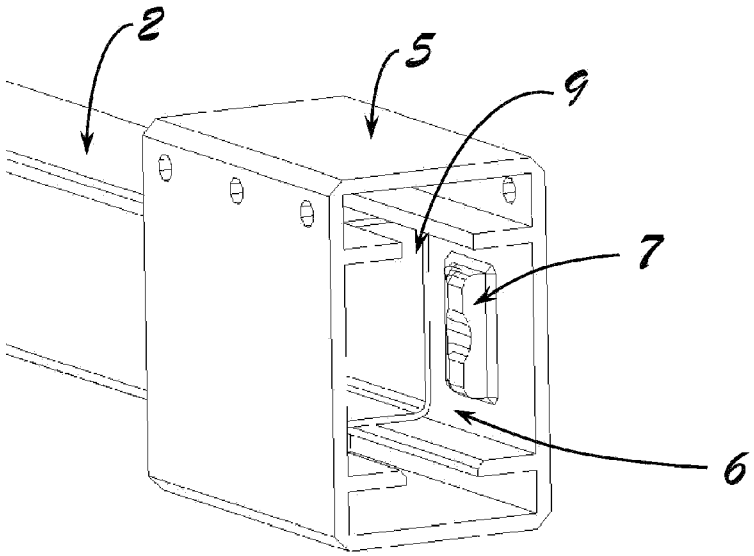

Fig. 1

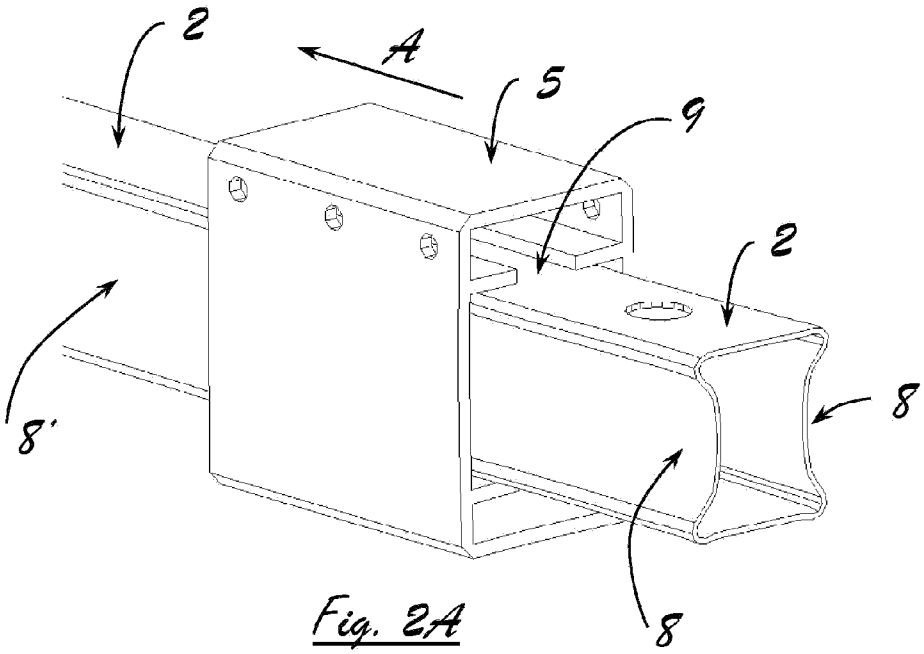

Fig. 2A

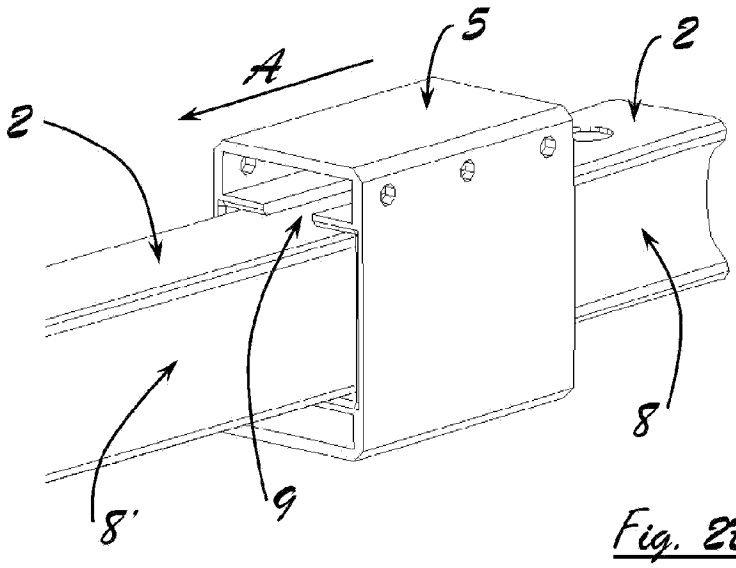

Fig. 2B

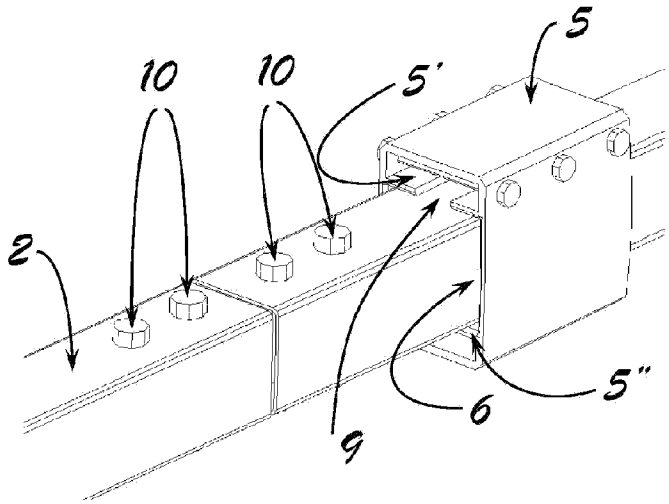

Fig. 3A

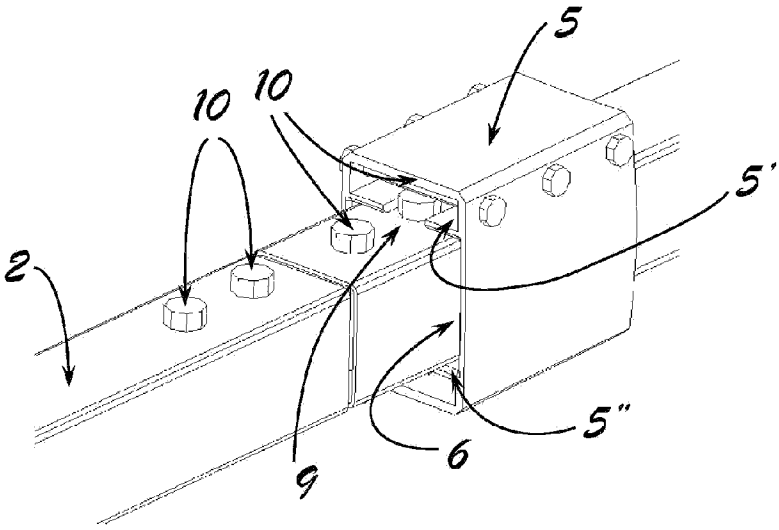

Fig. 3B

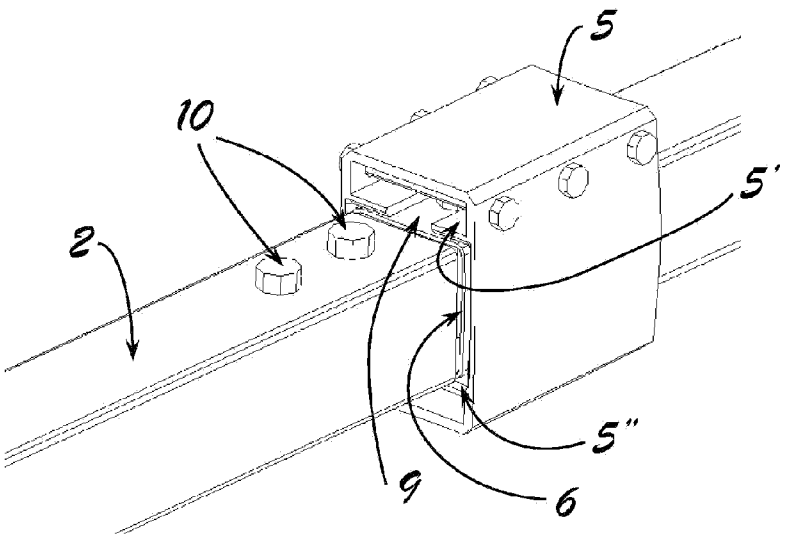

Fig. 3C

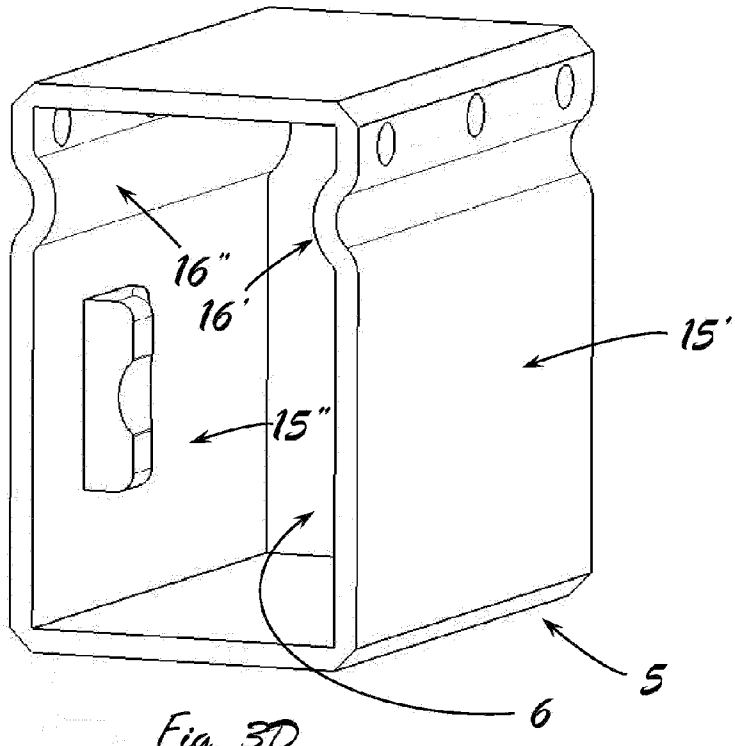

Fig. 3D

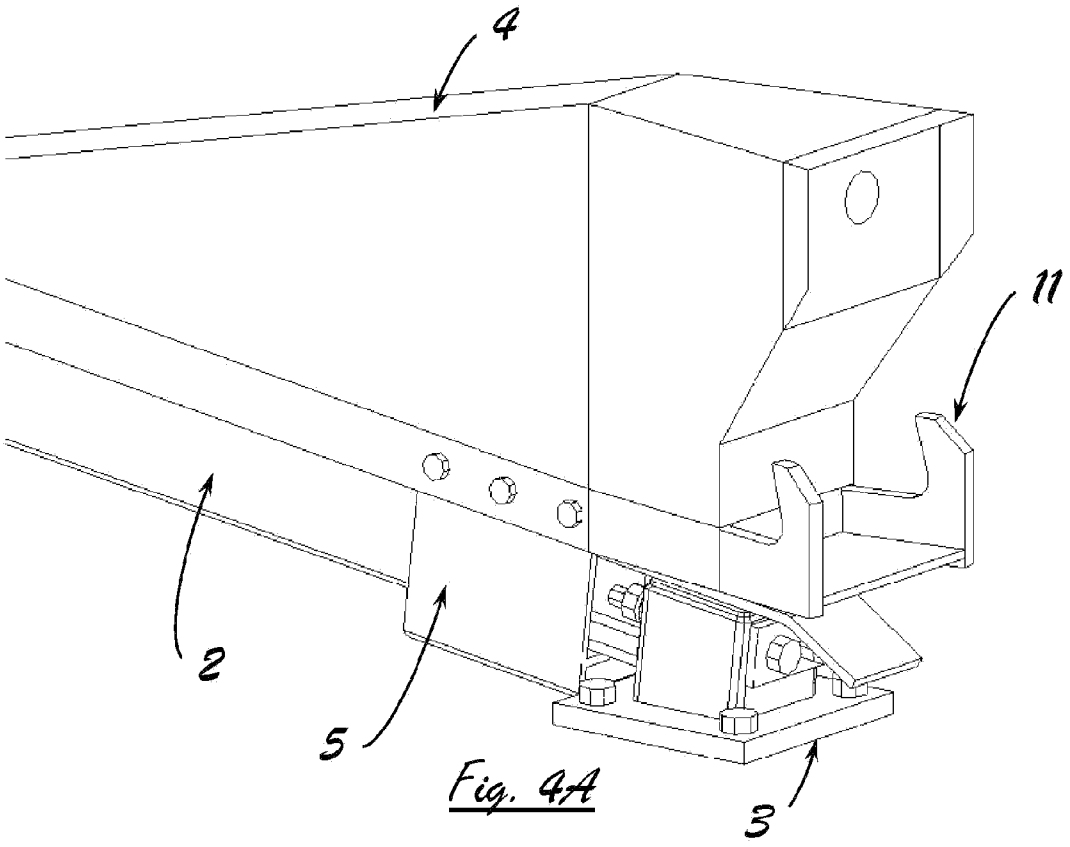

Fig. 4A

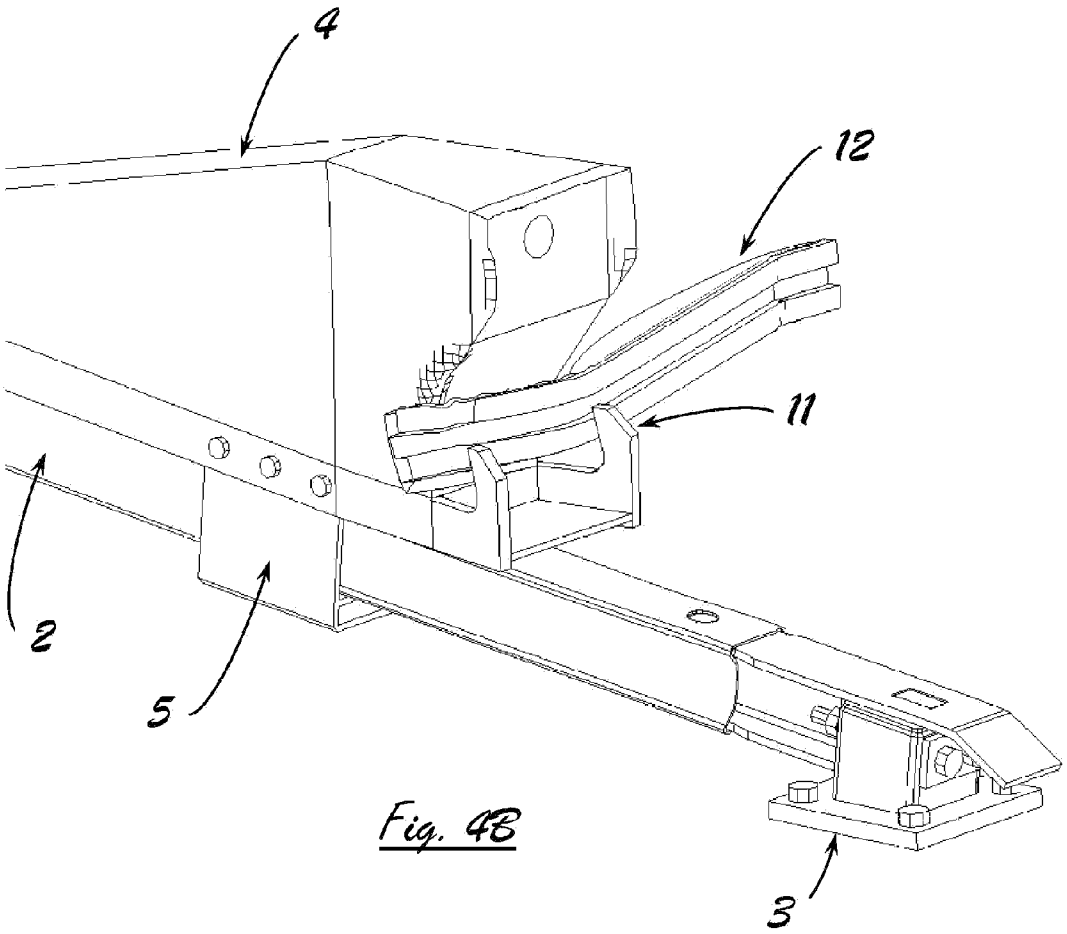

Fig. 4B

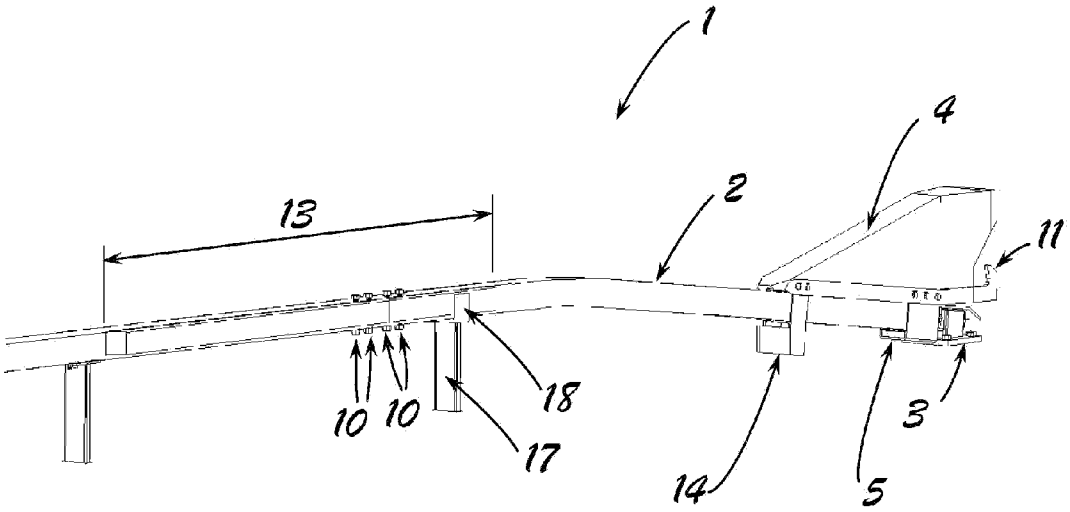

Fig. 5

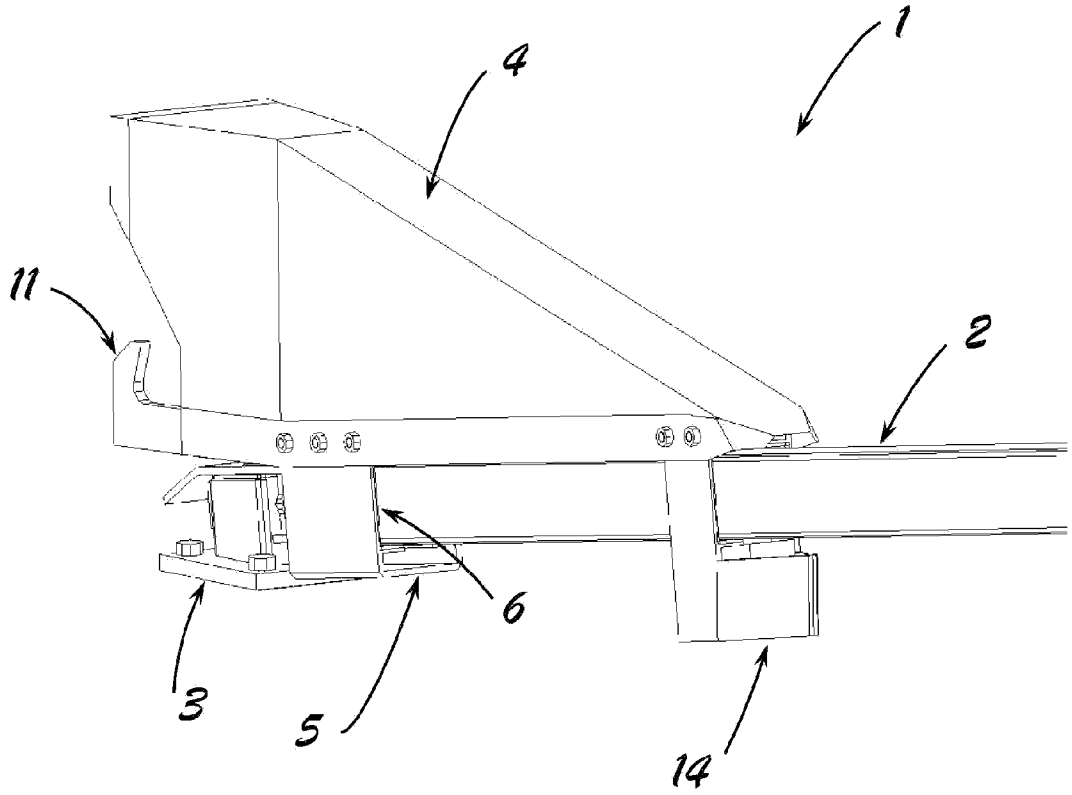

Fig. 6A

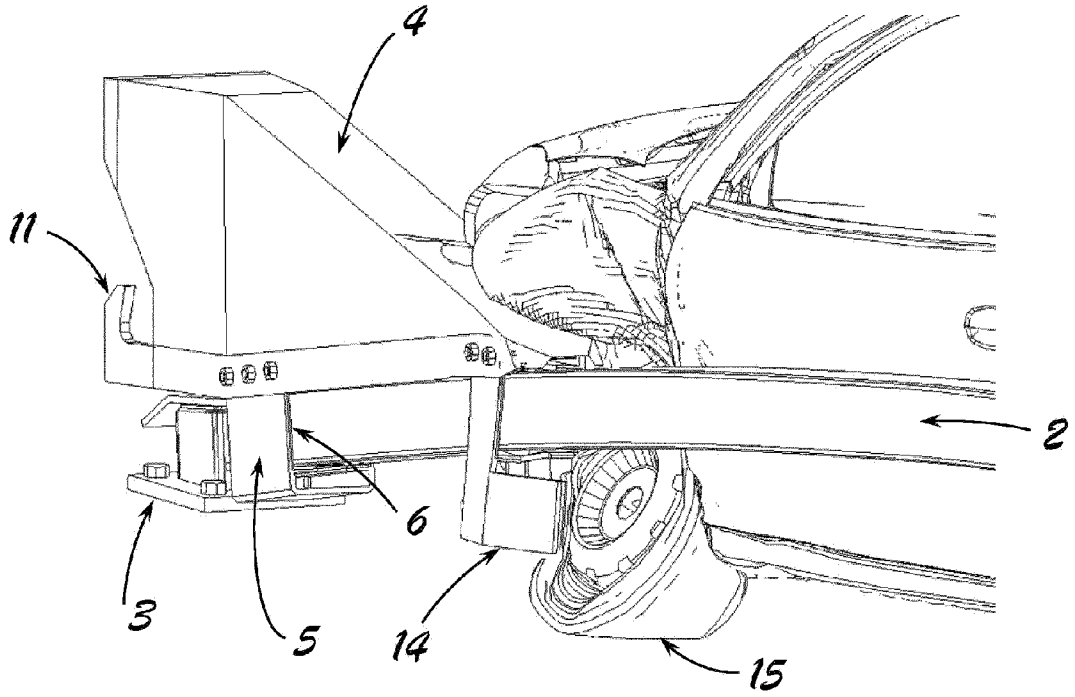

Fig. 6B