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(54) **Safety barrier terminal for motorway guard-rail**

Sicherheitsendanlage für Leitplanken

Elément de sécurité de fin de barrière routière

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Description

[0001] This invention refers to the field of safety barriers, or guard-rails, for use on roads or motorways. Safety barriers of the "guard-rail" type are currently known, which comprise a horizontal, longitudinal member, or stringer, which may consist of a strip of corrugated sheet iron mounted on uprights or posts. These safety barriers present quite safe and predictable results in the event of impact of a vehicle at angles of trajectory which are not too wide with respect to the longitudinal extent of the barrier. However, for reasons of convenient access to the roadway or for other reasons, it is unthinkable to build a continuous guard-rail all along a road between the points of start and arrival of the road itself. Consequently, the guard-rail will inevitably be built in more or less long stretches that have end portions. Whilst statistics have shown a rather satisfactory behaviour of the guard-rail in the case of impact against an intermediate portion thereof, they have also shown an increasing incidence of impact of vehicles against the end parts, or terminals, of the barrier, having consequences that are almost always serious or tragic because the stiffness of the barrier is high in its longitudinal direction, and because of the very high kinetic energy, due to the whole speed of the vehicle. In addition, the height of the ends may be dangerous.

[0002] Consequently, in more recent times, attention has been directed to the problem of shock absorption in the case of head-on impact against a safety barrier.

[0003] A widely adopted solution consists in setting the terminal segment of the barrier inclined downwards to the ground; this prevents a head-on collision of a vehicle with an end of the barrier at a dangerous height, but may cause the vehicle to leave the ground and even reach dangerous heights.

[0004] Other currently known solutions (US-A-4 838 523) involve barrier terminals that are able to absorb energy by means of telescoping, said terminals comprising various barrier segments which are fastened to one another in longitudinal succession by means of calibrated bolts engaged in slots in the segments; the barrier is double at least at the terminal portion, and each couple of parallel segments of the guard-rail are supported by a wooden post, which has a through hole at a certain height so as to be able to withstand impacts that are transverse to the barrier but to break under an impact of preset magnitude that is longitudinal to the barrier. The impact of a vehicle against the terminal causes the screws and posts to break, and the sections to telescope one over another. The known terminals of this type are widely used in some states of the United States, however, they have the drawback that, since a particularly high-priced type of wood must be used, the cost of such barriers is relatively high already when the wood is locally available; if they were to be transported as they are to other areas, the cost of the posts would be prohibitive, also considering that it is not possible to restore them

after impact. In addition, the stiffness of the posts is anyway excessive and relatively dangerous.

[0005] The state of the art also includes a safety barrier for motorways made of a single strip of curved section on the end of which is mounted a widened headpiece provided with a system of rollers. In the event of collision of a vehicle against the end, i.e., against the headpiece, of the terminal, this headpiece slides along the metal strip, flattening it out as it goes; the absorption of energy is provided by the deformation of the metal strip.

[0006] A variant of this system comprises a terminal with headpiece equipped with particular knives, which, in the event of impact of a vehicle, runs along the strip of the guard-rail so that the knives cut the guard-rail up into thin slices. In this case, the absorption of energy is provided by the longitudinal cutting of the strip.

[0007] These latter two systems present the drawback that they are difficult to calibrate, and anyway costly.

[0008] The state of the art also comprises so-called shock-attenuators. These are devices that are set to protect a particular object, which is considered to be dangerous or to be in a dangerous position for traffic. Shock-attenuators differ from terminals in that they present better performance and higher costs. In fact, a terminal functions only in so far as it is connected to a safety barrier, whereas a shock-attenuator may function even when it is isolated, protecting a dangerous but relatively narrow obstacle, such as the pier of a bridge or the end of a low wall.

[0009] The aim of this invention is to make a terminal for road safety barriers which enables good absorption of energy in the event of impact, good retention of the vehicle, and hence provides a good level of safety, and at the same time may be made and restored at acceptable costs.

[0010] These aims have been achieved with a terminal as described in Claim 1 attached. Further new and advantageous characteristics are described in the subsequent claims.

[0011] The new terminal comprises a longitudinally extended strip made up of a number of barrier segments provided with elongated slots in which screws for joining the segments together are screwed at a calibrated tightening torque; it further comprises a headpiece of the terminal applied on an outermost segment; each segment is mounted on an upright or post, which is made up of two half-posts, the bottom one of which is driven into the ground for a substantial portion of its height, and the top one is mounted on the bottom one by means of a predictably breakable transverse pin, i.e. a pin having a preset breaking strength, and preferably presenting a groove which engages with a peg of the bottom half-post. According to a further characteristic of the invention, at least between the bottom half-post, which supports the end segment and/or the headpiece, and the adjacent top half-post a tie rod is mounted, which com-

prises in its length a weakened section with a predictable or preset breaking strength.

[0012] According to a further characteristic, the headpiece comprises a plate which is set transverse to the longitudinal extension of the barrier and is provided with a protruding frame for retention of the vehicle, so as to prevent a vehicle that hits the terminal from sliding sideways without being able to exploit the absorption of energy provided by the terminal.

[0013] The new terminal enables a good absorption of energy, and hence a considerable degree of safety, for a vehicle in the event of impact of the latter against the terminal with a substantial component of force parallel to the longitudinal extent of the barrier or guard-rail. In addition, it has relatively reasonable production and installation costs, and it may be restored rapidly and at reasonable costs.

[0014] An exemplary explanatory unrestrictive embodiment of the invention will be described in below, with reference to the attached drawings, in which:

Figure 1 is a broken-away side view, in reduced scale, of a motorway safety barrier terminal according to the present invention;

Figure 2 is a top plan view with respect to Figure 1;

Figure 3 is a sectional view according to a plane indicated by 3-3 in Figure 1;

Figure 4 is a sectional view according to a plane indicated by 4-4 in Figure 1;

Figure 5 is a view of an end headpiece according to arrow referenced 5 in Figure 1;

Figure 6 shows enlarged a detail of Figure 1;

Figure 7 is a sectional view according to a plane indicated by 7-7 in Figure 6;

Figure 8 is a sectional view according to a plane indicated by 8-8 in Figure 6;

Figure 9 is a full-size scale representation of a predictably breakable plate, i.e. a plate having a preset breaking strength, of a tie rod of the barrier;

Figure 10 is a top plan view with respect to Figure 9;

Figure 11 is an enlarged side view of a terminal headpiece mounted on a barrier end segment;

Figure 12 is a top plan view with respect to Figure 11.

[0015] A safety terminal for road safety barriers is indicated as a whole by reference 10 in the figures and is

suitable for being applied to the ends of road safety barriers of the guard-rail type, which comprise one or more strips of corrugated sheet metal supported by uprights or posts.

[0016] The terminal 10 basically comprises a number of segments 12 of elastic metal strip, each of which is referenced 12a, 12b, 12c, ... respectively, starting from the outermost segment 12a.

[0017] Each of the segments 12a, 12b, 12c, ..., as may be seen in Figures 3, 11 and 12, comprises a corrugated metal strip with double corrugation, with longitudinal slits or slots aligned in two parallel rows, referenced 13 and 14 respectively. According to a characteristic of this invention, the slots 13 of one row and the slots 14 of the other row are mutually staggered in a longitudinal direction. In the area where edge parts of the segments are overlapping, the segments of corrugated section bar, 12a, 12b, 12c are fastened together, in a per se known way, by means of bolts 15. The bolts are tightened with a calibrated tightening torque, whilst the sheet metal bridges between each slot and the next one are sized so as to collapse at a preset applied force when the bolts pass through them. At each segment, 12a, 12b, 12c, etc., a supporting upright or post is provided, respectively referenced 18a, 18b, 18c, etc., whilst the reference 18 indicates an end upright which supports a headpiece 20 applied to the end segment 12a. Each upright or post comprises a bottom half-post and a top half-post, respectively referenced 18' and 18" for the post 18, 18'a and 18"a for the post 18a, and likewise 18'b and 18"b for the post 18b, and 18'c and 18"c for the post 18c. The bottom half-posts have a bottom retaining rod or peg 16 and, set at the top, a predictably breakable pin 17, i.e. a pin having a preset breaking strength, upon which the top half-post engages. In particular, the pin 17 passes through registering holes of the bottom half-post and in the top half-post, whilst rod 16 is engaged in a recess 16' of the top half-post. In the embodiment shown, the bottom half-post is made of I-section and the top half-post of channel section, whilst reinforcements 19 are provided along the flanges of the metal section which forms the top half-post.

[0018] Between the first upright 18 and the second upright 18a a tie rod 30 is stretched which is anchored with one end thereof on the bottom half-post 18' of 18 and with the other end thereof on the top half-post 18"a. The tie rod 30 generally comprises a cable portion, a tensioning device which is per se known, and preferably comprises a predictably breakable plate 32, i.e. a plate having a preset breaking strength, generally consisting, as may be seen from Figures 9 and 10, of a metal plate with one narrow portion 33.

[0019] The head or headpiece 20 (Figures 5, 11 and 12) comprises an end plate, referenced 22, which is substantially orthogonal to the longitudinal extent of the barrier and fastened to the end of the end segment of metal section 12a by means of a bottom bracket 24 and an oblique arm 25. The plate 22 comprises a restraining

projection 26 set around the perimeter of the plate close to the latter's periphery. The said restraining projection has the purpose of restraining a vehicle which collides against the headpiece so as to prevent any lateral displacements of the vehicle that might cause it to swerve and thus fail to exploit the possibilities of absorption of energy of the safety terminal, with consequent greater risks.

[0020] The restraining projection generally consists of a bent metal sheet welded to the base plate 22.

[0021] As has been said, the new terminal for guard-rails or road safety barriers is mounted with the uprights driven into the ground almost up to the full height of the bottom half-posts 18', 18'a, etc., as is indicated by the dashed line S in Figures 1, 3 and 4. When a vehicle hits the terminal with a component of force that is substantially longitudinal to the barrier, the energy of impact is substantially dissipated by the frictional force between the elements 12a, 12b, etc., by the breaking of the bridges that separate the slots of the said elements; by the breaking of the breakable plate 32; and by the breaking of the pegs 17 of the uprights.

[0022] After impact, the terminal may be restored relatively easily by replacing the barrier elements 12, 12a, etc. that have been deformed, by replacing the tie-rod element 30, by replacing the calibrated pins 17, and by restoring the top half-posts on them.

Claims

1. A terminal for road safety barrier comprising: barrier segments (12a, 12b, 12c, ...) provided with slots set one longitudinally with respect to the other in a double row (13, 14), separated in each row by predictably breakable bridges, the said barrier segments being connected together by means of bolts (15) passing in said slots, the said segments being supported on breakable uprights in such a way that, for an impact against said terminal having a force or a component of force or a level of energy higher than a preset threshold, the said segments may slide over one another, thus dissipating energy, and the said uprights may break;
characterised in that
each of said breakable uprights (18, 18a, 18b, 18c, ...) comprises a bottom half-post and a top half-post (18", 18"a, 18"b, 18"c, ...) separated from the bottom half-post, of which the top half-post is constrained to the bottom one by means of a breakable system (16, 17) comprising a breakable through-pin (17) oriented substantially perpendicular to the barrier segments, and **in that** the endmost segment (12a) carries a headpiece (20).
2. A terminal for road safety barrier according to Claim 1, **characterized in that** the said breakable system further comprises a peg and a peg-engaging sur-

face on opposed half-posts.

3. A terminal according to Claim 1, **characterized in that** the bottom half-posts are buried for a substantial part of their height in the ground.
4. A terminal for road safety barrier according to Claim 1, **characterized in that** in said barrier segments the slots are not continuous but are interrupted by breakable bridges having a preset breaking strength.
5. A terminal for road safety barrier according to Claim 1, **characterized in that** in said barrier segments the slots (13) of one row and the slots (14) of the other row are longitudinally staggered with respect to one another.
6. A terminal for road safety barrier according to Claim 1, **characterized in that** at least between one bottom half-post (18') of one upright (18) and one top half-post (18"a) of the adjacent upright (18a) a breakable tie-rod (30) is stretched having a preset breaking strength.
7. A terminal for road safety barrier according to Claim 6, **characterized in that** the said tie-rod (30) comprises a cable portion and a breakable plate (32) having a preset breaking strength.
8. A terminal for road safety barrier according to Claim 1, **characterized in that** the said headpiece (20) comprises an end plate (22) that is set substantially transverse to the longitudinal extent of the barrier and is equipped with a vehicle restraining projection or protruding edge (26).
9. A terminal for road safety barrier according to Claim 8, **characterized in that** the said restraining edge (26) is extended around the perimeter of the plate (22) at a short distance therefrom.

Patentansprüche

1. Ein Endelement für eine Straßensicherheitsschranke, die folgendes umfasst:
Schrankensegmente (12a, 12b, 12c,...), die mit Schlitten versehen sind, die jeweils längs zueinander in einer doppelten Reihe (13, 14) angeordnet sind und in jeder Reihe durch kalkulierbar brechbare Brücken getrennt werden, wobei die genannten Schrankenelemente miteinander durch Bolzen (15) verbunden werden, die durch die genannten Schlitten führen und die genannten Segmente in einer solchen Weise auf brechbaren Pfosten gelagert sind, dass die genannten Segmente sich bei einem Aufprall gegen das genannte Endelement, der eine

Stärke oder eine Stärkenkomponente bzw. ein Energieausmaß aufweist, das eine vorbestimmte Schwelle überschreitet, übereinander schieben können und auf diese Weise Energie abführen, und dass die genannten Pfosten brechen können;

dadurch gekennzeichnet, dass

jeder der genannten brechbaren Pfosten (18, 18a, 18b, 18c,...) eine untere Halbstrebe und eine obere Halbstrebe (18", 18"a, 18"b, 18"c,...) umfasst, die von der unteren Halbstrebe getrennt ist, wobei die obere Halbstrebe mit der unteren durch ein brechbares System (16, 17) verbunden ist, das einen brechbaren durchgehenden Stift (17) umfasst, der im wesentlichen senkrecht zu den Schrankenelementen ausgerichtet ist, sowie dadurch, dass das entfernteste Segment (12a) ein Kopfstück (20) trägt.

2. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das genannte brechbare System an gegenüberliegenden Halbstreben einen Dübel und eine Oberfläche umfasst, in die der Dübel einrastet.

3. Ein Endelement gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die unteren Halbstreben zu einem wesentlichen Teil ihrer Höhe in den Boden eingelassen sind.

4. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 1, **dadurch gekennzeichnet, dass** in diesen Schrankensegmenten die Schlitzte nicht durchgehend sind, sondern durch brechbare Brücken unterbrochen werden, die eine vorbestimmte Bruchfestigkeit aufweisen.

5. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 1, **dadurch gekennzeichnet, dass** in den genannten Schrankensegmenten die Schlitzte (13) der einen Reihe und die Schlitzte (14) der anderen Reihe jeweils längs im Verhältnis zueinander versetzt sind.

6. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 1, **dadurch gekennzeichnet, dass** sich mindestens zwischen der einen unteren Halbstrebe (18') des einen Pfosten (18) und der anderen oberen Halbstrebe (18"a) des anliegenden Pfostens (18a) eine brechbare Zugstange (30) erstreckt, die eine vorbestimmte Bruchfestigkeit aufweist.

7. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 6, **dadurch gekennzeichnet, dass** die genannte Zugstange (3) einen Kabelabschnitt und eine brechbare

Platte (32) umfasst, die eine vorbestimmte Bruchfestigkeit aufweist.

8. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das genannte Kopfstück (20) eine Endplatte (22) umfasst, die im wesentlichen quer zur Längsausdehnung der Schranke angeordnet und mit einem Vorsprung oder einer vorstehenden Kante (26) ausgerüstet ist, die die Fahrzeuge zurückhält.
9. Ein Endelement für eine Straßensicherheitsschranke gemäß Anspruch 8, **dadurch gekennzeichnet, dass** die genannte Rückhaltekannte (26) sich um den Umfang der Platte (22) herum und in geringem Abstand davon erstreckt.

Revendications

1. Partie finale pour barrière de sécurité routière comprenant :
des segments de barrière (12a, 12b, 12c, etc...) pourvus de fentes placées longitudinalement l'une par rapport à l'autre dans une rangée double (13, 14), séparées dans chaque rangée par des ponts cassables sur prévision, lesdits segments de barrière étant reliés ensemble au moyen de boulons (15) passant dans lesdites fentes, lesdits segments étant soutenus par des montants cassables de façon que, pour un impact contre ladite partie finale ayant une force ou un composant de force ou un niveau d'énergie supérieur à une limite préétablie, lesdits segments peuvent glisser l'un sur l'autre, dissipant ainsi l'énergie, et que lesdits montants peuvent se rompre ;

caractérisée en ce que

chacun desdits montants cassables (18, 18a, 18b, 18c, ...) comprend un demi-poteau inférieur et un demi-poteau supérieur (18", 18"a, 18"b, 18"c, ...) séparé du demi-poteau inférieur, dont le demi-poteau supérieur est forcé vers le demi-poteau inférieur au moyen d'un système cassable (16, 17) comprenant un tourillon diagonal (17) substantiellement orienté dans le sens perpendiculaire par rapport aux segments de la barrière, et **en ce que** le segment d'extrémité (12a) possède une pièce de tête (20).

2. Partie finale pour barrière de sécurité routière selon la revendication 1, **caractérisée en ce que** ledit système cassable comprend également une goupille et une surface d'engagement des goupilles sur des demi-poteaux opposés.
3. Partie finale selon la revendication 1, **caractérisée en ce que** les demi-poteaux inférieurs sont enterrés dans le terrain sur une partie substantielle de leur

hauteur.

4. Partie finale pour barrière de sécurité routière selon la revendication 1, **caractérisée en ce que**, dans lesdits segments de barrière, les fentes ne sont pas continues mais interrompues par des ponts cassables ayant une force de rupture préétablie. 5

5. Partie finale pour barrière de sécurité routière selon la revendication 1, **caractérisée en ce que**, dans lesdits segments de barrière, les fentes (13) d'une rangée et les fentes (14) de l'autre rangée sont placées dans le sens longitudinal les unes à une certaine distance des autres. 10
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6. Partie finale pour barrière de sécurité routière selon la revendication 1, **caractérisée en ce qu'**au moins entre un demi-poteau inférieur (18') d'un montant (18) et un demi-poteau supérieur (18"a) du montant adjacent (18a), une barre d'accouplement cassable (30) est étirée ayant une force de rupture préétablie. 20

7. Partie finale pour barrière de sécurité routière selon la revendication 6, **caractérisée en ce que** ladite barre d'accouplement (30) comprend un câble et une plaque cassable (32) ayant une force de rupture préétablie. 25

8. Partie finale pour barrière de sécurité routière selon la revendication 1, **caractérisée en ce que** ladite pièce de tête (20) comprend une plaque de fin (22) qui est substantiellement placée dans le sens transversal par rapport au sens longitudinal de la barrière et est équipée d'une saillie de retenue de véhicules ou d'un bord saillant (26). 30
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9. Partie finale pour barrière de sécurité routière selon la revendication 8, **caractérisée en ce que** ledit bord de retenue (26) s'étend autour du périmètre de la plaque (22) à une courte distance de celui-ci. 40

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