(54) Title: A ROAD BARRIER AND A METHOD FOR MANUFACTURING THEREOF

(57) Abstract: A road barrier comprising a support (101) to which a transverse beam (102) is connected via a spacer (110) such that upon impact the transverse beam (102) moves towards the support (101). The spacer (110) is movable upon impact and coupled, via coupling means (130, 150, 160, 170), with a rotatable energy absorber (140) mounted below the transverse beam (102) and comprising at least one rotor (142, 143) for absorbing in rotational movement at least part of the kinetic energy imparted to the transverse beam (102).

Declarations under Rule 4.17:
— as to the identity of the inventor (Rule 4.17(i))
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
— of inventorship (Rule 4.17(iv))

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A ROAD BARRIER AND A METHOD FOR MANUFACTURING THEREOF

DESCRIPTION

TECHNICAL FIELD

The present invention relates to road barriers and methods for manufacturing thereof.

BACKGROUND ART

Road barriers installed along the edges of roads protect vehicles from accidentally exiting the road. The barriers are usually made of transverse beams installed on posts.

There are known road barriers in which the beam is distanced from the post and mounted to the post via an energy absorbing spacer. A barrier of this type is known from a PCT application WO051 18958A1, which discloses a road safety barrier wherein the beam is mounted to the post via a spring. Upon impact, the beam moves towards the post and the energy of impact is at least partially absorbed by the spring. The amount of absorbed energy is therefore dependent on the parameters of the spring.

A US patent application US20070007780 describes a kinetic energy absorber for connecting to a bumper of a car and comprising a rotor connected with the bumper via a toothed bar and a multiplying gear. Upon impact directed to the bumper, the translational motion of the bumper induces translational motion of the toothed bar, which induces rotation of the rotor. The displacement vector of the bumper is parallel to the displacement vector of the toothed bar driving the rotor.

DISCLOSURE OF THE INVENTION

The aim of the invention is to provide a road barrier with alternative energy absorbing means.
The object of the invention is a road barrier comprising a support to which a transverse beam is connected via a spacer such that upon impact the transverse beam moves towards the support. The spacer is movable upon impact and coupled, via coupling means, with a rotatable energy absorber mounted below the transverse beam and comprising at least one rotor for absorbing in rotational movement at least part of the kinetic energy imparted to the transverse beam.

The rotatable energy absorber can be fixed to the support.

The coupling means may comprise a rack having a first toothed bar coupled via a toothed wheel with a toothed bar of the spacer and a second toothed bar coupled via a toothed wheel transmission with the at least one rotor.

The spacer can be configured to move in a substantially horizontal direction and the rack is configured to move in a substantially vertical direction.

The rack may comprise a compressible element.

The coupling means may comprise a strand connected at a first end to the spacer and at a second end to the rotatable energy absorber.

The strand can be wound at the second end around a driving shaft of the rotatable energy absorber.

The strand can be connected at the second end to a toothed bar coupled with a toothed wheel transmission of the rotatable energy absorber.

The coupling means and the rotatable energy absorber can be housed within the support.

The rotatable energy absorber can be fixed to a structure offset horizontally from the support.

The coupling means may comprise vertical coupling means in a form of a rotatable shaft having a first end coupled with the spacer and configured to be induced into rotation upon movement of the spacer, and a second end located below the first end and coupled with a first end of horizontal coupling means having its second end coupled with the at least one rotor.

The spacer may comprise a compressible element.

The object of the invention is also a method for manufacturing of a road barrier comprising a support to which a transverse beam is connected via a spacer such that upon impact the transverse beam moves towards the support, wherein the spacer is movable upon impact and coupled, via coupling means, with a
rotatable energy absorber fixed to the support below the transverse beam and comprising a toothed wheel transmission driving at least one rotor for absorbing in rotational movement at least part of the kinetic energy imparted to the transverse beam. The method comprises the steps of forming and balancing of the at least one rotor, forming and hardening of the toothed wheel transmission of the rotatable energy absorber and forming of the support, the coupling means and the transverse beam and assembling the elements to make the road barrier.

BRIEF DESCRIPTION OF DRAWINGS

The invention is shown by means of an exemplary embodiments on a drawing, in which:

Fig. 1 shows an overview of a road barrier,
Fig. 2 shows the elements of the road barrier according to a first embodiment of the invention in a side view,
Fig. 3 shows the core elements of the road barrier according to a first embodiment of the invention in a perspective view from the left,
Fig. 4 shows the core elements of the road barrier according to a first embodiment of the invention in a perspective view from the right,
Fig. 5 shows the operating principle of the road barrier during impact,
Fig. 6 shows the elements of the road barrier according to a second embodiment of the invention in a side view,
Fig. 7 shows the elements of the road barrier according to a third embodiment of the invention in a side view,
Fig. 8 shows the elements of the road barrier according to a fourth embodiment of the invention in a side view,
Fig. 9 shows the elements of the road barrier according to a fifth embodiment of the invention in a perspective view,
Fig. 10 shows the process of manufacturing of the road barrier according to the invention.

Fig. 1 shows an overview of a road barrier to which the present invention is applicable. The road barrier comprises supports 101, to which a transverse beam 102 is connected. The supports can have a form of a vertical post anchorable to
the ground or a holder fixed to another vertical structure, such as a wall. The beam 102 is connected to the supports 101 via a movable spacer 110 such that upon impact the transverse beam 102 moves towards the support 101.

Fig. 2 shows the elements of the road barrier according to a first embodiment of the invention in a side view, and Figs. 3 and 4 show the core elements of that embodiment in a perspective view from the left and right, respectively. Preferably, the core elements are all housed within the support, such as to protect them from external factors, such as dirt, rain or third persons. The movable spacer is coupled, via coupling means 130 in form of a rack 130, with a rotatable energy absorber 140 mounted below the transverse beam 102. As shown in Fig. 2, the rotatable energy absorber 140 can be fixed to the support 101. In particular, the transverse beam 102 can be mounted in the upper portion of the support 101 and the rotatable energy absorber 140 can be mounted in the lower portion of the support 101. The movable spacer 110 drives a transmission 120, which in turn drives a rack 130. The spacer 110 is movable in a first direction and the rack 130 is movable in a second direction tilted with respect to the first direction. Therefore, upon impact, at least part of the energy imparted to the transverse beam 102 in the first direction of the movement of the spacer 110 is passed to the rack 130 movable in the second direction. The rack 130 is coupled at its second end with a rotatable energy absorber 140 with at least one rotor 142, 143 which absorbs in rotational movement at least part of the kinetic energy imparted to the transverse beam 102. The amount of energy accumulated in the rotor 142, 142 in other words a rotatable mass, depends on the weight and the moment of inertia of the rotor, its diameter and rotational speed, which in turn depends on the parameters of the transmission between the beam 102 and the rotor 142, 143. Preferably, the rotors 142, 143 are freewheels.

The transmission 120 can be a toothed wheel mounted on a shaft attached to the housing of the support 101. The spacer 110 and the rack 130 can be coupled with the transmission 120 via toothed bars 111, 131. The rack 130 can have a toothed bar 132 coupled with a toothed wheel 141 of the rotatable energy absorber 140. However, other types of transmission can be used, such as pneumatic, hydraulic, magnetic, etc.
The rotatable energy absorber 140 comprises at least one rotor 142, 143, preferably in form of one or more flywheels, mounted on shafts fixed to the support 101. The rotor is coupled with the rack 130 via a transmission which may comprise one or more toothed wheels 144, 145, 146. The movement of the rack 130 induces rotation of the toothed wheels 141, 144, 145, 146 and therefore the rotation of the rotor 142, 143.

The elements are preferably arranged on two main vertical planes, for example elements 110, 111, 20, 144, 145, 146 are arranged on one main plane and elements 130, 131, 132, 141, 142, 143 are arranged on another main plane. This provides compact size of the energy absorbing mechanism according to the invention and allows to house it within the support 101.

As shown in Fig. 2, the spacer 110 is configured to move in a substantially horizontal direction and the rack 130 is configured to move in a substantially vertical direction, preferably downwards. Mounting of the rotatable energy absorber 140 below the transverse beam 102 lowers the centre of gravity of the road barrier and increases its stability during impact.

Fig. 5 shows the operating principle of the road barrier during impact. An impact force imparted to the transverse beam 102 causes movement of the spacer 110 towards the support 101 and, via the transmission 120, movement of the rack 130 downwards. The downwards movement of the rack 130 induces rotation of the at least one rotor 142, 143 of the rotatable energy absorber 140. At least part of the impact energy is therefore converted to the kinetic energy of the rotor 142, 143.

Fig. 6 shows the elements of the road barrier according to a second embodiment of the invention in a side view. The second embodiment is equivalent to the first embodiment, with the following differences. The spacer 110 may comprise a compressible element 112, such as a spring or a damper. Furthermore, the rack 130 may comprise a compressible element 133, such as a spring or a damper. The compressible elements 112, 133 allow absorbing of a part of energy during the first phase of impact and facilitate inducing the rotation of the rotatable energy absorber 140.

Fig. 7 shows the elements of the road barrier according to a third embodiment of the invention in a side view. The movable spacer 110 is coupled,
via coupling means 150 in form of a strand 150, with a rotatable energy absorber 140 fixed to the support 101 below the transverse beam 102. The strand 150 is connected at a first end 151 to the movable spacer 110 and at a second end 152 to the rotatable energy absorber 140. A roller 153 defines the pathway of the strand 150 along the support 101. Upon impact, at least part of the energy imparted to the transverse beam 102 in the first direction of the movement of the spacer 110 is passed to the strand 150. The second end 152 of the strand 150 is wound around a driving shaft 147 of the rotatable energy absorber 140 such that when impact is imparted to the spacer 110 and the spacer moves into the support, the tension of the strand 150 induces rotation of the driving shaft 147 of the rotatable energy absorber 140 and, consequently, rotation of the toothed wheels 144, 145, 146 and of the rotors 142, 143.

Fig. 8 shows the elements of the road barrier according to a fourth embodiment of the invention in a side view. The fourth embodiment is equivalent to the third embodiment, with the following differences. The second end 154 of the strand 150 is attached to a toothed bar 154 coupled with a toothed wheel transmission 141 of the rotatable energy absorber 140 such that when impact is imparted to the spacer 110 and the spacer 110 moves into the support 101, the tension of the strand 150 induces, via the toothed bar 154, rotation of the toothed transmission 141 of the rotatable energy absorber 140 and, consequently, rotation of the toothed wheels 144, 145, 146 and of the rotors 142, 143.

Fig. 9 shows the elements of the road barrier according to a fifth embodiment of the invention in a perspective view. The rotatable energy absorber 140 is fixed to a structure 103 offset horizontally from the support 101, to which the spacer 110 is fixed. The structure 103 can be a ground anchor located aside the post. The structure 103 can be also a neighbouring post, to which the transverse beam 102 is connected. In this embodiment, the coupling means comprise vertical and horizontal coupling, for transferring the energy of impact both in vertical and horizontal direction. The vertical coupling means may have a form of a vertical rotatable shaft 160, preferably housed within the support 101. The first end 161 of the vertical shaft 160 is coupled with the spacer 110 and configured to be induced into rotation upon translational movement of the spacer 110. In one example, the first end 161 of the vertical shaft may be a toothed wheel coupled with a toothed
bar at the end of the spacer 110. In another example, as shown in Fig. 9, a strain may be connected between the end of the spacer 110 and wound around a disc mounted at the end 161 of the shaft 160. The horizontal coupling means 170 may have a form of a toothed bar, coupled at one end 171 with a toothed wheel at the second end 162 of the shaft 160 and at another end 172 with the rotor 142. Alternatively, as shown in Fig. 9, the horizontal coupling means 170 may have a form of a strand, wound at one end 171 around the second end 162 of the shaft 160 and at another end 172 around a disc mounted on the shaft of the rotor 142. Horizontally offsetting the rotatable energy absorber 140 from the support 101 allows using various kinds of rotatable energy absorbers 140, which do not have to accommodate within the housing of the support 101. In all embodiments, the rotors of the rotatable energy absorbers may be mounted so as to rotate around a horizontal or vertical axis, depending on the desired configuration.

Fig. 10 shows the process of manufacturing of the road barrier according to the invention. In steps 301–306 the elements via which the impact energy is transmitted to the rotatable energy absorber are formed, including the rotor formed in step 301, the toothed bars formed in step 303 and the toothed wheels formed in step 305. The elements are manufactured with high degree of precision, such as to allow efficient movement of the elements with limited friction upon impact of forces of large magnitude. The rotor is balanced in step 302 by precise profiling such that it can rotate with high rotational speeds. The teeth of the toothed bars and toothed wheels are hardened in steps 304, 306 such as to withstand large forces and limit the friction between them. The other elements of the road barrier, such as the post and the transverse beam, are formed in step 307 and assembled in step 308. In order to provide high precision of manufacture of the energy absorber and the other components of the road barrier of the invention, the following tools can be used: a water jet cutter, a band saw, welding machines, a standard lathe, a precision lathe, a standard miller, a precision miller, a surface grinder, an external grinder, an internal grinder, a standard drill, a pillar drill, a hydraulic press, a brake press, a bending machine for tubes and sections, a hydraulic bending machine, a belt grinder, a fitter’s vice, a compressor, an electro-erosion machine, a hobber, a threader, a welder, cleaning tanks, measurement
and control apparatus, a hardening furnace, an electronic balancer, a marking-off table and marking-off tools.

The road barrier may comprise supports of the first and/or second embodiment, and in addition it may be also supported by other, typical supports. The supports of the first or second embodiment may be installed at places with high impact risk, such as sharp turns, while typical supports may be installed at straight segments of the road.
CLAIMS

1. A road barrier comprising a support (101) to which a transverse beam (102) is connected via a spacer (110) such that upon impact the transverse beam (102) moves towards the support (101), characterized in that the spacer (110) is movable upon impact and coupled, via coupling means (130, 150, 160, 170), with a rotatable energy absorber (140) mounted below the transverse beam (102) and comprising at least one rotor (142, 143) for absorbing in rotational movement at least part of the kinetic energy imparted to the transverse beam (102).

2. The road barrier according to claim 1, wherein the rotatable energy absorber (140) is fixed to the support (101).

3. The road barrier according to claim 1 or 2, wherein the coupling means comprise a rack (130) having a first toothed bar (131) coupled via a toothed wheel (120) with a toothed bar (111) of the spacer (110) and a second toothed bar (132) coupled via a toothed wheel transmission (141, 144, 145, 146) with the at least one rotor (142, 143).

4. The road barrier according to claim 3, wherein the spacer (110) is configured to move in a substantially horizontal direction and the rack (130) is configured to move in a substantially vertical direction.

5. The road barrier according to claim 3 or 4, wherein the rack (130) comprises a compressible element (133).

6. The road barrier according to claim 1 or 2, wherein the coupling means comprise a strand (150) connected at a first end (151) to the spacer (110) and at a second end (152) to the rotatable energy absorber (140).

7. The road barrier according to claim 6, wherein the strand (150) is wound at the second end (152) around a driving shaft (147) of the rotatable energy absorber (140).
8. The road barrier according to claim 6, wherein the strand (150) is connected at the second end (152) to a toothed bar (154) coupled with a toothed wheel transmission (141) of the rotatable energy absorber (140).

9. The road barrier according to any of previous claims, wherein the coupling means (130, 150) and the rotatable energy absorber (140) are housed within the support (101).

10. The road barrier according to claim 1, wherein the rotatable energy absorber (140) is fixed to a structure (103) offset horizontally from the support (101).

11. The road barrier according to claim 10, wherein the coupling means comprise vertical coupling means (160) in a form of a rotatable shaft (160) having a first end (161) coupled with the spacer (110) and configured to be induced into rotation upon movement of the spacer (110), and a second end (162) located below the first end (161) and coupled with a first end (171) of horizontal coupling means (170) having its second end (172) coupled with the at least one rotor (142).

12. The road barrier according to any of previous claims, wherein the spacer (110) comprises a compressible element (112).

13. A method for manufacturing of a road barrier comprising a support (101) to which a transverse beam (102) is connected via a spacer (110) such that upon impact the transverse beam (102) moves towards the support (101), wherein the spacer (110) is movable upon impact and coupled, via coupling means (130, 150, 160, 170), with a rotatable energy absorber (140) fixed to the support (101) below the transverse beam (102) and comprising a toothed wheel transmission (141, 144, 145, 146) driving at least one rotor (142, 143) for absorbing in rotational movement at least part of the kinetic energy imparted to the transverse beam (102), characterized in that it comprises the steps of forming and balancing of the at least one rotor (142, 143), forming and hardening of the toothed wheel transmission (141, 144, 145, 146) of the rotatable energy absorber (140) and
fornning of the support (101), the coupling means (130, 150, 160, 170) and the transverse beam (102) and assembling the elements to make the road barrier.
301 Rotor forming → 302 Rotor balancing

303 Toothed bar forming → 304 Teeth hardening

305 Toothed wheel(s) forming → 306 Teeth hardening

307 Constructional elements forming → 308 Assembly

Fig. 10
**A. CLASSIFICATION OF SUBJECT MATTER**

INV. E01F15/04

According to International Patent Classification (IPC) or its own national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

E01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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See patent family annex.

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Name and mailing address of the ISA:
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