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Alberson et al.

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(54) **CABLE ANCHOR BRACKET**

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E01F 15/04 (2006.01)

(52) **U.S. Cl.** **256/13.1**; 404/6; 404/10

(58) **Field of Classification Search** 256/13.1; 404/6, 9, 10

See application file for complete search history.

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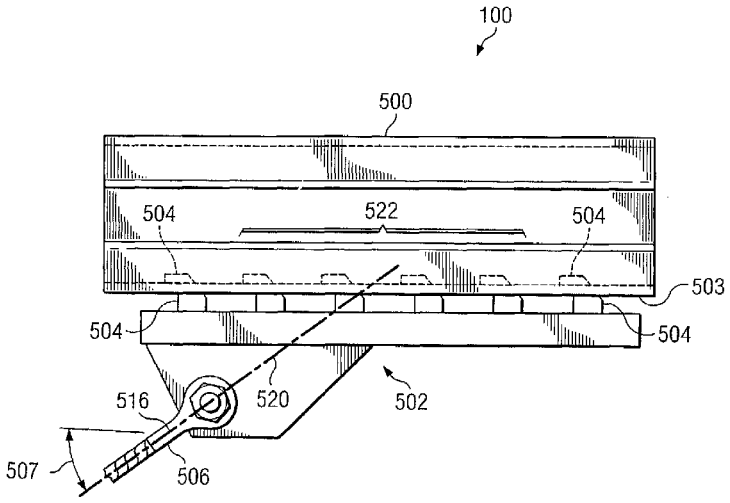
(57) **ABSTRACT**

According to one embodiment, a cable anchor system for an end terminal includes a cable anchor bracket configured to couple to a guardrail, in which the cable anchor bracket includes a flat plate having an aperture formed therein and a plurality of protrusions extending from a plane containing the aperture. The protrusions are configured to releasably engage the guardrail.

11 Claims, 4 Drawing Sheets



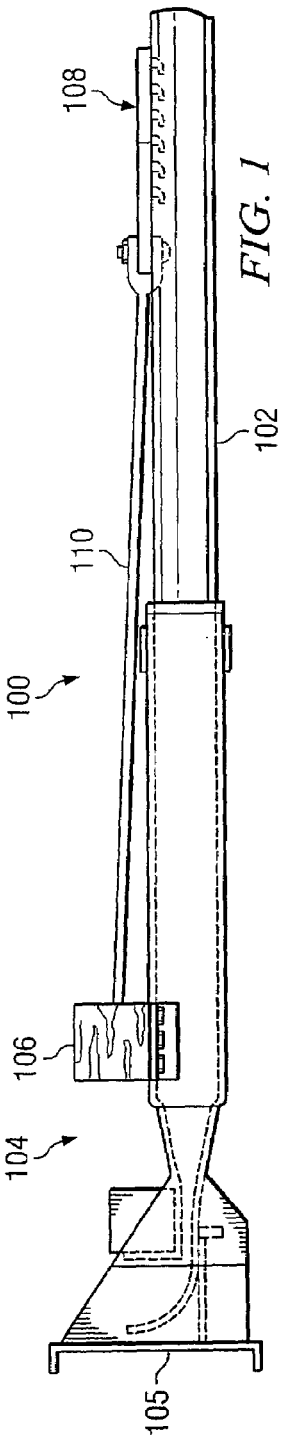
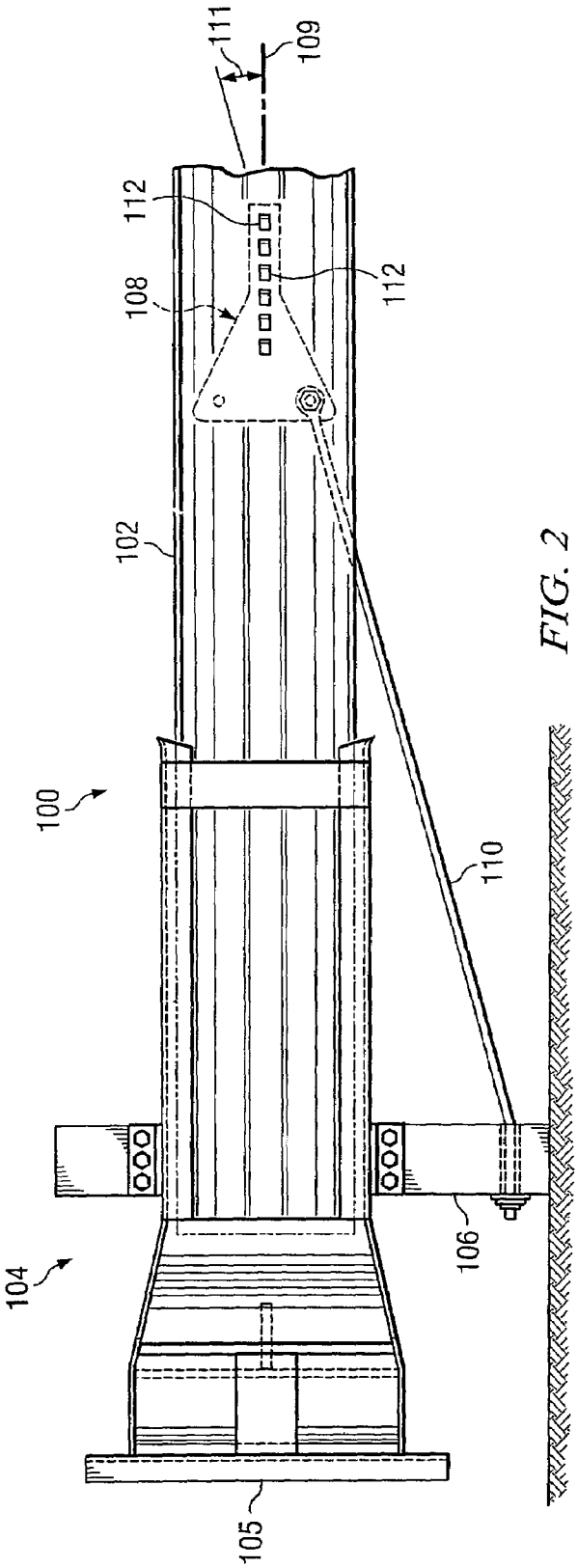

108
102
110
100
106
104
105

FIG. 1


111
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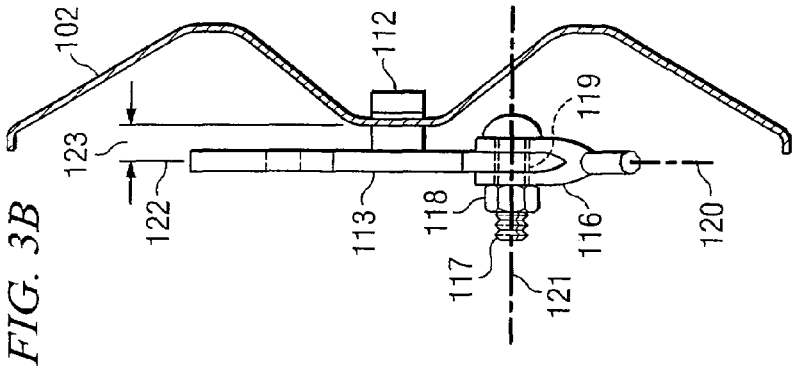
105

FIG. 2


102
112
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123
122
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117
121

FIG. 3B

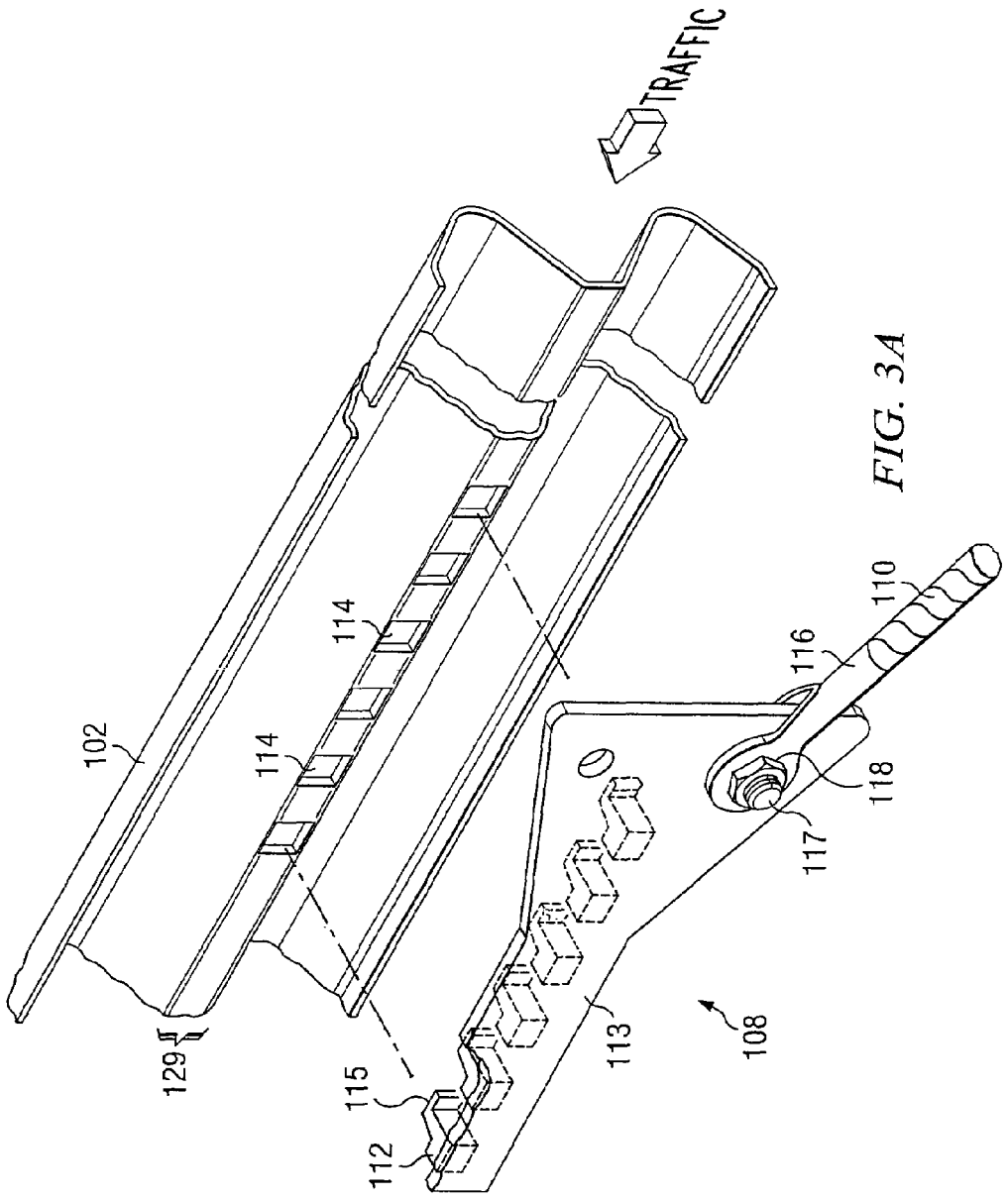
TRAFFIC
102
114
114
110
116
118
117
129
115
112
113
108

FIG. 3A

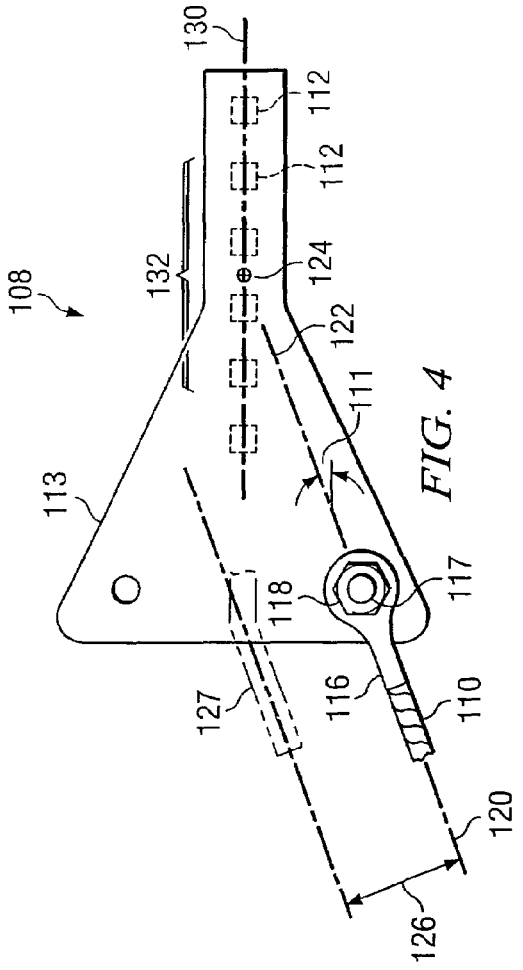
108
132
130
112
112
124
122
111
113
117
118
127
116
110
120
126

FIG. 4

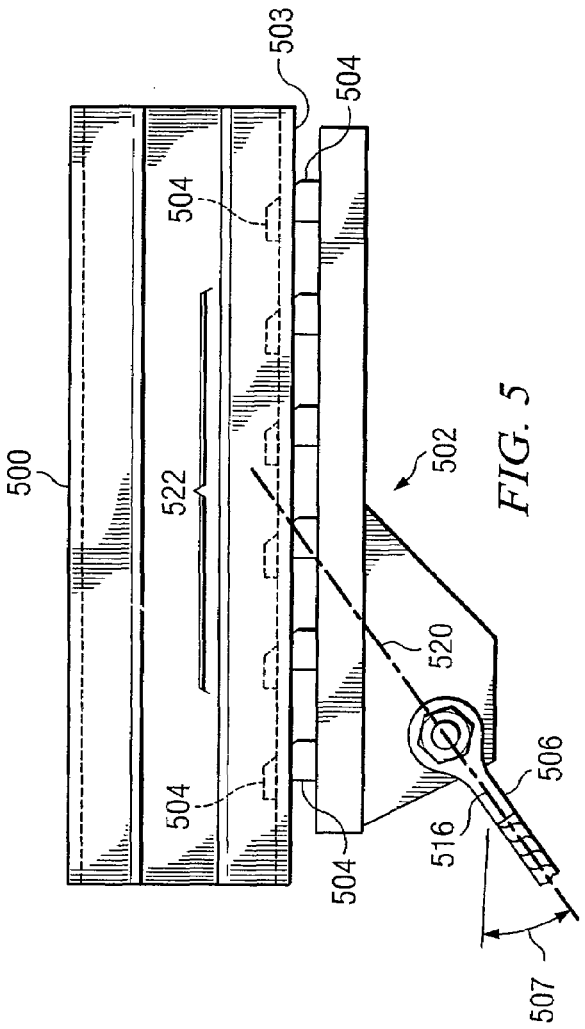
100
500
503
504
504
504
504
522
502
520
506
516
507

FIG. 5

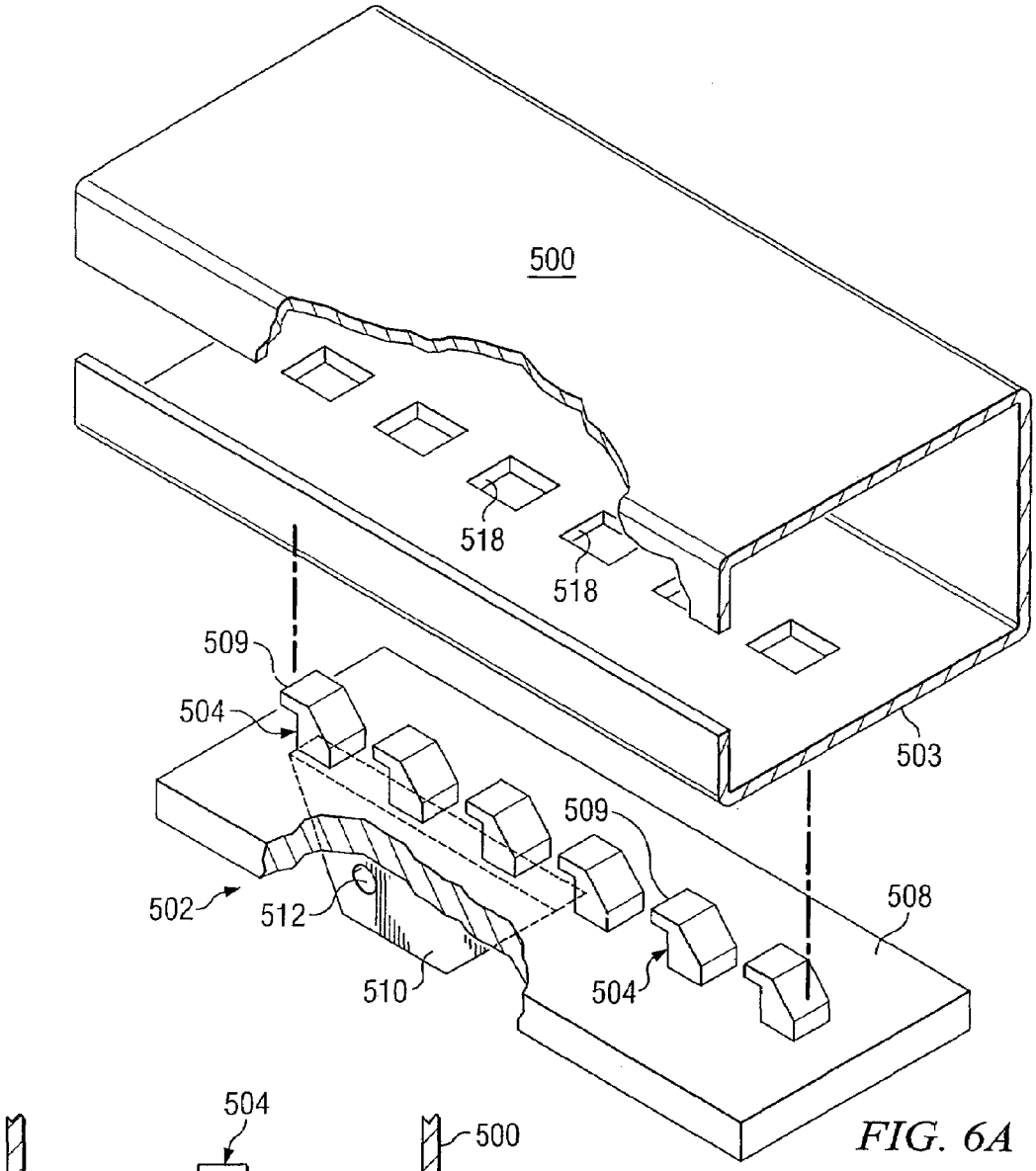
500
518
518
509
504
503
509
502
512
508
510
504

FIG. 6A

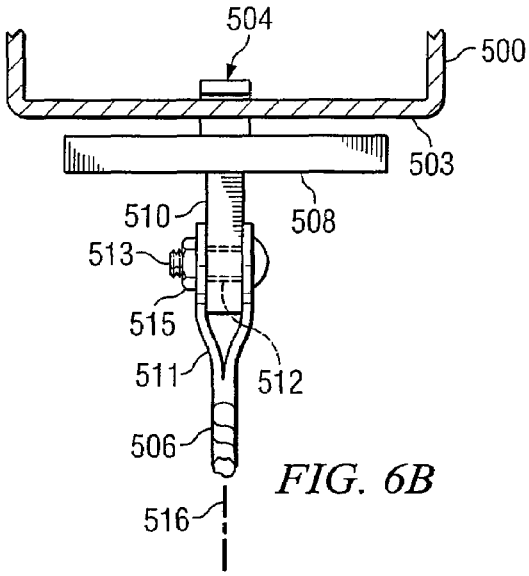
504
500
503
510
508
513
515
511
512
506
516

FIG. 6B

CABLE ANCHOR BRACKET

RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 10/819,526, filed Apr. 7, 2004, and entitled "CABLE ANCHOR BRACKETS," now U.S. Pat. No. 7,243,908.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to guardrail systems and, more particularly, to a cable anchor system.

BACKGROUND OF THE INVENTION

Guardrail systems are widely used along heavily traveled roadways to enhance the safety of the roadway and adjacent roadside. For example, end terminals are utilized at the upstream end of guardrail systems to dissipate impact energy from head-on collisions of vehicles with the upstream end to prevent intense deceleration of the vehicles. In addition, guardrail systems are designed to contain and redirect vehicles that impact the guardrails predominantly from the side.

One element that is utilized in guardrail systems to address impacts along the side of the guardrail downstream from the end terminal is a tension cable that connects between the end terminal support post and the guardrail. The tension cable is designed to provide tension strength during side impacts and to breakaway during head-on impacts to avoid counteracting the benefits of the impact absorbing end terminal.

SUMMARY OF THE INVENTION

According to one embodiment, a cable anchor system for an end terminal includes a cable anchor bracket configured to couple to a guardrail, in which the cable anchor bracket includes a flat plate having an aperture formed therein and a plurality of protrusions extending from a plane containing the aperture. The protrusions are configured to releasably engage the guardrail.

Technical advantages of particular embodiments of the present invention include improved performance of the connection between the tension cable and the guardrail by improving the alignment between the tension cable and anchor bracket. This is facilitated by an improved cable anchor bracket that reduces the eccentricity of the alignment between the cable and the guardrail. The cable anchor bracket also reduces manufacturing cost.

Other technical advantages are readily apparent to one skilled in the art from the following figures, descriptions and claims. Moreover, while specific advantages have been enumerated above, various embodiments may include all, some or none of the enumerated advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** are plan and elevation views, respectively, of a guardrail system according to one embodiment of the present invention;

FIGS. **3**A and **3**B are perspective and elevation views, respectively, illustrating the coupling of a cable anchor bracket to a guardrail in accordance with one embodiment of the present invention;

FIG. **4** is an elevation view of a cable anchor bracket according to one embodiment of the present invention;

FIG. **5** is an elevation view of a guardrail system according to one embodiment of the present invention in which the guardrail is a box beam; and

FIGS. **6**A and **6**B are perspective and elevation views, respectively, illustrating the coupling of a cable anchor bracket to a box beam in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. **1** and **2** are plan and elevation views, respectively, of a guardrail system **100** according to one embodiment of the present invention. Guardrail system **100** may be installed adjacent a roadway to protect vehicles, drivers and passengers from various obstacles and hazards and prevent vehicles from leaving the roadway during a traffic accident or other hazardous condition. Guardrail systems incorporating aspects of the present invention may be used in median strips or shoulders of highways, roadways, or any suitable path that is likely to encounter vehicular traffic.

In the illustrated embodiment, guardrail system **100** includes a guardrail **102**, an end terminal **104**, a support post **106**, a cable anchor bracket **108**, and a cable **110**.

Guardrail **102** may be any suitable guardrail, such as a w-beam (illustrated in FIGS. **1** and **2**) or a box beam (as illustrated in FIG. **5**), having any suitable length. In the embodiment illustrated in FIGS. **1** and **2**, an end of guardrail **102** is supported by end terminal **104**, which may be any suitable end treatment. In the illustrated embodiment, end terminal **104** resembles a guardrail extruder terminal ("GET"), such as the ET-2000® and ET-PLUS® manufactured by Trinity Industries, Inc. An example description of a GET is described in U.S. Pat. No. 4,928,928 by Buth et al., which is herein incorporated by reference. The present invention contemplates any suitable end terminal that has a releasable anchor plate, such as a Sequential Kinking Guardrail Terminal System ("SKGTS"), an Anchor Assembly for Highway Guardrail End Terminal ("AAHGET"), a Guardrail Cutting Terminal ("GCT"), and a Box Beam Terminal.

Support post **106** functions to support end terminal **104** and/or guardrail **102**. In the illustrated embodiment, support post **106** is a breakaway support post formed from a generally rectangular wood post; however, support post **106** may be any suitable support post formed from any suitable material and having any suitable shape.

Cable anchor bracket **108** may be coupled to guardrail **102** in any suitable manner; however, it is envisioned that cable anchor bracket **108** be releasably engaged with guardrail **102** so that cable anchor bracket **108** may be easily released from guardrail **102** during a head-on collision of a vehicle with an end **105** of end terminal **104** to avoid possible jamming of the movement of end terminal **104** and facilitate the safe and effective kinetic energy reduction during the head-on collision. In the illustrated embodiment, cable anchor bracket **108** is releasably coupled to guardrail **102** with a plurality of protrusions **112**, as described in greater detail below in conjunction with FIGS. **3**A and **3**B.

According to the teachings of the present invention, cable anchor bracket **108** provides an improved alignment of cable **110** with guardrail **102** to provide improved performance of the connection between cable **110** and guardrail **102**. As described in greater detail below, eccentricities with respect to cable **110** and the connection between cable anchor bracket **108** and guardrail **102** are reduced, thereby reducing moments resulting from a collision of a vehicle with the side of guardrail **102**. A reduction in moments reduces the likelihood of "tear-out" of protrusions **112** and strengthens the

connection between cable anchor bracket **108** and guardrail **102**. The connection between cable anchor bracket **108** and guardrail **102** is described in greater detail below in conjunction with FIGS. **3**A and **3**B.

Cable **110** extends between support post **106** and cable anchor bracket **108**. Cable **110** may be any suitable elongated element formed from any suitable material that provides tension to guardrail system **100** during a collision of a vehicle with a side of guardrail **102**. A general function of cable **110** during a collision may be found in U.S. Pat. No. 4,928,928. In the illustrated embodiment, cable **110** forms an acute angle **111** with respect to a longitudinal axis **109** of guardrail **102**. Acute angle **111** may be any suitable angle; however, in one embodiment, acute angle **111** is between approximately 15 and 25 degrees. One end of cable **110** couples to a lower portion of support post **106** in any suitable manner and the other end of cable **110** couples to cable anchor bracket **108** in any suitable manner. One example of coupling cable **110** to cable anchor bracket **108** is shown and described below in conjunction with FIGS. **3**A and **3**B.

FIG. **3**A is a perspective view and FIG. **3**B is an elevation view illustrating the coupling of cable **110** to cable anchor bracket **108** and cable anchor bracket **108** to guardrail **102** according to one embodiment of the invention. In the illustrated embodiment, cable anchor bracket **108** is formed from a plate **113** having an aperture **119** formed therein and a plurality of protrusions **112** coupled to plate **113** and extending from a plane containing aperture **119**. Plate **113** is preferably a single flat plate of structural steel with a thickness between approximately ¼ inches and ¾ inches. However, plate **113** may be formed from any suitable material having any suitable thickness.

Aperture **119** is utilized to couple cable **110** to cable anchor bracket **108** by any suitable method. In the illustrated embodiment, a shackle **116** is utilized along with a bolt **117** and a nut **118** to couple the end of cable **110** to plate **113**. The use of shackle **116** allows a longitudinal axis **120** (FIG. **3**B) of cable **110** to substantially align with a plane containing plate **113**. For example, a plane running through the mid-thickness of plate **113**, as denoted by reference number **122**, substantially aligns with longitudinal axis **120**. Depending on the location of support post **106** (see FIG. **1**) and where cable **110** couples to support post **106**, longitudinal axis **120** may form a slight angle with a plane containing plate **113**. In addition, a longitudinal axis **121** of aperture **119** (FIG. **3**B) is substantially perpendicular to longitudinal axis **120**. This positioning of cable **110** with respect to plate **113** results in an eccentricity **123** with guardrail **102** that is less than eccentricities of prior cable anchor systems. The reduction in eccentricity reduces the moment on the connection of protrusions **112** with guardrail **102**, thereby introducing less stress to the connection during a side impact collision. Thus, there is less chance for "tearing-out" of protrusions **112** during a side impact collision, which improves the performance of the connection.

In the illustrated embodiment, protrusions **112** cooperate with a plurality of apertures **114** formed in guardrail **102** in order to releasably couple cable anchor bracket **108** to guardrail **102**. In the illustrated embodiment, this is facilitated by a plurality of tabs **115** associated with respective protrusions **112** that "hook on" respective apertures **114** formed in an attachment portion **129** of guardrail **102**. The tautness of cable **110** after installation ensures the correct positioning of cable anchor bracket **108** in addition to keeping a snug fit of protrusions **112** with apertures **114**. Any suitable number and arrangement of protrusions **112** may be utilized within the teachings of the present invention. The present invention also contemplates other suitable coupling methods for cable anchor bracket **108** that facilitate a releasable engagement.

FIG. **4** is an elevation view illustrating another advantage of cable anchor bracket **108** according to one embodiment of the invention. As described above in conjunction with FIGS. **1** and **2**, cable **110** forms acute angle **111** with respect to the longitudinal axis **109** of guardrail **102**. As illustrated by FIG. **4**, this facilitates an extension **122** of longitudinal axis **120** of cable **110** intersecting a line **130** extending through the interior protrusions, as denoted by reference numeral **132**, when viewed from a side elevation as in FIG. **4**. In a particular embodiment, extension **122** may intersect a centroid **124** of all of the protrusions **112**. Interior protrusions are defined by all of the protrusions **112** except the upstream-most protrusion(s) **112** and downstream-most protrusion(s) **112**.

This positioning of cable **110** with respect to plate **113** substantially reduces or eliminates eccentricities, as denoted by eccentricity **126**, that exists in prior cable anchor systems, thereby reducing an additional moment on the connection between cable anchor bracket **108** and guardrail **102**. Eccentricity **126** results from the positioning of prior cables (denoted by reference numeral **127**) of prior cable anchor systems. Eccentricity **126** causes additional stress on the connection between the cable anchor bracket and the guardrail of prior guardrail systems, thereby enhancing the possibility of failure of the connection and minimizing the effectiveness of a tension cable during a side impact with the guardrail.

Referring now to FIG. **5**, an elevation view of guardrail system **100** according to another embodiment of the present invention is illustrated in which the guardrail is a box beam **500**. In this embodiment, guardrail system **100** includes a cable anchor bracket **502** that couples to a bottom **503** of box beam **500**. In the illustrated embodiment, box beam **500** has an "open" cross-section that resembles a C-section; however, box beam **500** may also have a "closed" cross-section.

Cable anchor bracket **502** may be coupled to bottom **503** of box beam **500** in any suitable manner; however, it is envisioned that cable anchor bracket **502** be releasably engaged with box beam **500** for reasons discussed above in conjunction with cable anchor bracket **108**. In the illustrated embodiment, cable anchor bracket **502** is releasably coupled to box beam **500** with a plurality of protrusions **504**, as described in greater detail below in conjunction with FIGS. **6**A and **6**B.

FIG. **6**A is a perspective view and FIG. **6**B is an elevation view illustrating the coupling of a cable **506** to cable anchor bracket **502** and cable anchor bracket **502** to box beam **500** according to one embodiment of the invention. In the illustrated embodiment, cable anchor bracket **502** is formed from a flange plate **508**, a web plate **510** having an aperture **512** formed therein, and a plurality of protrusions **504** coupled to flange plate **508**. Flange plate **508** and web plate **510** are preferably single flat plates of structural steel with a thickness between approximately ¼ inches and ¾ inches. However, flange plate **508** and web plate **510** may be formed from any suitable material having any suitable thickness. In the illustrated embodiment, web plate **510** extends substantially perpendicular to flange plate **508**; however, web plate **510** may be angled with respect to flange plate **508** in some embodiments.

Aperture **512** is utilized to couple cable **506** to cable anchor bracket **502** by any suitable method. In the illustrated embodiment, a shackle **511** is utilized along with a bolt **513** and a nut **515** to couple the end of cable **506** to web plate **510**. The use of shackle **511** allows a longitudinal axis **516** (FIG. **6**B) of cable **506** to substantially align with web plate **510**. Depending on the location of support post **106** (see FIG. **1**) and where

cable **506** couples to support post **106**, longitudinal axis **516** may form a slight angle with web plate **510**.

In the illustrated embodiment, protrusions **504** cooperate with a plurality of apertures **518** formed in bottom **503** of box beam **500** in order to releasably couple cable anchor bracket **502** to box beam **500**. In the illustrated embodiment, this is facilitated by a plurality of tabs **509** associated with respective protrusions **504** that "hook on" respective apertures **518** formed in bottom **503** of box beam **500**. The tautness of cable **506** after installation ensures the correct positioning of cable anchor bracket **502** in addition to keeping a snug fit of protrusions **504** with apertures **518**. Any suitable number and arrangement of protrusions **504** may be utilized within the teachings of the present invention. The present invention also contemplates other suitable coupling methods for cable anchor bracket **502** that facilitate a releasable engagement.

Referring back to FIG. **5**, cable **506** forms an acute angle **507** with respect to the longitudinal axis of box beam **500**. This facilitates an extension **520** of longitudinal axis **516** of cable **506** intersecting a line extending through the interior protrusions, as denoted by reference numeral **522**. In a particular embodiment, extension **520** may intersect a centroid of all of the protrusions **504**.

Thus, an improved cable anchor bracket is disclosed by the present invention that improves performance of the connection of the cable anchor bracket with the guardrail by reducing eccentricities associated therewith. Reduced eccentricities result in reduced moments and reduced stress at the connection, thereby increasing the strength of the connection and ensuring that the anchor cable may perform its function in an efficient and safe manner.

Although the present invention is described by several embodiments, various changes and modifications may be suggested to one skilled in the art. The present invention intends to encompass such changes and modifications as they fall within the scope of the present appended claims.

What is claimed is:

1. A guardrail system, comprising:

a box beam;

an end terminal coupled to the box beam;

a support post for supporting the end terminal;

a cable anchor bracket coupled to the box beam;

a cable extending between the support post and the cable anchor bracket;

the cable anchor bracket comprising:

a flange plate having first and second opposing sides;

a plurality of protrusions coupled to and protruding in a longitudinally extending line from the first side of the flange plate, the plurality of protrusions releasably engaging a plurality of apertures formed in the box beam; and

a web plate coupled to and protruding from the second side of the flange plate in alignment with the longitudinally extending line and having an aperture formed therein; and

wherein the cable is coupled to the support post at a first end and coupled to the aperture of the web plate at a second end, the cable terminating at the aperture such that an extension of a longitudinal axis of the cable from the second end forms an acute angle with respect to a longitudinal axis of the box beam and the flange plate and approximately intersects a centroid of the protrusions along the longitudinally extending line.

2. The guardrail system of claim **1**, further comprising a shackle coupling the second end of the cable to the aperture.

3. The guardrail system of claim **1**, wherein the longitudinal axis of the cable substantially aligns with a plane containing the web plate.

4. The guardrail system of claim **1**, wherein the acute angle is between approximately 15 and 25 degrees.

5. The guardrail system of claim **1**, wherein a thickness of each of the flange and web plates is between approximately ¼ inches and ¾ inches.

6. The guardrail system of claim **1**, wherein the end terminal comprises a box beam terminal.

7. A cable anchor system for an end terminal, comprising:

a box beam having a plurality of apertures formed in a bottom of the box beam;

a cable anchor bracket configured to couple to the bottom of the box beam, the cable anchor bracket comprising:

a flange plate having first and second opposing sides;

a plurality of protrusions coupled to and protruding in a longitudinally extending line from the first side of the flange plate, the plurality of protrusions releasably engaging the plurality of apertures formed in the bottom of the box beam;

a web plate coupled to and protruding substantially perpendicularly from the second side of the flange plate in alignment with the longitudinally extending line, the web plate having an aperture formed therein; and

a cable having a first end configured to couple to a support post of the end terminal and a second end configured to couple to the aperture such that an extension of a longitudinal axis of the cable forms an acute angle with respect to a longitudinal axis of the box beam and the flange plate and intersects a line segment extending between interior ones of the protrusions along the longitudinally extending line when the cable is coupled to the aperture.

8. The cable anchor system of claim **7**, further comprising a shackle configured to couple the cable to the aperture.

9. The cable anchor system of claim **7**, wherein the longitudinal axis of the cable substantially aligns with a plane containing the web plate.

10. The cable anchor system of claim **7**, wherein the acute angle is between approximately 15 and 25 degrees.

11. The cable anchor system of claim **7**, wherein a thickness of each of the flange and web plates is between approximately ¼ inches and ¾ inches.

* * * * *