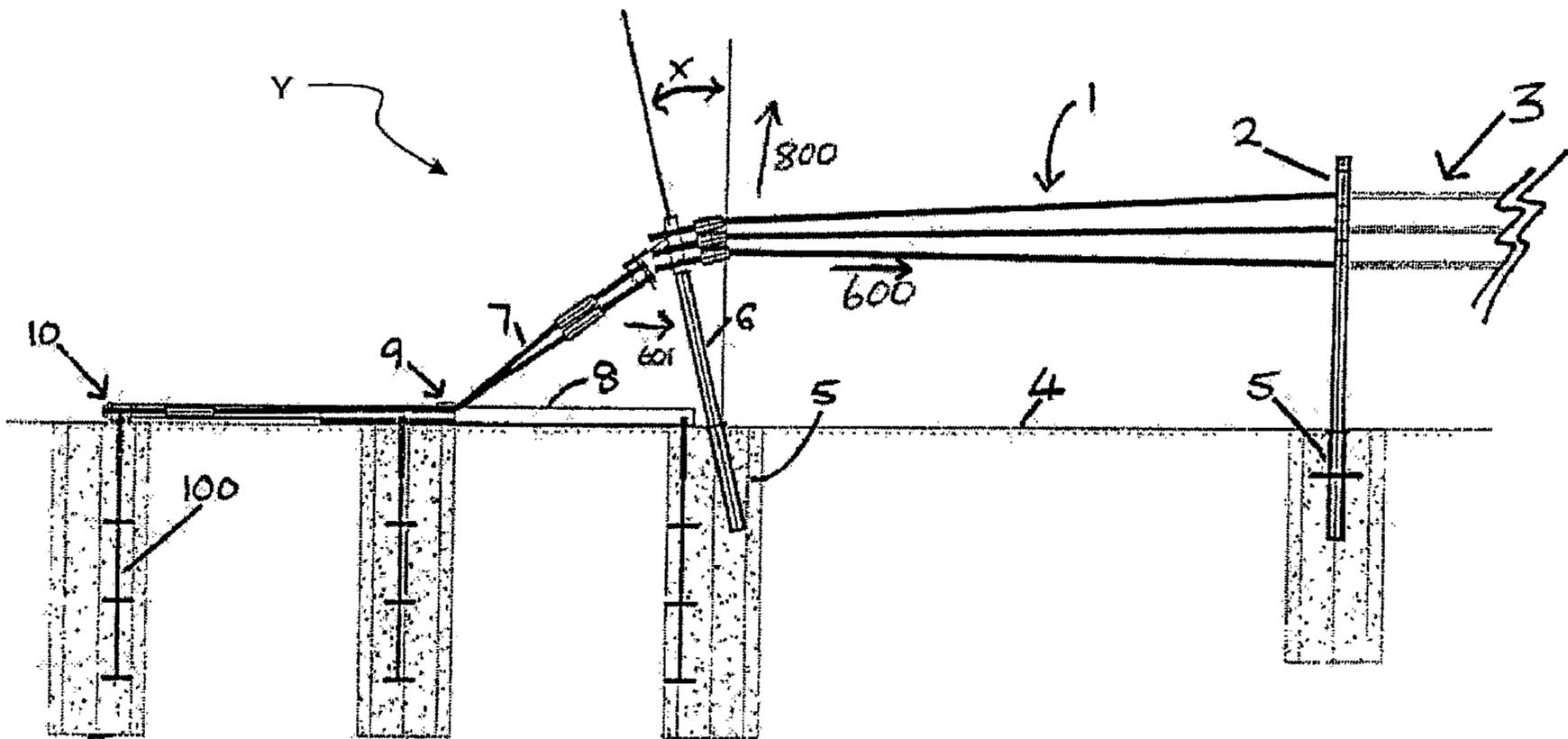




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(54) **Titre : CABLES D'ANCRAGE AMOVIBLES POUR BARRIERE DE SECURITE A CABLES SE DEGAGEANT SOUS CERTAINES CONDITIONS DE CHARGES S'APPLIQUANT A LA BARRIERE DE SECURITE**
 (54) **Title: RELEASABLE ANCHOR CABLES FOR CABLE BARRIERS THAT RELEASE UPON CERTAIN LOAD CONDITIONS UPON THE CABLE BARRIER**



(57) **Abrégé/Abstract:**

The invention relates to an improved cable-barrier system. This cable-barrier system includes an anchor-body and terminal post which receive and retain one or more anchor-cables and are anchored to counter balance the force applied to the anchor body by one or more barrier-cable(s). The system also allows for the release of the anchor-cables during a collision with a vehicle. The release of the cables is particularly important in situations where the cable-barrier is capable of acting as a ramp and/or snag during the collision.

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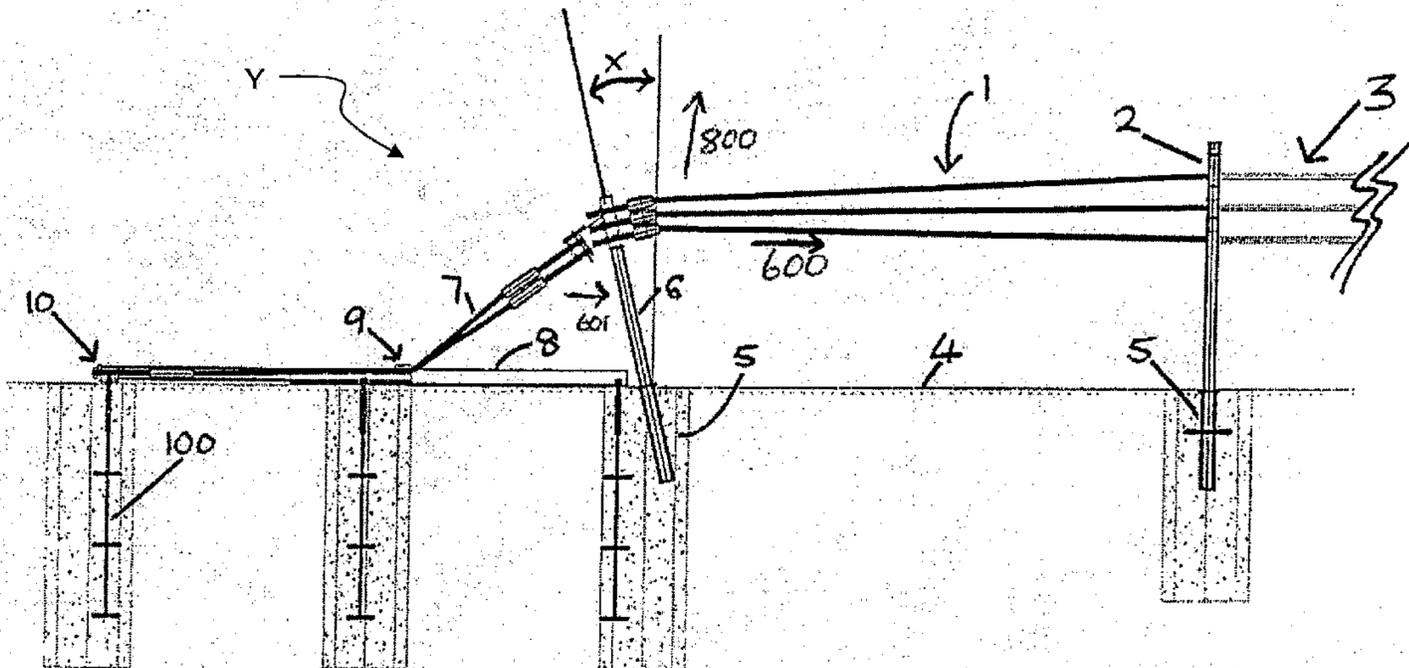
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(54) Title: **RELEASABLE ANCHOR CABLES FOR CABLE BARRIERS THAT RELEASE UPON CERTAIN LOAD CONDITIONS UPON THE CABLE BARRIER**



(57) Abstract: The invention relates to an improved cable-barrier system. This cable-barrier system includes an anchor-body and terminal post which receive and retain one or more anchor-cables and are anchored to counter balance the force applied to the anchor body by one or more barrier-cable(s). The system also allows for the release of the anchor-cables during a collision with a vehicle. The release of the cables is particularly important in situations where the cable-barrier is capable of acting as a ramp and/or snag during the collision.

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**RELEASABLE ANCHOR CABLES FOR CABLE BARRIERS THAT
RELEASE UPON CERTAIN LOAD CONDITIONS UPON THE CABLE
BARRIER**

5

10 **TECHNICAL FIELD**

The present invention relates to improvements in and relating to cable-barriers. In particular, though not solely, the present invention is directed towards an anchoring system for cable-barriers, for use in roading networks and/or vehicle road lanes requiring separation by a barrier.

15

BACKGROUND ART

The present invention will now be described in relation to cable-barriers for use in relation to roading networks. However, this should not be seen as limiting, as aspects of the present invention may also have application in relation to different fields.

20

Existing cable-barriers which employ a cable assembly as part of the barrier have a variety of different ways for anchoring the cable assembly to the ground, at the terminal ends of the cable-barrier. Typically, the cable(s) employed in the cable-barrier are guided through one or more terminal posts and are inclined towards one or more ground anchor points.

25

However, one problem with existing anchoring systems is that the inclined nature of the cable(s) at the terminal end of the barrier, together with the integrity of the anchoring system, acts to effectively create a ramp when impacted by an errant vehicle. As a result, the impacting vehicle either rolls or becomes at least partially airborne, following an impact.

30
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Some existing cable-barriers, such as the cable-barrier system manufactured by Gibraltar, have attempted to overcome this 'ramping' problem by having their cables anchored to the ground via a quick release mechanism.

5 However, one draw back of existing cable-barrier systems is that the anchoring systems only function in one direction. If a vehicle impacts the cable-barrier in the other or 'reverse' direction, snagging of the vehicle between the cables can occur, which in turn causes substantial damage to the vehicle and potentially more harm to the driver. Another drawback of existing cable-barriers is that if hit in the
10 'reverse' direction, ramping of the vehicle may still occur.

In the inventors experience, no such quick release mechanism has been fully effective at reducing or preventing an inclined cable anchoring system from acting as a ramp or snag, during impacts from a number of different angles, particularly
15 'reverse' direction impacts – these are impacts that occur in a direction other than a substantially head on impact.

It would therefore be useful to have a cable-barrier system or release mechanism that could withstand impact from collisions from both directions. Additionally, it
20 would also be useful to have a cable-barrier which can release the anchor-cable downwardly extending from the terminal post of a cable-barrier, in situations where the anchor-cables are capable of acting as a ramp or snag during a collision.

It is an object of the present invention to address the foregoing problems or at least
25 to provide the public with a useful choice.

No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly
30 understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is acknowledged that the term 'comprise' may, under varying jurisdictions, be attributed with either an exclusive or an inclusive meaning. For the purpose of this specification, and unless otherwise noted, the term 'comprise' shall have an inclusive meaning - i.e. that it will be taken to mean an inclusion of not only the
5 listed components it directly references, but also other non-specified components or elements. This rationale will also be used when the term 'comprised' or 'comprising' is used in relation to one or more steps in a method or process.

Further aspects and advantages of the present invention will become apparent
10 from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

The term 'cable-barrier' or grammatical variations thereof refers to a barrier that is constructed from one or more cables and a number of supporting posts.

5

The term 'terminal post' or grammatical variations thereof refers to the first post located at the first distal end of a cable-barrier.

For the purposes of this specification, the term 'anchor-body' or grammatical variations thereof refer to a portion of the terminal post which receives and retains one end of the anchor cable(s) to the terminal post.

10

The term 'anchor-cable' or grammatical variations thereof refer to the cable(s) that anchor the terminal post and/or the anchor-body to the ground.

15

The term 'barrier-cable' or grammatical variations thereof refer to the cable(s) that span the length of the cable-barrier.

The term 'snag', 'snagging' or other grammatical variations thereof refers to when a vehicle impacts the cable-barrier and causes the vehicle to become entangled between the anchor-cables and/or barrier-cables.

20

The term 'ramp' or grammatical variations thereof refer to when a vehicle impacts a barrier in a substantially head-on. This impact generally causes the vehicle to become airborne.

25

According to a first aspect of the present invention there is provided an anchor-body which includes at least one aperture adapted to, in use:

30

- receive and retain one or more anchor-cables which are anchored so as to counter balance the force applied to the anchor body by one or more barrier-cable(s); and

35

- release said anchor-cables from the aperture during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp and/or snag during said collision.

According to second aspect of the present invention there is provided an anchor-body for a terminal post of a cable-barrier;

5 wherein said anchor-body is adapted to, in use:

- receive and retain one or more anchor-cables which are also anchored to a support surface so as to counter balance the force applied to the terminal post by one or more barrier-cable(s); and

10

- release said anchor-cables from the anchor-body, during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp and/or snag during said collision.

15 According to third aspect of the present invention there is provided a terminal post for a cable-barrier which includes:

- a cable-portion which has been adapted to, in use, receive and retain one or more barrier-cables used in the cable-barrier;

20

characterised in that the post also includes an anchor-body which is adapted to, in use:

- receive and retain one or more anchor-cables which are anchored so as to counter balance the force applied to the terminal post by said barrier-cable(s); and

25

- release said anchor-cables, during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp and/or snag during said collision.

30

According to another aspect of the present invention there is provided an anchor-body for a terminal post of a cable-barrier;

wherein said anchor-body is adapted to, in use:

35

- receive and retain one or more anchor-cables which are also anchored to a support surface so as to counter balance the force applied to the terminal post by said barrier-cable(s); and
- 5 - release said anchor-cables from the anchor-body, during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp and/or snag during said collision.

10 The cable-portion may be adapted in a variety of different ways so as to receive and retain one or more barrier-cables, when in use.

In general, the cable-portion may be in the form of one or more apertures through which the terminal end of a barrier-cable may pass.

15 In preferred embodiments the cable-portion may be in the form of a slot through which the terminal end of one or more barrier-cables may pass.

In further preferred embodiments the cable-portion may be a slot which has a mouth at the top end of the post.

20

The inventor has found an advantage with this embodiment is that any collision with the terminal post itself releases the barrier-cables which escape out the mouth of the slot when the post deforms. This in turn causes the anchor-cables to be released from the anchor-body.

25

The anchor-body may be adapted to receive and retain and release said anchor cable in a variety of different ways.

30 In general, the anchor-body includes an aperture into which, in use, anchor-cables may pass and be retained therein, wherein said aperture is adapted to release said anchor-cables upon application of a force.

In some embodiments the aperture may include a frangible portion which will break off upon application of a force, so said anchor-cables can exit the anchor-body.

35

In preferred embodiments, the aperture of the anchor-body, into which, in use, anchor-cables may pass and be retained therein, may be in the form of a slot which includes a mouth at one end thereof through which said anchor-cables may exit upon application of a force, to release said anchor-cables from the anchor-
5 body.

Preferably, the force applied to the anchor-body, anchor-cables or barrier-cables may be applied to the anchor-body in a substantially downward direction with respect to the anchor-cables. In other embodiments, the force may be applied to
10 the anchor-body in a substantially side-on direction with respect to the anchor-cables. While, in even further embodiments, the force applied to the anchor-body may be in a substantially downward and side-on direction with respect to the anchor-cables.

15 In further preferred embodiments the anchor-body may also include at least two arms which can extend the anchor-body out from the post. In use the arms position the anchor-body on the post so it faces substantially the opposite direction to the force applied by the barrier-cables to the post, away from the barrier-cables.

20 According to another aspect of the present invention there is provided a kit for erecting a terminal post for cable-barrier system wherein the kit includes:

- at least one terminal post which includes a cable-portion which has
25 been adapted to, in use, receive and retain one or more barrier-cables used in the cable-barrier; and
- an anchor-body which forms part of the terminal post, or which can be attached to said terminal post;

30 wherein said anchor-body is adapted to, in use:

- receive and retain one or more anchor-cables which are anchored so as to counter balance the force applied to the terminal post by said barrier-cable(s); and

35

- release said anchor-cables, during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp and/or snag during said collision.

5 According to another aspect of the present invention there is provided a cable-barrier system which includes:

- 10 - at least one terminal post, as substantially described above, which includes a cable-portion which has been adapted to, in use, receive and retain one or more barrier-cables used in the cable-barrier; and
- an anchor-body, as substantially described above, which forms part of the terminal post, or which can be attached to said terminal post;

15 wherein the cable-barrier system further includes;

- a plurality of posts capable of receiving and retaining at least one cable therein;
- 20 - one or more barrier-cables retained within the posts.

According to another aspect of the present invention there is provided a method of anchoring a cable-barrier to a support surface characterised by the steps of:

- 25 a) connecting one end of at least one anchor-cable to an anchor-body on a terminal post of the cable-barrier;
- b) anchoring the other end of the anchor-cable(s) to the support surface,

30

wherein said anchor-body is adapted to, in use:

- receive and retain one or more anchor-cables which are anchored so as to counter balance the force applied to the terminal post by said barrier-cable(s); and
- 35

- release said anchor-cables, during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp and/or snag during said collision.

5 The anchor-cable(s) may be anchored to the support surface in a variety of different ways.

In general, the anchor-cable(s) may be anchored to the support surface in a manner which reduces any substantially upward force exerted by the anchor-cable
10 at the anchor point(s).

In preferred embodiments, the anchor-cable(s) may be attached to:

- a strut running substantially parallel to the support surface, and which
15 may be connected to the ground; and
- at least two points along a strut, such that at least some of any substantially upward force can be converted to a shear force which is substantially parallel to the longitudinal axis of the strut.

20

Preferably, the anchor-cables may be connected at two or more points along the strut.

Preferably, the strut prevents the mid-point of the anchor-cables from lifting away
25 from the ground upon application of a force.

Thus, it should be appreciated that preferred embodiments of the present invention may have a number of advantages over the prior art which can include:

- 30 - providing a terminal post for, and/or method of anchoring, a cable-barrier which can release anchor-cable downwardly extending from the terminal post of a cable-barrier, in situations where said anchor-cables are capable of acting as a ramp and/or snag during a collision;

- a barrier-cable release mechanism on a terminal post of a cable-barrier which releases barrier-cables when a vehicle collides with the terminal post and/or anchor-cables of the cable-barrier;
- 5
- A barrier-cable release mechanism that can withstand impact from collisions from both directions.

BRIEF DESCRIPTION OF DRAWINGS

10 Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 shows a partial side elevation view of a cable-barrier in accordance
15 with the preferred embodiment of the present invention;

Figure 2 shows further views of a cable-barrier, where;

Figure 2a shows a further partial side elevation view and corresponding
20 plan elevation view of a cable-barrier in accordance with the preferred embodiment of the present invention;

Figure 2b shows a corresponding plan elevation view of the cable-
25 barrier as shown in Figure 2a;

Figure 3 shows a further perspective elevation view of a cable-barrier in
accordance with the preferred embodiment of the present invention;

Figure 4 shows a perspective elevation view of the top of the terminal post
30 shown in Figure 1 without any cables attached thereto;

Figure 5 shows a perspective elevation view of the top portion of the terminal
35 post (as indicated by Box A in Figure 3) with cables and anchor-cables attached thereto;

Figure 6 shows a photograph of the terminal post of the present invention with cables and anchor-cables attached thereto;

Figure 7 shows a front elevation view of the anchor-body washer; and

5

Figure 8 shows a detail view of the distal end of the ground strut connection, as indicated by box B in Figure 3.

BEST MODES FOR CARRYING OUT THE INVENTION

10

Figures 1 to 3 show a cable-barrier (1). The cable-barrier (1) includes a plurality of posts (2) (of which only one is shown) which support the cables (3) of the cable barrier (1). The posts (2) are secured to the ground (4) via concrete footings (5). The cable-barrier (1) also includes a terminal post (6) which is also secured to the ground (4) via a concrete footing (5). The terminal post (6) is at an angle of approximately 8 degrees to the vertical, as indicated by double ended arrow X. The terminal post (6) is further secured to the ground (4) via two anchor-cables (7) which are connected to the ground (4) via a strut (8) which runs parallel to the surface of the ground (4) and is attached thereto via bolts (indicated by arrow 21 on Figure 2 only) which are connected to threadable socket portions (indicated by arrow 22 on Figure 2 only) of reinforcing elements (100) embedded in the concrete footings (5). As shown in Figures 1 to 3, the anchor-cables (7) travel through the hollow centre of the strut (8) from an entry point (9) to the terminal end of the strut (10) where the anchor-cables (7) are secured by a bolt (39) and washer (40) arrangement (as indicated by arrow B, and Box B in Figures 2 and 3 respectively). The bolt and washer arrangement is shown in detail in Figure 8.

15

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The terminal post and anchor body arrangement, of the cable-barrier, as specifically indicated by Box A on Figure 3, is shown in greater detail in Figures 4 to 6.

The terminal post (6) has a substantially upright portion (11) and a post transition plate (12) which is welded on top of upright portion (11). Additionally, two vertical strain plates (13) are welded to the post transition plate (12). The strain plates (13) form a cable-portion in the form of a slot (14).

35

Also shown in Figures 4 to 6 is an anchor-body (15). The anchor-body (15) has two side plates (16) which are respectively attached to the outside of the two vertical strain plates (13). The two side plates (16) are connected to one another
5 via two top plates (17) which are also respectively welded (indicated by line 18). At the distal end of the side plates (16) two further plates (19) are welded together, which form an aperture (20).

Figure 5 show the terminal post (6) and anchor-body (15) in an in use position,
10 within a cable-barrier system. As shown, the terminal ends of cables (3) include a threaded section (30) which passes through the slot (14) of the cable-portion. To retain the cables within the threaded section (30), the cables (3) are secured within slot (14) via nuts and bolts (31) and a washer (32). Additionally, the anchor-cables (7) are retained within a threaded section (34) which passes through aperture (20)
15 in the anchor-body. Similarly, the anchor-cables (7) are retained therein via a washer (37) and nuts (41).

Figure 6 shows a photograph of both the terminal post (6) and anchor-body (15) while in use.

20

Figure 7 shows the washer for the anchor-cables (7) in greater detail. As indicated, the washer (37) has two apertures (38) through which the threaded sections of the anchor-cables (7) can pass through and be retained in.

25 In use, if a vehicle travelling in direction Y hits or contacts the anchor-cables (7) the resultant force from the impact moves the anchor-cables (7) substantially in the direction of arrow (200) which releases the anchor-cables (7) from the anchor-body (15).

30 As the cables (3) of the cable-barrier (1) are held under tension in the direction of arrow (600) the release of the anchor-cables (7) causes the terminal post (6) to deform substantially in the direction of arrow (601) and as a consequence the cables (3) move in a substantially vertical direction as indicated by arrow (800) and are released from slot (14) of the cable portion.

35

A similar net result occurs if a vehicle impacts into the terminal post (6) itself as

any substantial deformation of the terminal post (6) causes the respective release of the cables (3) and/or anchor-cables (7) from the slot (14) of the cable-portion of the terminal post or the aperture (20) of the anchor-body (15). This is the outcome of when a vehicle impacts the anchor-cables (7), the terminal post (6) or anchor-
5 body (15) substantially side-on. Here, the force causes the terminal post (6) and anchor-body (15) to twist or buckle, due to the opposing forces between the cable tension and direction of force caused by the impact.

Aspects of the present invention have been described by way of example only and
10 it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the appended claims.

What we claim is:

1. An anchor-body for a terminal post of a cable barrier, the anchor-body being configured to connect to the terminal post and including at least one anchor-cable aperture in the form of a slot adapted to, in use:
 - releasably receive and retain, within the slot, one or more anchor-cables which are anchored to a footing in a support surface so as to counter balance the force applied to the terminal post by one or more barrier-cables releasably received and retained by a barrier-cable aperture, having a first mouth at a top end thereof, in a cable portion of the terminal post; and

wherein the slot includes a second mouth at a bottom end thereof through which, said one or more anchor-cables, are configured to slideably exit, upon application of a downward force on said one or more anchor-cables, which releases said anchor-cables from the anchor-body.
2. An anchor-body as claimed in claim 1, wherein said anchor-cables are capable of being released during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp during said collision.
3. An anchor-body as claimed in claim 1 or claim 2, wherein said barrier-cables are capable of being released during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a snag during said collision.
4. An anchor-body as claimed in any one of claims 1 to 3, wherein the slot of the anchor body includes a frangible portion which breaks off, upon application of a force, so said anchor-cables exit the anchor-body.
5. An anchor-body as claimed in any one of claims 1 to 4, wherein the anchor-body includes at least two arms which extend the anchor-body.

6. An anchor-body as claimed in claim 5, wherein the arms position the anchor-body on the terminal post so the anchor-body extends out from the terminal post on substantially the opposite side of the terminal post to the barrier-cables.
7. An anchor-body as claimed in any one of claims 1 to 6, wherein the anchor-cable(s) are anchored to the support surface in a manner which reduces any substantially upward force exerted by the anchor-cable at the anchor point(s).
8. An anchor-body as claimed in any one of claims 1 to 7, wherein the anchor-cable(s) are attached to:
 - a. a strut running substantially parallel to the support surface, and which are connected to the ground; and
 - b. at two points along said strut, such that at least some of any substantially upward force can be converted to a shear force which is substantially parallel to the longitudinal axis of the strut.
9. An anchor-body as claimed in claim 8, wherein the anchor-cable(s) are connected to the strut at two or more points.
10. An anchor-body as claimed in claim 8 or claim 9, wherein the strut prevents the mid-point of the anchor-cables from lifting away from the ground upon application of a force.
11. An anchor-body as claimed in any one of claims 1 to 10, wherein the force applied to the anchor-body is in a substantially downward and horizontal direction.
12. A terminal post for a cable-barrier which includes:
 - a post member comprising a cable-portion including a barrier-cable aperture, having a first mouth at a top end thereof, which has been

adapted to, in use, releasably receive and retain one or more barrier-cables used in the cable-barrier;

- an anchor-body attached to said cable portion and including an anchor-cable aperture in the form of a slot which is adapted to, in use, releasably receive and retain one or more anchor-cables which are anchored to a footing in a support surface so as to counter balance the force applied to the terminal post by said barrier-cable(s);

wherein the slot includes a second mouth at a bottom end thereof through which, said one or more anchor-cables, are configured to slideably exit, upon application of a downward force on said one or more anchor-cables, which releases said anchor-cables from the anchor-body.

13. A terminal post as claimed in claim 12, wherein said anchor-cables are capable of being released during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a ramp during said collision.
14. A terminal post as claimed in claim 12 or claim 13, wherein said barrier-cables are capable of being released during a collision with a vehicle, in situations where said anchor-cables are capable of acting as a snag during said collision.
15. A terminal post as claimed in any one of claims 12 to 14, wherein the slot of the anchor-body includes a frangible portion which breaks off, upon application of a force, so said anchor-cables can exit the anchor-body.
16. A terminal post as claimed in any one of claims 12 to 15, wherein the anchor-body includes at least two arms which can extend the anchor-body out from the post.
17. A terminal post as claimed in claim 16, wherein the arms position the anchor-body on the terminal post so the anchor body extends out from the

terminal post on substantially the opposite side of the terminal post to the barrier-cables.

18. A terminal post as claimed in any one of claims 12 to 17, wherein the anchor-cable(s) are anchored to the support surface in a manner which reduces any substantially upward force exerted by the anchor-cable at the anchor point(s).
19. A terminal post as claimed in any one of claims 12 to 18, wherein the anchor-cable(s) are attached to:
 - a strut running substantially parallel to the support surface, and which are connected to the ground; and
 - at least two points along said strut, such that at least some of any substantially upward force can be converted to a sheer force which is substantially parallel to the longitudinal axis of the strut.
20. A terminal post as claimed in claim 19, wherein the anchor-cable(s) are connected to the strut at two or more points.
21. A terminal post as claimed in claim 19 or 20, wherein the strut prevents the mid-point of the anchor-cables from lifting away from the ground upon application of a force.
22. A terminal post as claimed in any one of claims 12 to 21, wherein the force applied to the anchor-body during the collision with the vehicle is in a substantially downward and horizontal direction.
23. A kit for erecting a terminal post for cable-barrier system wherein the kit includes:
 - at least one terminal post which includes a cable-portion including a barrier-cable aperture, having a first mouth at a top end thereof, which has been adapted to, in use, releasably receive and retain one or more barrier-cables used in the cable-barrier; and

- an anchor-body which forms part of the cable-portion, or which can be attached to said cable-portion;

wherein said anchor-body includes an anchor-cable aperture in the form of a slot adapted to, in use, releasably receive and retain one or more anchor-cables which are anchored to a footing in a support surface so as to counter balance the force applied to the terminal post by said one or more barrier-cables;

wherein the slot includes a second mouth at a bottom end thereof through which, said one or more anchor-cables, are configured to slideably exit, upon application of a downward force on said one or more anchor-cables, which releases said anchor-cables from the anchor-body.

24. A cable-barrier system which includes:

- at least one terminal post, as claimed in any one of claims 12 to 22, which includes a cable-portion which has been adapted to, in use, releasably receive and retain one or more barrier-cables used in the cable-barrier; and
- a plurality of posts capable of receiving and retaining at least one cable therein;
- one or more barrier-cables retained in the posts;
- one or more anchor-cables releasably retained by said at least one terminal post and anchored to a footing in a support surface so as to counter balance the force applied to the at least one terminal post by said barrier-cables.

25. A method of anchoring a cable-barrier to a footing in a support surface characterised by the steps of:

- a) connecting one end of at least one anchor-cable to an anchor-body on a terminal post of the cable-barrier;
- b) anchoring the other end of the anchor-cable(s) to the footing;

wherein said terminal post includes a cable-portion including a barrier-cable aperture, having a first mouth a top end thereof, which has been adapted to, in use, releasably receive and retain one or more barrier-cables used in the cable-barrier; and

wherein said anchor-body is attached to said cable portion and includes an anchor-cable aperture in the form of a slot adapted to, in use, releasably receive and retain one or more anchor-cables which are anchored to a footing so as to counter balance the force applied to the terminal post by said one or more barrier-cable(s);

wherein the slot includes a second mouth at a bottom end thereof through which, said one or more anchor-cables, are configured to slideably exit, upon application of a downward force on said one or more anchor-cables, which releases said anchor-cables from the anchor-body.

FIGURE 1

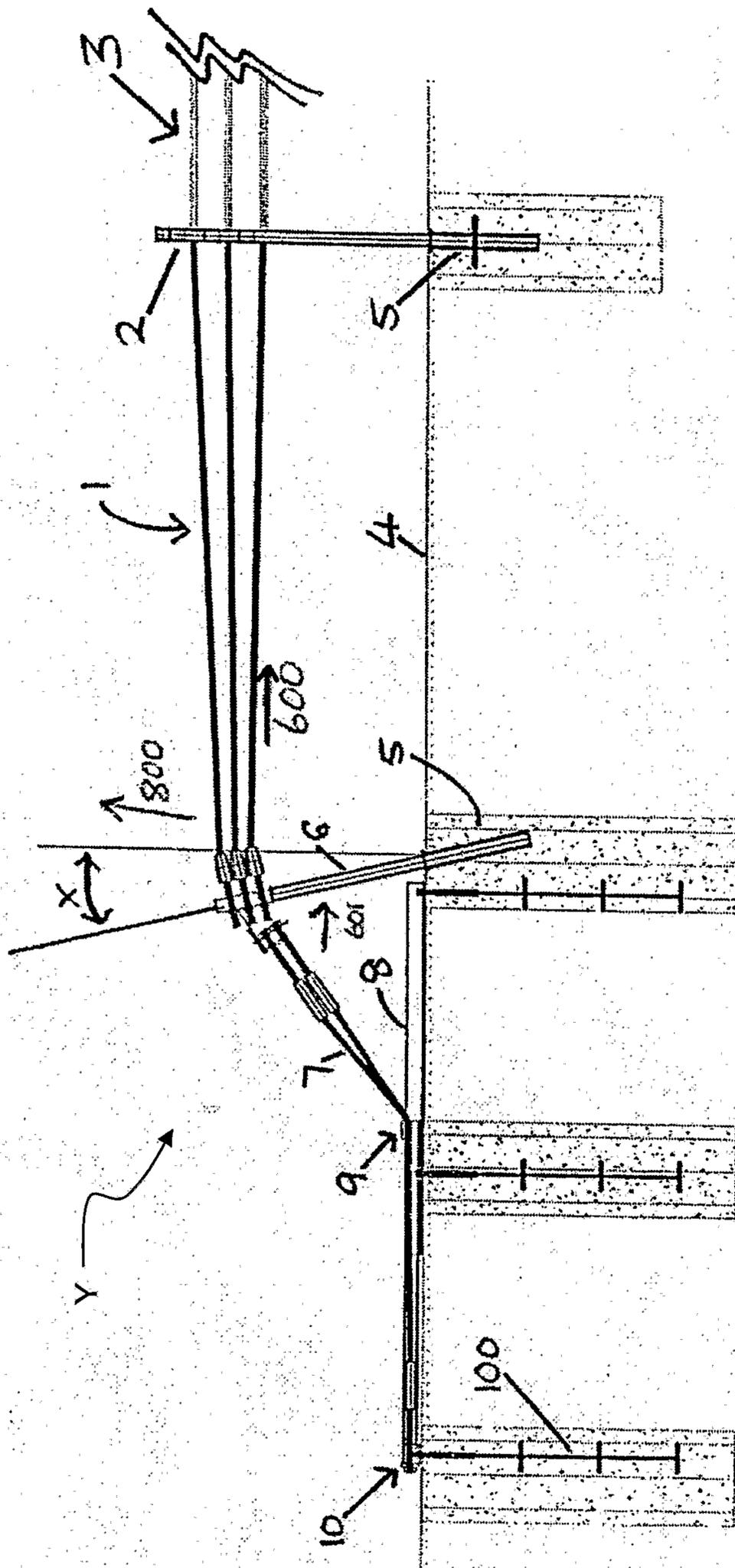


FIGURE 3

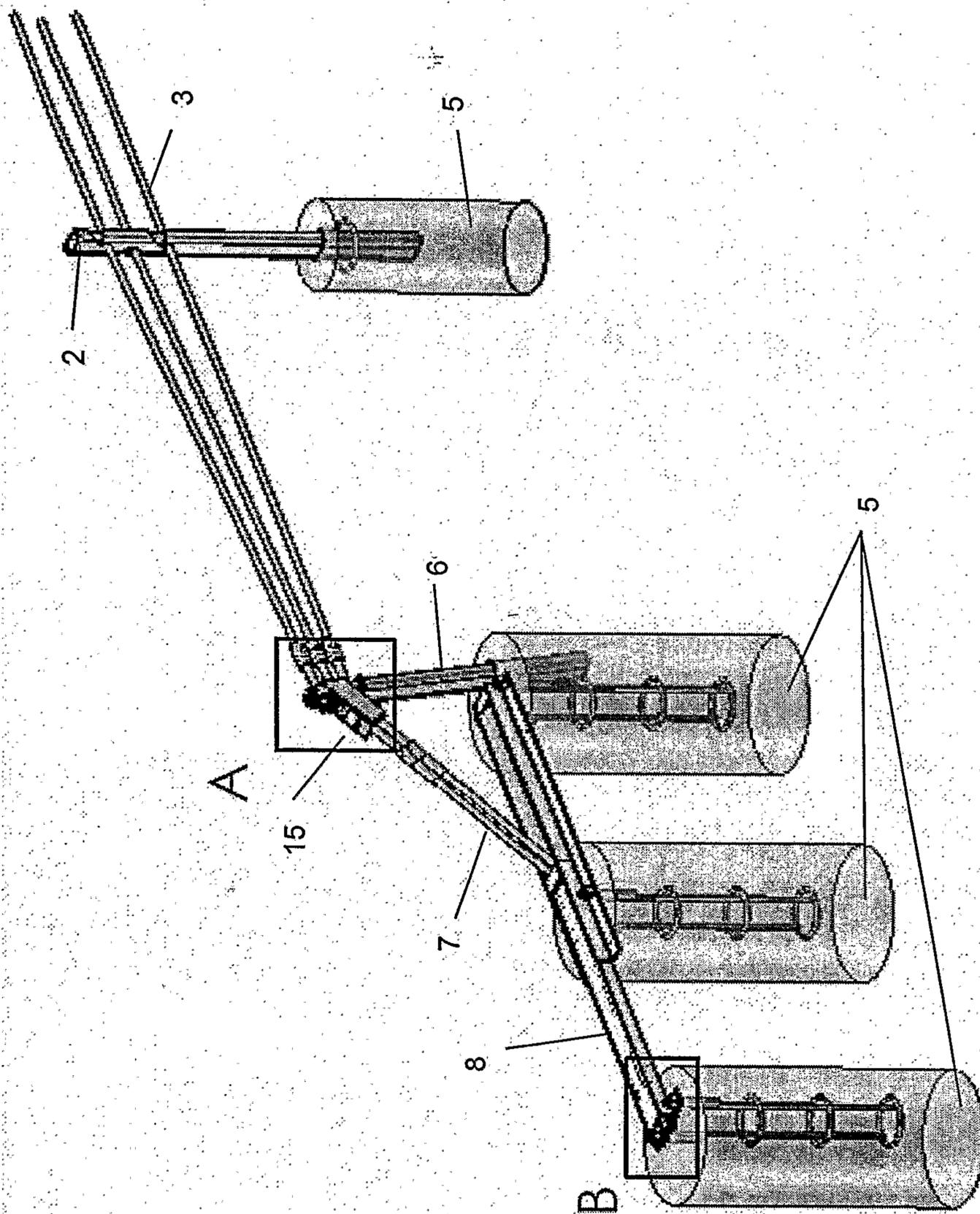


FIGURE 4

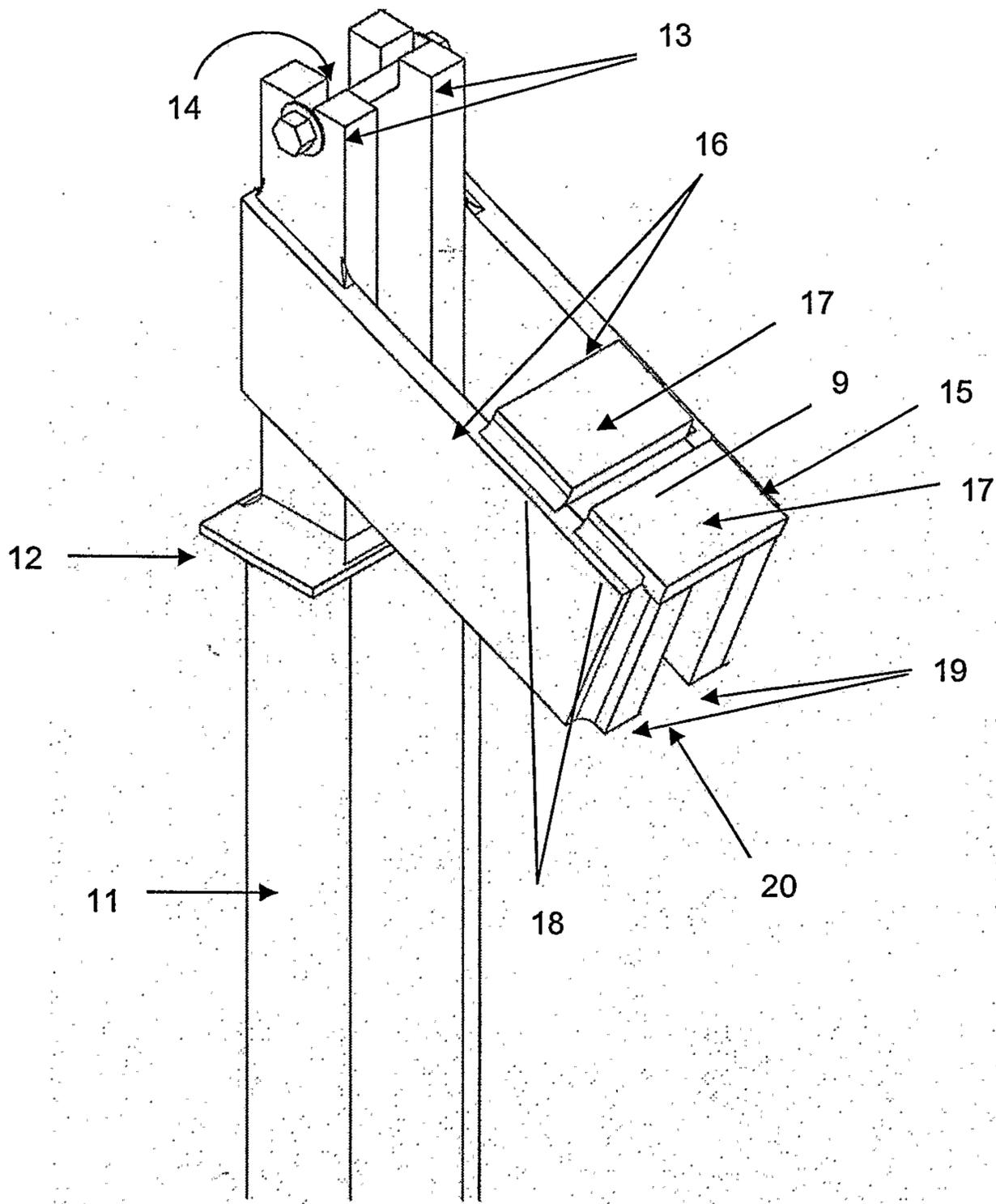


FIGURE 5

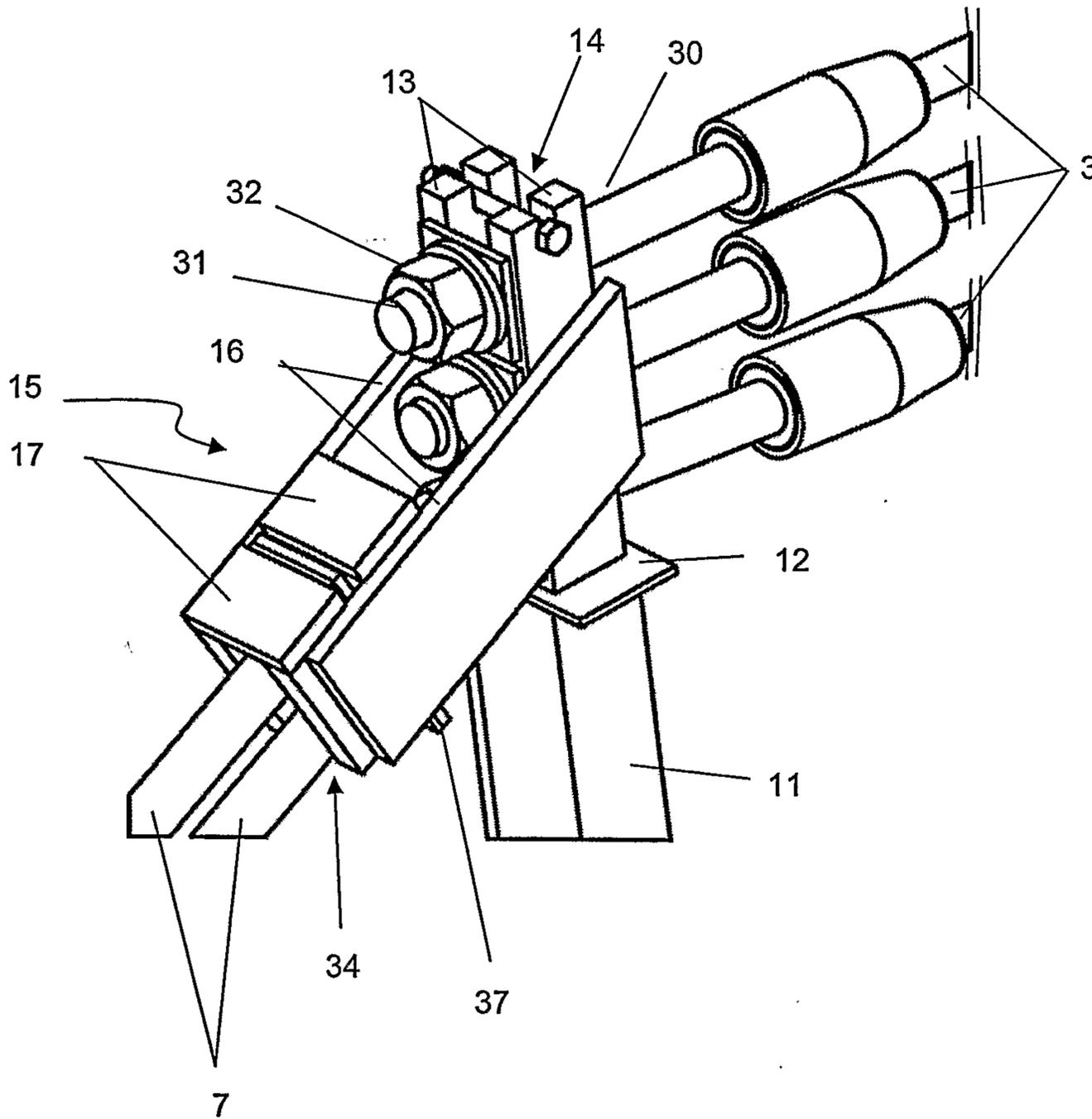


FIGURE 6

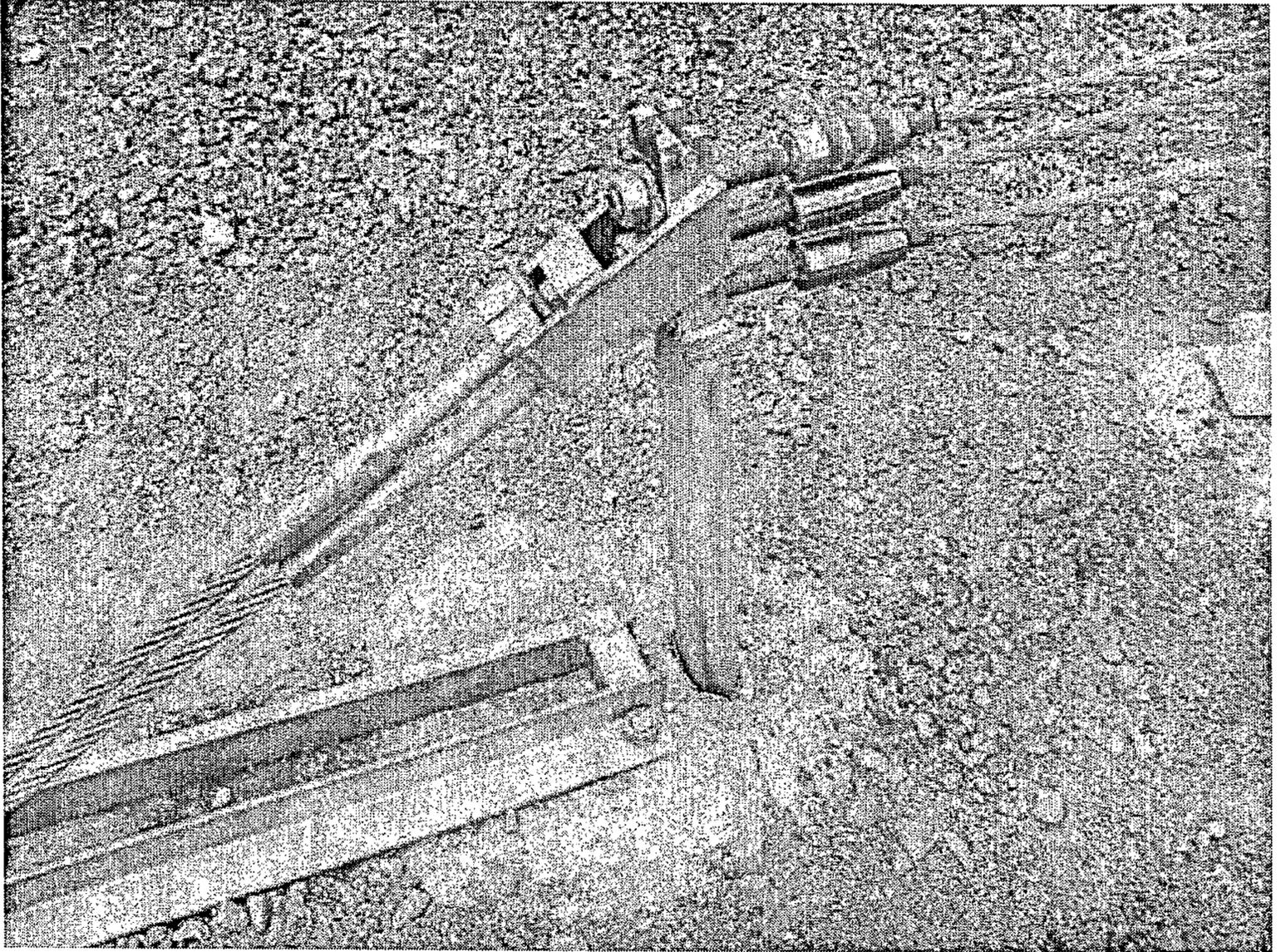


FIGURE 7

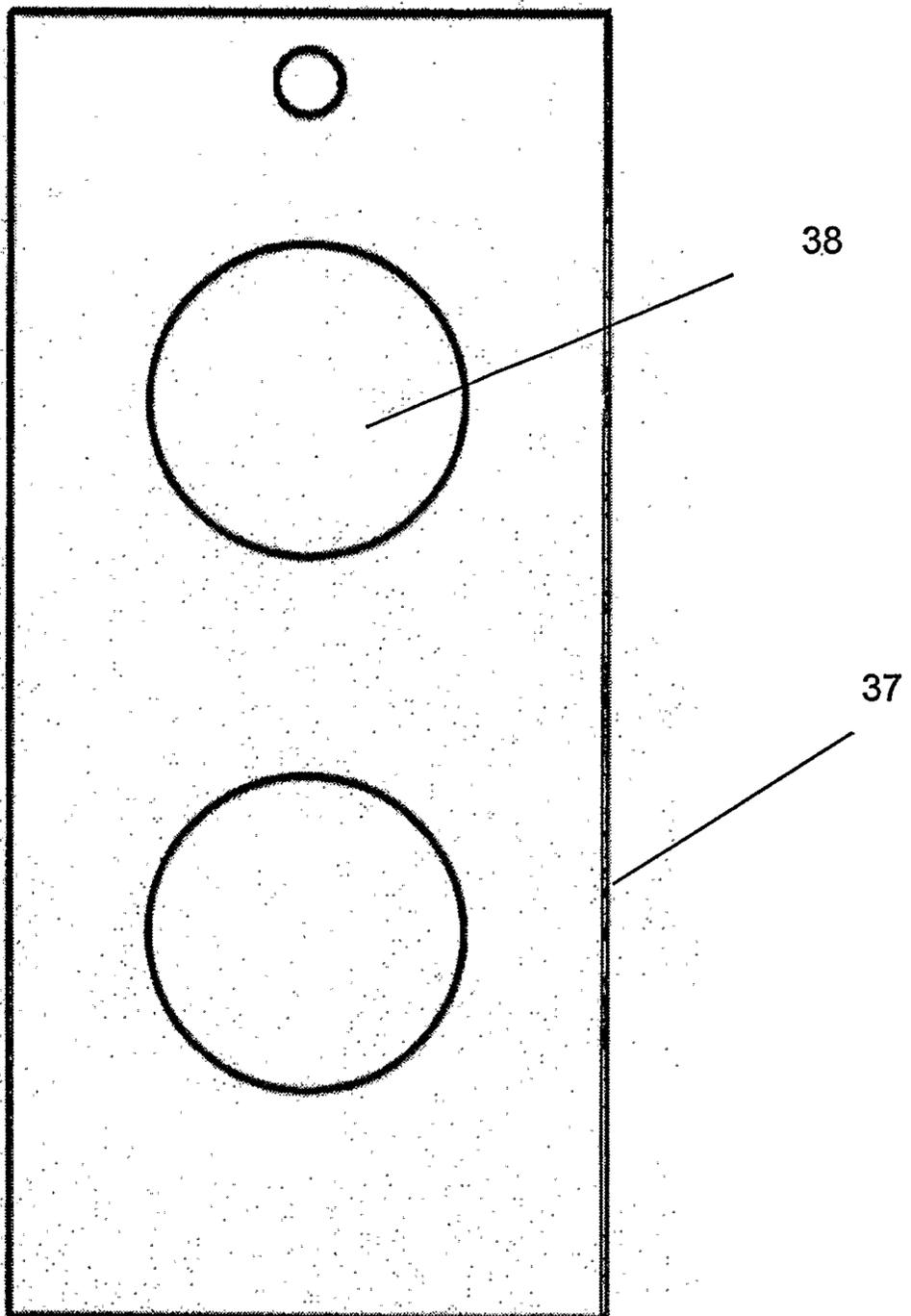


FIGURE 8

