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(54) Title: ROAD BARRIER SYSTEM, POST AND BRACKET FOR SUCH A BARRIER SYSTEM

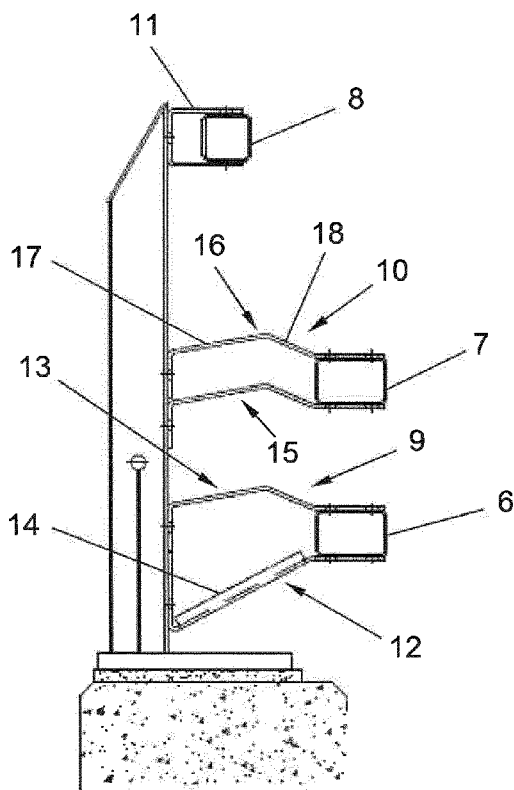


Fig.1B

(57) Abstract: The invention relates to a road barrier system, such as a bridge parapet, with a plurality of posts, wherein a post comprises a hollow section secured to a base plate, and one or more rails attached to the posts, wherein one or more of the posts are provided with a weakened zone in the hollow section to enable deformation of the post in a predetermined way on impact of an errant vehicle.



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SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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— with international search report (*Art. 21(3)*)

Field of the invention

The invention relates to a road barrier system and a post for such a system,
5 more in particular to a bridge parapet system, a post for such bridge parapet designed
to have a limited deflection when an errant vehicle crashes into the barrier system and
a bracket for such post.

Background of the invention

10 The standards for road barrier systems have been increased over the years for
several reasons among which are the increase of traffic and the increase of the weight
of most cars, busses and lorries. Moreover, the road barrier systems that have been
accredited to the safety standards in the past have proven to not always provide the
protection that is expected.

15 When existing road barrier systems need to be replaced because the end of
lifetime is reached, this implies that these in many cases cannot simply be replaced by
the same barrier system again because more severe safety standards apply at present
than when the road barrier systems that have to be replaced were originally installed.

In a significant number of cases, in particular with bridge parapets, there is a
20 space restriction for the installation of the barrier system, requiring the deflection of the
barrier to be limited within certain bounds during an impact with an errant vehicle. This
deflection is known as 'working width' in the safety standard, in other words the space
needed behind the barrier in order for the system to work properly.

With increased safety standards this will mean in most cases that when the old
25 road barrier system has to be replaced by a new more sturdier barrier system that the
new barrier system should not take up more space than the old barrier system. At the
same time the new road barrier system should preferably be designed such that the
mounting points of the previous safety fence can be used without having to make
additional mounting points. Another important point is, especially for bridge parapets,
30 that the deflection of the barrier system with a vehicle crashing into the barrier system
stays within certain limits. This also applies for parts of other barrier systems that are
close to constructions or adjacent pedestrian ways. Moreover, the new road barrier
system, which especially is of importance for bridge parapets, should preferably not
have an increased wind loading compared to that of the old safety fence.

Objectives of the invention

It is an objective of the present invention to provide a road barrier system with a limited deflection of the barrier system when a vehicle crashes into the barrier system.

It is another objective of the present invention to provide a road barrier system in which the posts are designed to deform in a predetermined way on impact of an errant vehicle.

It is another objective of the present invention to provide a road barrier system that is capable of sustaining impact from vehicles within a wide range of size and mass.

It is another objective of the present invention to provide a road barrier system that minimises the severity of impact for the errant vehicle, and thus reduce the risk of injury to the vehicle's occupants.

Description of the invention

The invention relates to a barrier system as defined in claims 1-13, a post for a barrier system as defined in claims 14-15 and a bracket for a post for a barrier system as defined in claims 16-18.

According to a first aspect a barrier system is provided with a plurality of posts, wherein a post comprises a section secured to a base plate, and one or more rails attached to the posts and wherein one or more of the posts are provided with a weakened zone in the section to enable deformation in a predetermined way.

A post for a barrier system with a weakened zone is disclosed in EP2305890, wherein the post has a strong direction with high mechanical strength and a weak direction, with the strong direction oriented perpendicular to the rail.

Typically a post for a barrier system yields at the base of the post on impact of an errant vehicle into the barrier system which, especially with vehicles of larger size and mass, results in that the post will deflect in a direction transverse to the rail of the barrier system to outside the working width. With a weakened zone according to the invention the post is provided with an extra hinge point which allows the post to hinge at the connection with the base plate and higher up along the post in the weakened zone. The result is that on impact is that the post hinges at the base plate and higher up in the weakened zone in opposite directions. It will also allow the post to absorb higher levels of energy while remaining within the required working width.

According to a further aspect it is provided that the weakened zone comprises at least one slot in the length direction of the hollow section. A weakened zone could be made in various ways, for example by providing a zone with reduced wall thickness,

such as a groove. The easiest manner to provide a zone with reduced wall thickness is to provide a cut through the wall of the post. Throughout the description and claims the term "slot" will be used which will mean that a strip of a certain width and length has been removed from the section, that a "groove" has been made in the section which does not extend through the entire thickness of the section, and that a "cut" and or "slot" in the section has been made in the section which extends through the entire thickness of the section. With "in the length direction of the section" comprises all directions within a certain range around parallel to the length direction, wherein the range is up to and including 20° on both sides of the parallel direction.

The width of a slot is in a range from the width of a laser cut to a width of 50mm, preferably up to a width of 25mm. A larger width of the slot would require two cuts which can be parallel or at an angle to each other. Of course it is also possible to construct a post with a slot where opposite parts of the slot butt against each other, a slot with zero width, but that is not very practical.

Preferably it is provided that the weakened zone comprises two slots in the length direction of the hollow section opposite to each other. These slots are made at opposite sides of the post such that the post can deform in a direction transverse to the rails. With a rectangular section the slots are made in the sides directly connecting to the front side of the post to which the rails are attached.

Another way of providing such a slot would be to make a hollow section by welding together two channel sections, flange to flange. In this example the slot is a discontinuity in the weld.

The slots extend over a certain length and height of the post. At the lower side the slot extends preferably to the lower end of the post where it is secured to the base plate. The hollow section is secured to the base plate for instance by means of welding. With a slot extending to the lower end of the hollow section, the slot provides a crack stopping mechanism at the joint between the hollow section of the post and the base plate. This crack stopping behaviour reduces the likelihood of the hollow section of the post detaching from the base plate upon impact of an errant vehicle.

According to a further aspect a slot ends in a hole at the upper end of the slot. This hole provides for an optimisation of the post yielding sequence on impact and acts as a stress reliever and prevents unwanted splitting of the post.

The hole can have various shapes but most practical is to provide a circular hole. The diameter or else the largest size of such a hole can be up to 75mm, for a 100mm wide post, with the smallest size being larger than the width of the slot. In practice a hole with a diameter in the range of 6-50mm, preferably 12-40mm will be sufficient.

According to a further aspect the section is a hollow section. Although an open section would work, such an open section would work less efficient since an open section could collapse in a non-preferred fashion for instance by rotation.

According to a further aspect the barrier system comprises a rail positioned
5 above the upper end of the slot. The wording "above the upper end of the slot" either means above the upper end of the slot or above the hole at the upper end of the slot whichever applies. When a vehicle impacts the rail the post absorbs crash energy by yielding and buckling at two predetermined heights, that is at or near the base plate and at or near the end of the slot. The configuration with the slot and hole provided in
10 the post and with the rail mounted above the slot allows the upper portion of the post to remain substantially upright after deformation of the post, which reduces the total system deflection.

According to a further aspect the barrier system comprises a first and a second rail attached to the posts with at least the second rail positioned above the upper end
15 of the slot. With this configuration the first rail is preferably below the upper end of the slot. The first rail is positioned such that an errant vehicle will hit the rail at wheel level and because that is between the base plate and the hole at the upper end of the slot this part of the post allows for the largest deflection. With the second rail above the hole at the upper end of the slot the part of the post above the hole will remain pretty
20 much in an upright position or with minimal deflection.

According to a further aspect it is provided that at least one of the rails is attached to a post by means of a deformable bracket. With a deformable bracket part of the impact energy is absorbed by the bracket by yielding and buckling of the bracket resulting in that less of the impact energy has to be absorbed by the post.

25 According to a further aspect it is provided that the first rail is attached to a post by means of a bracket designed to move the first rail on deformation upward in direction of the post. The advantage of this feature is that it has a tendency to provide better control of the vehicle during the impact, such as vaulting the barrier or bridge parapet as the case may be.

30 According to a particular embodiment it is provided that the bracket of the first rail is provided with a lower arm and an upper arm, wherein the lower arm extends from the post below the position of the first rail to the rail and is provided with a non-yielding part between end parts of the lower arm. The non-yielding part of the lower arm will not buckle on impact whereas the end parts with which the lower arm
35 connects to respectively the post and the first rail will be deformed therewith rotating the first rail upward and in the direction of the post.

This can be realized for instance by providing that the lower arm of the bracket comprises a strip provided with flanges over part of the length of the strip as the non-yielding part of the lower arm. The end parts of the strip are free of such flanges or swages. Instead of a strip with flanges, a channel or box section, or a swaged section
5 could be used with strip lugs as the end parts.

It is further provided that the upper arm of the bracket comprises a pre-bent strip, designed to absorb part of the impact energy. By varying the various parameters of the lower arm and the upper arm of the bracket, the bracket can be tuned for absorbing a specific range of impact energy.

10 According to a further aspect it is provided that the second rail is attached to the post with a deformable bracket. According to a further elaboration this is a pre-bent bracket with at least one pre-bent arm extending from the rail to the post. The bend in the arm or arms determines in which direction the pre-bent arm will be displaced on impact of an errand vehicle. With the first rail rotating in upward direction on impact the
15 bend in the bracket of the second rail is preferably applied such that part of the displacement of the pre-bent arm is also in upward direction.

According to a further aspect the barrier system is provided with a third rail attached to the barrier post above the second rail. This third rail can be attached directly to the posts or with a short U-bracket extending over a limited distance from
20 the post. The bracket of the third rail is not designed to take up a substantial part of the impact energy as the first and second rail do and serves to protect pedestrians and/or to prevent a tall vehicle like a coach vault the barrier system. Moreover, the third rail contributes in keeping the part of the post above the slot and hole in a substantially vertical position, which because of the direct or almost direct mounting against the post
25 is a substantial contribution.

According to a further aspect the top of the barrier post is chamfered wherein the chamfer inclines from top down to the side of the post opposite to the side of the post to which the rails are attached. The chamfer helps to minimize the deflection in as far as the part of the post deflects from the vertical.

30 Further a post is provided for a road barrier system with one or more rails, comprising a section secured to a base plate wherein the section is provided with a weakened zone to enable deformation in a predetermined way, wherein the section is a hollow section and wherein the weakened zone comprises two slots in the length direction of the hollow section opposite to each other and wherein a slot ends in a hole
35 at the upper end of the slot. The opposite slots are at the sides of the post turned away

from the road such that deformation of the post is in a direction at about a right angle to the length direction of the road.

According to a further aspect the post is provided with a first and a second bracket for a first and a second with the bracket for the first rail below the upper end of the slot and with the bracket for the second rail positioned above the upper end of the slot.

According to still another aspect a bracket is provided for the post, wherein the bracket comprises a mounting portion to mount the bracket to a post, a lower arm and an upper arm, wherein the lower arm extends from the mounting portion in upward direction when mounted to the post and wherein the lower arm is provided with a non-yielding part between end parts of the lower arm.

The non-yielding part of the lower arm of the bracket could for example comprise a strip provided with flanges over part of the length of the strip as the non-yielding part of the lower arm.

Brief description of the drawings

The invention will be further explained by means of the example shown in the drawing, in which:

fig.1A shows a post for a barrier system without rails,

fig.1B shows a post for a barrier system with brackets and rails, and

fig.2A,B,C shows successive stages in deformation of a post for a barrier system.

Detailed description of the drawings

In fig.1A a post 1 for a barrier system is shown before attachment of rails and brackets. The post 1 is secured to a base plate 2 and the base plate 2 is mounted to a structure 3 for instance to a bridge structure. The post 1 is a hollow rectangular section that is welded to the base plate 2. A welded connection proved to be a strong enough connection between the post and base plate for this purpose. The base plate 2 is preferably mounted to the structure with bolts, preferably with high performance mounting bolts.

The post 1 is provided with a slot 4 which runs from the base plate 2 to a hole 5 in the side of the post 1. On the opposite side the post 1 is provided with a slot and a hole in a corresponding position and of the same size. The holes 5 on opposite sides provide hinge points around which the post will yield when the barrier is hit by an errant vehicle. The holes 5 will relieve at least part of the stress in the post on deformation therewith preventing the splitting of the post 1.

Fig.1B shows post 1 provided with rails 6, 7 and 8 which are mounted by means of brackets 9, 10 and 11 to the post 1. The brackets 9, 10 keep the first and second rails 6 and 7 at a distance from the post 1 which is considerable larger than the distance between the upper rail 8 and the post. Bracket 9 has a lower arm 12 and an upper arm 13, wherein the lower arm 12 is provided with a non-yielding part 14 between end parts of the lower arm 12 and wherein the upper arm 13 is pre-bent. The angle between the lower arm 12 and the post 1 is an acute angle with the lower arm 12 extending upward from the post. On deformation of the bracket the non-yielding part 14 of lower arm 12 will rotate around the mounting point of the lower arm to the post 1 in upward direction to the post 1. The upper arm 13 of bracket 9 is pre-bent in order to deform when a pre-determined stress is exceeded. The bend in the upper arm is such that the arm will give way in upward direction.

The bracket 10 of the second rail 7 has a lower arm 15 and an upper arm 16 which are both pre-bent also in order to deform when a pre-determined stress is exceeded. Both the lower and upper arm 15, 16 are pre-bent such that on deformation the bend in the lower and upper arm 15, 16 move upward. This prevents that the rotation of bracket 9 with first rail 6 is obstructed on simultaneous deformation or about simultaneous deformation of bracket 9 and bracket 10. To realize that the first part 17 of upper arm 16 encloses an acute angle with post 1 with the first part 17 extending in upward direction. The second part 18 of the arm 16 is at an angle with the first part 17 of the arm 16 which is less than 180° from this side view. Moreover, the length of the first part 17 is at least equal to that of the second part 18 but preferably longer. The upper and lower arm 15, 16 are parallel or about parallel to each other. In this example the upper arm 13 of bracket 9 is the same or about the same as those of bracket 10.

It is further provided that the dimensions of the brackets 9, 10 and the mounting distance between these brackets allow a free rotation of the non-yielding part 14 of lower arm 12 around the mounting point of the lower arm to the post 1. The bracket 10 with the second rail 7 are mounted above the hole 5 above the end of the slot.

The brackets 9,10 are mounted against the post 1 through mounting portions between the respective lower and upper arms.

The upper rail 8 is mounted with a U-bracket 11 and is close to the post 1.

In fig.2A,B and C successive stages in deformation of a post for a barrier system are shown. The brackets and rails are not shown in the drawing to aid visualisation. In fig.2A the post 1 is shown without any deformation, in fig.2A an example of a deformation stage during impact of a vehicle and in Fig.2C an example of a final

deformation stage of the post. The arrow 19 represents an impacting vehicle in the drawing.

The post 1 in Fig.2B has started to yield at the base plate 2 and at the level of hole 5 in the post, indicated with arrows 20. At the same time the slot 4 and hole 5
5 allow shearing as indicated with arrows 21 along the slot 4. Fig.2C shows a final deformation stage wherein the yield and shear as indicated in fig.2B with arrows 20 and 21 have increased considerably. As a result of that the lower part 22 of the post up to the hole 5 has been deformed such that it deflects over a far larger angle from the upright position than the upper part 23 of the post. The difference is such that the
10 upper part of the post only deviates over only a small angle with respect to the original upright position.

The post is provided with a chamfer 24 which further reduces the actual working width after deformation.

CLAIMS

1. Barrier system with a plurality of posts, wherein a post comprises a section
secured to a base plate, and one or more rails attached to the posts and wherein
5 one or more of the posts are provided with a weakened zone in the section to
enable deformation in a predetermined way, characterised in that the weakened
zone comprises at least one slot in the length direction of the section and
wherein the system comprises a first and a second rail attached to the posts with
the first rail below the upper end of the slot and with the second rail positioned
10 above the upper end of the slot.
2. Barrier system according to claim 1, wherein the weakened zone comprises two
slots in the length direction of the section opposite to each other.
- 15 3. Barrier system according to claim 1 or 2, wherein a slot ends in a hole at the
upper end of the slot.
4. Barrier system according to claim 3, wherein the hole is a circular hole.
- 20 5. Barrier system according to one or more of claims 1-3, wherein the section is a
hollow section.
6. Barrier system according to one or more of claims 1-5, wherein at least one of
the rails is attached to a post by means of a deformable bracket.
- 25 7. Barrier system according to claim 6, wherein the first rail is attached to a post by
means of a bracket designed to move the first rail on deformation upward in
direction of the post.
- 30 8. Barrier system according to claim 7, wherein the bracket of the first rail
comprises a lower arm and an upper arm, wherein the lower arm extends from
the post below the position of the first rail to the rail and is provided with a non-
yielding part between end parts of the lower arm.

9. Barrier system according to claim 8, wherein the lower arm of the bracket comprises a strip provided with flanges over part of the length of the strip as the non-yielding part of the lower arm.
- 5 10. Barrier system according to claim 8 or 9, wherein the upper arm of the bracket comprises a pre-bent strip.
11. Barrier system according to one or more of claims 1-10, wherein the second rail is attached to the post with a pre-bent bracket.
- 10 12. Barrier system according to one or more of claims 1-11, wherein the system is provided with a third rail attached to the barrier post above the second rail.
13. Barrier system according to one or more of claims 1-12, wherein the top of each post is chamfered and wherein the chamfer inclines from top down to the side of the post opposite to the side of the post to which the rails are attached.
- 15 14. Post for a road barrier system with one or more rails, comprising a section secured to a base plate wherein the section is provided with a weakened zone to enable deformation in a predetermined way, characterised in that the section is a hollow section and wherein the weakened zone comprises two slots in the length direction of the hollow section opposite to each other and wherein a slot ends in a hole at the upper end of the slot.
- 20 15. Post according to claim 14, wherein the post is provided with a first and a second bracket for a first and a second with the bracket for the first rail below the upper end of the slot and with the bracket for the second rail positioned above the upper end of the slot.
- 25 16. Bracket for a post according to claims 14-15 or a post in the barrier system according to claims 1-13, wherein the bracket comprises a mounting portion to mount the bracket to a post, a lower arm and an upper arm, wherein the lower arm extends from the mounting portion in upward direction when mounted to the post and wherein the lower arm is provided with a non-yielding part between end parts of the lower arm.
- 30 35

17. Bracket according to claim 16, wherein the lower arm of the bracket comprises a strip provided with flanges over part of the length of the strip as the non-yielding part of the lower arm.
- 5 18. Bracket according to claim 16-17, wherein the upper arm of the bracket comprises a pre-bent strip.

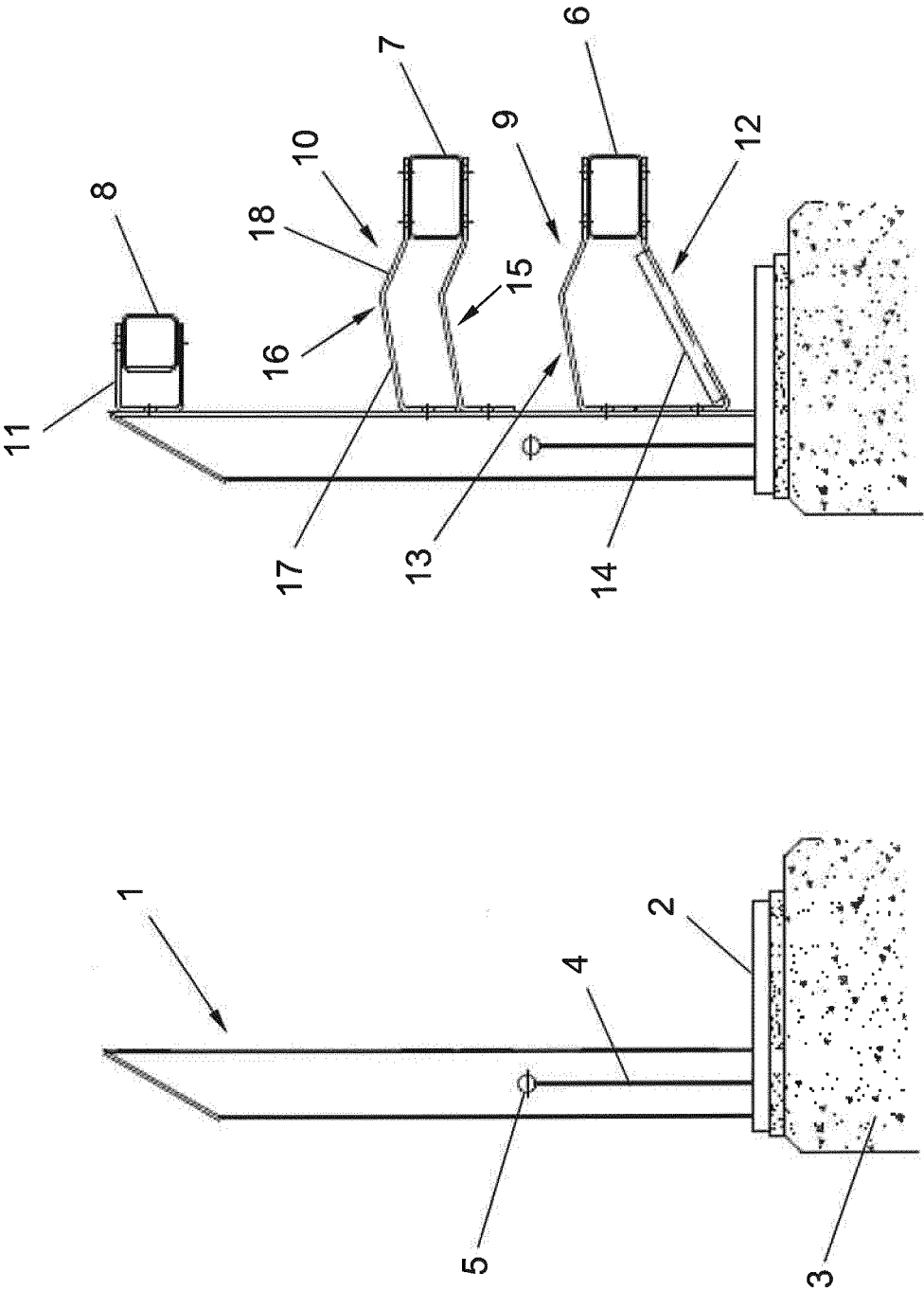


Fig.1A

Fig.1B

Fig.2A

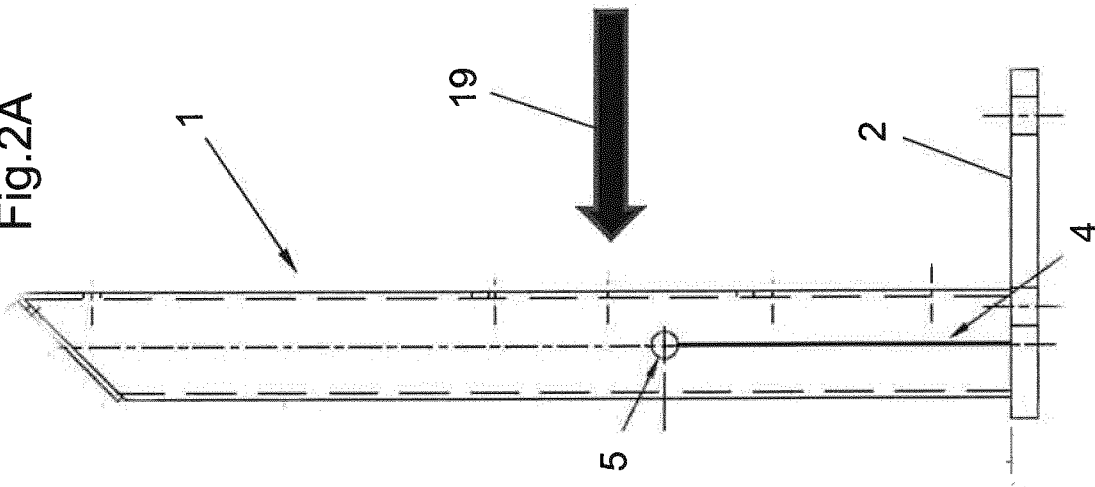


Fig.2B

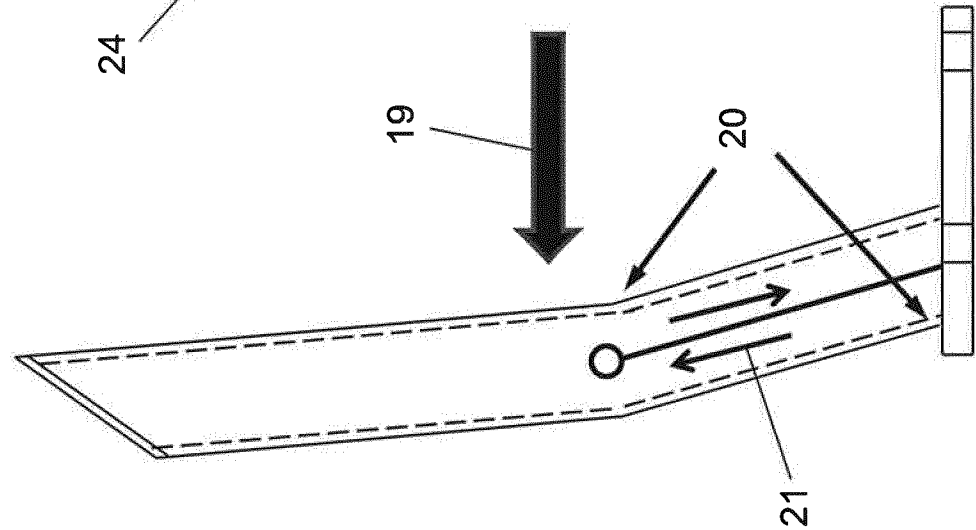
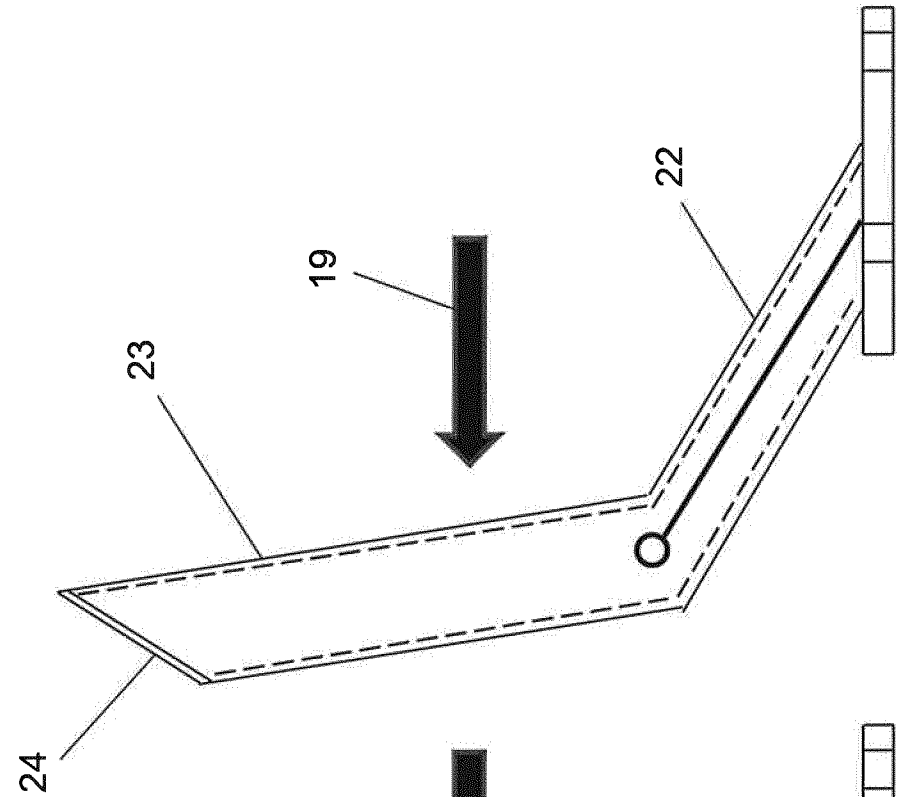


Fig.2C



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/080710

A. CLASSIFICATION OF SUBJECT MATTER
INV. E01F15/04
ADD.

According to International Patent Classification (IPC) or to both 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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ES 1 071 317 U (IND DUERO S A [ES]) 12 February 2010 (2010-02-12)	16-18
A	page 2, lines 34-40 page 5, paragraphs 2,3 figures 1-3	1-15
X	----- EP 2 305 890 A2 (TRINITY IND INC [US]) 6 April 2011 (2011-04-06)	14
A	paragraphs [0001], [0024], [0032], [0045], [0046] pages 7,8	1-13, 15-18
A	----- US 2004/007654 A1 (VEGA PETER [US]) 15 January 2004 (2004-01-15)	1-18
	paragraphs [0005], [0016], [0021], [0022] figures 5,6 ----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

23 January 2017

Date of mailing of the international search report

08/02/2017

Name and mailing address of the ISA/

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Kremsler, Stefan

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/080710

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2 455 546 A1 (VOLKMANN & ROSSBACH GMBH & CO KG [DE]) 23 May 2012 (2012-05-23) paragraphs [0001], [0007], [0021] - [0023] figures 1-3,12,19a-e -----	1-18
A	WO 2013/164097 A1 (TATA STEEL UK LTD [GB]) 7 November 2013 (2013-11-07) the whole document -----	1-18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2016/080710

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-18

Barrier system with 2 rails and posts with weakening slots

1.1. claims: 16-18

Bracket with reinforced lower arm

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/080710

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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