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(54) Title: AN IMPACT PROTECTION DEVICE FOR A VEHICLE AND A METHOD FOR PROVIDING SHOCK PROTECTION FOR A VEHICLE

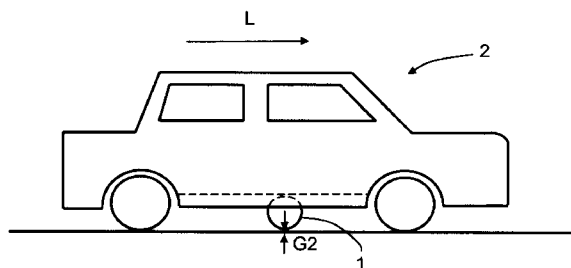


FIG. 2

(57) Abstract: The present invention relates to an expandable beam element (1) arranged for being mounted to a vehicle (2), where the vehicle (2) has a longitudinal extension (L) in its main travelling direction and a normal vehicle ground clearance (G1). The expandable beam element (1) is arranged to be expandable from a first state (S1) to a second state (S2). Furthermore, the expandable beam element (1) is arranged to be mounted to the vehicle (2) such that the normal vehicle ground clearance (G1) is reduced to a reduced vehicle ground clearance (G2) when the mounted expandable beam element (1) expands from the first state (S1) to the second state (S2). The present invention relates to a corresponding vehicle and a corresponding method.



An impact protection device for a vehicle and a method for providing shock protection for a vehicle

Description of the invention

5 The present invention relates to an expandable beam element arranged for being mounted to a vehicle, where the vehicle has a longitudinal extension in its main travelling direction and a normal vehicle ground clearance. The expandable beam element is arranged to be expandable from a first state to a second state.

10

The present invention also relates to a vehicle comprising an expandable beam element, where the vehicle has a longitudinal extension in its main travelling direction and a normal vehicle ground clearance. The expandable beam
15 element is arranged to be expandable from a first state to a second state.

The present invention also relates to a method for providing shock protection for a vehicle, the method
20 comprising the steps of detecting a situation associated with a collision and expanding an expandable beam element from a first state to a second state.

25 Today, vehicles are constructed to comprise a framework that is adapted for handling impact situations; some beams should be collapsible and some beams should be as rigid as possible.

30 In the case of an impact from the side, a vehicle is relatively vulnerable for structural and personal damage. This is especially important in the case of electric and hybride cars which are equipped with large battery packs.

An electric car may for example carry a battery pack with a weight of about 250 kilos. It is therefore of interest to enhance the vehicle side impact protection.

- 5 DE 102008039514 discloses a vehicle structure construction unit where, in the case of an impact, the internal pressure within the structure construction unit is increased such that it is plastically deformed to produce an increased rigidity and/or pressure maintained for increased rigidity.

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However, it is desired that the obtainable rigidity of an expandable beam element for a vehicle is further increased compared to the structure construction unit discussed above.

15

It is an object of the present invention to provide an expandable beam element for a vehicle, the expandable beam element having an obtainable rigidity that is increased in relation to prior solutions.

20

Said object is achieved by means of an expandable beam element arranged for being mounted to a vehicle, where the vehicle has a longitudinal extension in its main travelling direction and a normal vehicle ground clearance. The

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expandable beam element is arranged to be expandable from a first state to a second state. The expandable beam element is furthermore arranged to be mounted to the vehicle such that the normal vehicle ground clearance is reduced to a reduced vehicle ground clearance when the mounted

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expandable beam element expands from the first state to the second state.

Said object is also achieved by means of a vehicle comprising an expandable beam element, where the vehicle has a longitudinal extension in its main travelling direction and a normal vehicle ground clearance. The expandable beam element is arranged to be expandable from a first state to a second state. The expandable beam element is furthermore mounted to the vehicle such that the normal vehicle ground clearance is reduced to a reduced vehicle ground clearance when the mounted expandable beam element expands from the first state to the second state.

In this context, the term vehicle ground clearance should be considered to be constituted by the shortest distance between the lower side of a stationary vehicle and the ground, where the ground is flat. The wheels, which normally are in contact with the ground should not be considered, but only those parts that are positioned between the respective wheel-pairs.

Generally, the expandable beam element may have a main extension that runs in any direction relative the longitudinal extension. According to an example, the vehicle further comprises a first side beam and a second side beam, where the side beams have a respective main extension running along the longitudinal extension. The expandable beam element is here arranged to be mounted between the side beams with a main extension that runs across the longitudinal extension, and thus is essentially perpendicular to the longitudinal extension.

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According to another example, the expandable beam element comprises at least one meandered section that is arranged to de-fold when the mounted expandable beam element expands

from the first state to the second state. The expansion may be driven by a pyrotechnical device.

According to another example, the expanded expandable beam
5 element mainly forms a cylinder which runs between the side beams.

Preferably, the expandable beam element is arranged to expand from the first state to the second state in
10 association with the occurrence of a collision, either before the collision or at the collision.

Said object is also achieved by means of a method for providing shock protection for a vehicle, the method
15 comprising the steps of detecting a situation associated with a collision and expanding an expandable beam element from a first state to a second state. The method further comprises the step of partly using a vehicle normal ground clearance as expansion space, such that the normal vehicle
20 ground clearance is reduced to a reduced vehicle ground clearance when the mounted expandable beam element expands from the first state to the second state.

The present invention enables the expansion to mainly be
25 directed downwards, from the vehicle towards the ground, which means that the expandable beam element normally is mounted outside the vehicle compartment.

This in turn means that there is no interaction with
30 vehicle occupant or vehicle interior when the expandable beam element is expanded

Furthermore, the expandable beam element can be added to the vehicle after the cataphoresis process and can easily be replaced if needed.

5 By means of the present invention the vehicle ground clearance is used at the occurrence of a collision only, not interfering with the normal vehicle ground clearance otherwise. By using the vehicle ground clearance at the occurrence of a collision, the expandable beam element
10 according to the present invention presents an obtainable rigidity that is increased in relation to prior solutions.

It is to be noted, that when the expandable beam element is expanded, the vehicle ground clearance is reduced, but not
15 removed, some vehicle ground clearance remaining. In other words, when the expandable beam element is expanded, it is not intended to contact the ground. The reduced vehicle ground clearance is thus larger than zero. The normal vehicle ground clearance is larger than the reduced vehicle
20 ground clearance.

When the expandable beam element expands, it expands beyond the lower part of the underside of a vehicle, protruding towards the ground.

25

Brief description of the drawings

The present invention will now be described more in detail with reference to the appended drawings, where

30 Figure 1 shows a schematical side view of a vehicle equipped with the expandable beam element according to the present invention in a first state;

Figure 2 shows a schematical side view of a vehicle equipped with the expandable beam element according to the present invention in a second state;

Figure 3 shows a schematical partial bottom view of a vehicle equipped with the expandable beam element according to the present invention in a first state;

Figure 4 shows a schematical partial perspective view of the expandable beam element according to the present invention, without gables, in a first state;

Figure 5 shows a schematical partial perspective view of the expandable beam element according to the present invention, without gables, in a second state;

Figure 6 shows a flowchart for a method according to the present invention; and

Figure 7 shows a schematical partial perspective view of the expandable beam element according to the present invention, with gables, in a first state.

Detailed description

With reference to Figure 1 and Figure 3, an expandable beam element 1 is mounted to the bottom of a vehicle 2. The vehicle 2 has a longitudinal extension L in its main travelling direction and a normal vehicle ground clearance

G1. The normal vehicle ground clearance G1 is constituted by the closest distance between the vehicle 2 and the ground 10 on which it runs for parts that are not in contact with the ground, such as the wheels 11, 12.

5

The general term vehicle ground clearance should thus be considered to be constituted by the shortest distance between the lower side of a stationary vehicle and the ground, where the ground is flat. The wheels, which
10 normally are in contact with the ground, should not be considered, but only those parts that are positioned between the respective wheel-pairs.

Furthermore, the normal vehicle ground clearance G1
15 comprises a distance interval for the vehicle ground clearance during use; the normal vehicle ground clearance G1 may for example change due to the vehicle load and the driving conditions and is not a static measure.

20 The vehicle 2 further comprises a first side beam 3 and a second side beam 4, the side beams 3, 4 having a respective main extension running along the longitudinal extension L. The expandable beam element 1 is mounted between the side beams 3, 4, and has a main extension running across the
25 longitudinal extension L.

With reference to Figure 4, showing the expandable beam element 1 in a first state S1, the expandable beam element 1 has a relatively thin circumferential wall 8 enclosing an
30 inner space 9 where the inner space 9 is arranged to expand when the mounted expandable beam element 1 changes from the first state S1 to a second state S2 as shown in Figure 5.

According to the present invention, the expandable beam element 1 is arranged to be mounted to the vehicle 2 such that the normal vehicle ground clearance G1 is reduced to a reduced vehicle ground clearance G2 when the mounted expandable beam element 1 expands from the first state S1, as shown in Figure 1 and Figure 4, to the second state S2, as shown in Figure 2 and Figure 5.

This means that the reduction of vehicle ground clearance is caused by the expandable beam element 1 expanding from the first state S1 to the second state S2, and in practice the reduced vehicle ground clearance G2 is constituted by a distance between the part of the expanded expandable beam element that is closest to the ground 10, and the ground 10.

As discussed previously regarding the normal vehicle ground clearance G1, the reduced vehicle ground clearance G2 comprises a distance interval for the vehicle ground clearance during use. In accordance with the present invention, the vehicle ground clearance is reduced from a normal vehicle ground clearance G1 to a reduced vehicle ground clearance G2 when the expandable beam element 1 expands from the first state S1 to the second state S2.

25

Thus, by means of the invention, a part of the vehicle ground clearance is used in the moment of impact to expand the expandable beam element 1, such that the forming of a larger and more rigid expanded beam element then disclosed in prior solutions is enabled.

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The expandable beam element 1 may be made in many forms, for example, with reference to Figure 4, the expandable

beam element 1 comprises meandered sections 5, 6 that are arranged to de-fold when the mounted expandable beam element 1 expands from the first state S1 to the second state S2. The number of meandered sections 5, 6 may vary,
5 but according to this example there is at least one.

With reference to Figure 3, in order to enable the expandable beam element 1 to expand properly in the event of an impact, a pyrotechnical device 7 is arranged to
10 provide the pressure necessary for expanding the mounted expandable beam element 1 from the first state S1 to the second state S2. The pyrotechnical device 7 may be mounted in the expandable beam element 1 as shown in Figure 3, or in any suitable other place.

15

With reference to Figure 6, the present invention also relates to a method for providing shock protection for a vehicle, the method comprising the steps:

- 13: detecting a situation associated with a collision;
- 20 14: expanding an expandable beam element 1 from a first state S1 to a second state S2; and
- 15: partly using a vehicle normal ground clearance G1 as expansion space, such that the normal vehicle ground clearance G1 is reduced to a reduced vehicle ground
25 clearance G2 when the mounted expandable beam element 1 expands from the first state S1 to the second state S2.

The present invention is not limited to the examples provided above, but may vary within the scope of the
30 appended claims. For example, the expandable beam element 1 may be made in many ways except the described example with meandered sections, such as having the circumferential wall running in a rectangular shape or in a wavy shape.

Furthermore, with reference to Figure 5, in the second state S1, the circumferential wall 8 may have a mainly circular shape, such that the expanded expandable beam element 1 mainly forms a cylinder which runs between the side beams 3, 4.

In the examples discussed, the expandable beam element 1 may alternatively be mounted such that it has a main extension that runs along the longitudinal extension L, being mounted in a suitable manner (not shown). Generally, the expandable beam element 1 may have a main extension that runs in any direction relative the longitudinal extension L.

15

The expandable beam element 1 is preferably arranged to expand from the first state S1 to the second state S2 in association with the occurrence of a collision, preferably a short time before the actual impact. Any type of suitable pre-collision detection system may be used for providing necessary information regarding an upcoming collision situation.

With reference to Figure 7, the expandable beam element 1 is preferably arranged with gables, a first gable 16 being indicated at one end of the expandable beam element 1. Another corresponding gable is arranged at the other end of the expandable beam element 1 (not shown in Figure 7). Preferably, the gables 16 are arranged to expand with the expandable beam element 1, the gables 16 having a folded configuration and/or flanges 16a, schematically indicated in Figure 7, overlapping a part of the expandable beam

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element 1. The gables 16 are either part of the expandable beam element 1, or formed from separate pieces of material.

5 The pressure in the expandable beam element 1 when expanding is for example in the range of more than 10 bar, depending on design and material. A conventional airbag is normally pressurized with a pressure of about 1 bar.

10 As shown in Figure 3, the expandable beam element 1 may comprise an interior expandable chamber 17, the expandable chamber 17 being arranged to communicate with pressurized air from the pyrotechnical device 7. Such an expandable chamber 17 is preferably made of plastic or fabric. The main advantage using an expandable chamber 17 is that
15 pressure losses in the expandable beam element 1 due to leakage would be reduced.

It is to be noted, that when the expandable beam element 1 is expanded, the vehicle ground clearance is reduced, but
20 not removed, some vehicle ground clearance remaining. In other words, when the expandable beam element 1 is expanded, it is not intended to contact the ground. The reduced vehicle ground clearance G2 is thus larger than zero. The normal vehicle ground clearance G1 is larger than
25 the reduced vehicle ground clearance G2.

CLAIMS

1. An expandable beam element (1) arranged for being
5 mounted to a vehicle (2), the vehicle (2) having a
longitudinal extension (L) in its main travelling direction
and a normal vehicle ground clearance (G1), the expandable
beam element (1) being arranged to be expandable from a
first state (S1) to a second state (S1), **characterized in**
10 that the expandable beam element (1) is arranged to be
mounted to the vehicle (2) such that the normal vehicle
ground clearance (G1) is reduced to a reduced vehicle
ground clearance (G2) when the mounted expandable beam
element (1) expands from the first state (S1) to the second
15 state (S2).

2. An expandable beam element according to claim 1,
characterized in that the vehicle (2) further comprises a
first side beam (3) and a second side beam (4), the side
20 beams (3, 4) having a respective main extension running
along the longitudinal extension (L), the expandable beam
element (1) being arranged to be mounted between the side
beams (3, 4) and having a main extension running across the
longitudinal extension (L).

25

3. An expandable beam element according to any one
of the claims 1 or 2, **characterized in** that the expandable
beam element (1) comprises at least one meandered section
(5, 6) that is arranged to de-fold when the mounted
30 expandable beam element (1) expands from the first state
(S1) to the second state (S2).

4. An expandable beam element according to any one of the previous claims, **characterized in** that the expandable beam element (1) is associated with a pyrotechnical device (7) that is arranged to provide the
5 force necessary for expanding the mounted expandable beam element (1) from the first state (S1) to the second state (S2).

5. An expandable beam element according to any one
10 of the previous claims, **characterized in** that the expandable beam element (1) has a circumferential wall (8) enclosing an inner space (9), the inner space (9) being arranged to expand when the mounted expandable beam element (1) expands from the first state (S1) to the second state
15 (S2).

6. An expandable beam element according to claim 5, **characterized in** that in the second state (S2), the circumferential wall (8) has a mainly circular shape such
20 that the expanded expandable beam element (1) mainly forms a cylinder.

7. An expandable beam element according to any one of the previous claims, **characterized in** that the
25 expandable beam element (1) is arranged to expand from the first state (S1) to the second state (S2) in association with the occurrence of a collision.

8. A vehicle (2) comprising an expandable beam
30 element (1), the vehicle (2) having a longitudinal extension (L) in its main travelling direction and a normal vehicle ground clearance (G1), the expandable beam element (1) being arranged to be expandable from a first state (S1)

to a second state (S1), **characterized in** that the expandable beam element (1) is mounted to the vehicle (2) such that the normal vehicle ground clearance (G1) is reduced to a reduced vehicle ground clearance (G2) when the
5 mounted expandable beam element (1) expands from the first state (S1) to the second state (S2).

9. A vehicle according to claim 8, **characterized in** that that the vehicle (2) further comprises a first side
10 beam (3) and a second side beam (4), the side beams (3, 4) having a respective main extension running along the longitudinal extension (L), the expandable beam element (1) being arranged to be mounted between the side beams (3, 4) and having a main extension running across the longitudinal
15 extension (L).

10. A vehicle according to any one of the claims 8 or 9, **characterized in** that the expandable beam element (1) comprises at least one meandered section (5, 6) that is
20 arranged to de-fold when the mounted expandable beam element (1) expands from the first state (S1) to the second state (S2).

11. A vehicle according to any one of the claims 8-
25 10, **characterized in** that the expandable beam element (1) has a circumferential wall (8) enclosing an inner space (9), the inner space (9) being arranged to expand when the mounted expandable beam element (1) expands from the first state (S1) to the second state (S2).

30

12. A vehicle according to claim 11, **characterized in** that in the second state (S2), the circumferential wall (8)

has a mainly circular shape such that the expanded expandable beam element (1) mainly forms a cylinder.

13. A vehicle according to any one of the claims 8-
5 12, **characterized in** that the expandable beam element (1) is arranged to expand from the first state (S1) to the second state (S2) in association with the occurrence of a collision.

10 14. A method for providing shock protection for a vehicle, the method comprising the steps:

(13) detecting a situation associated with a collision;

(14) expanding an expandable beam element (1)
15 from a first state (S1) to a second state (S2);

characterized in that the method further comprises the step:

(15) partly using a vehicle normal ground clearance (G1) as expansion space, such that the normal
20 vehicle ground clearance (G1) is reduced to a reduced vehicle ground clearance (G2) when the mounted expandable beam element (1) expands from the first state (S1) to the second state (S2).

25 15. A method according to claim 14, **characterized in** that the method further comprises the step of de-folding at least one meandered section (5, 6) when the mounted expandable beam element (1) is expanding from the first state (S1) to the second state (S2).

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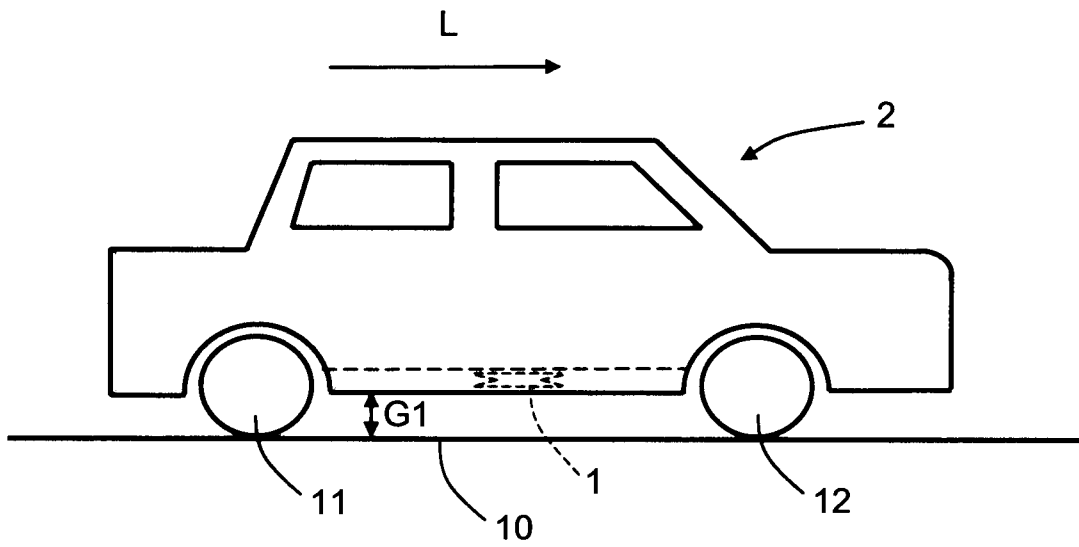


FIG. 1

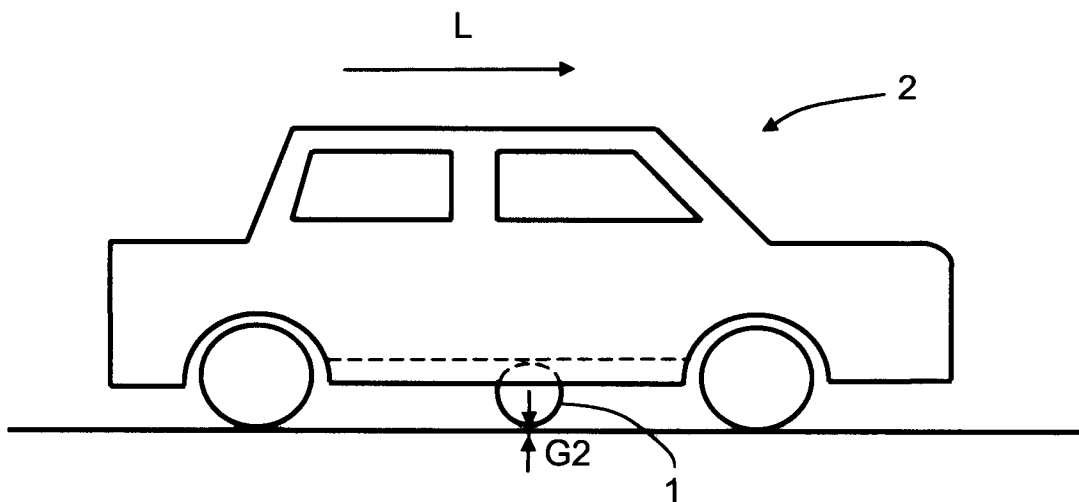


FIG. 2

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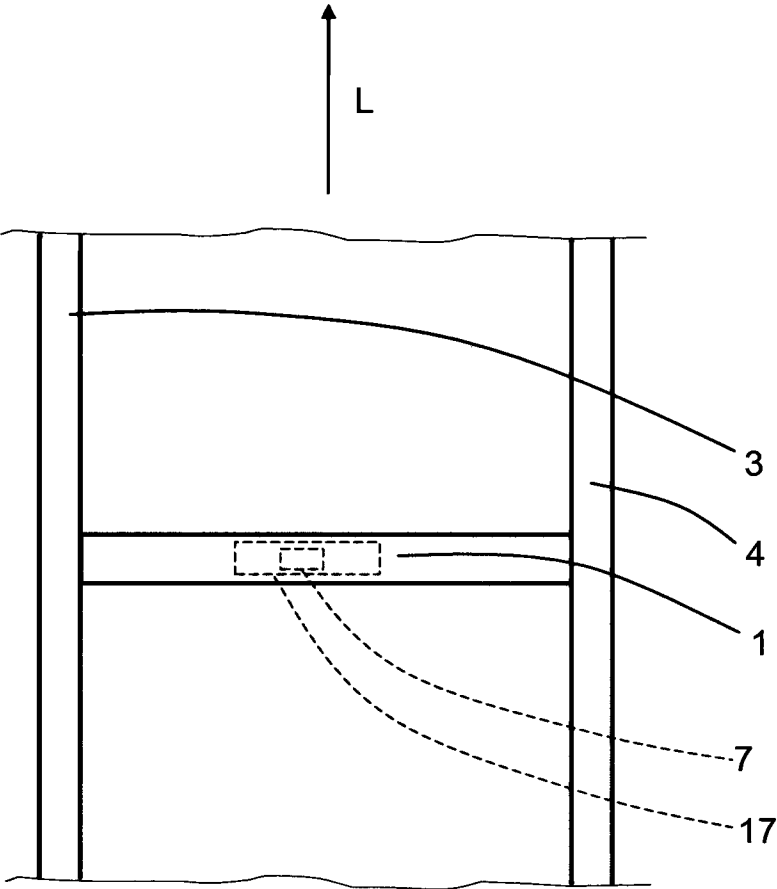


FIG. 3

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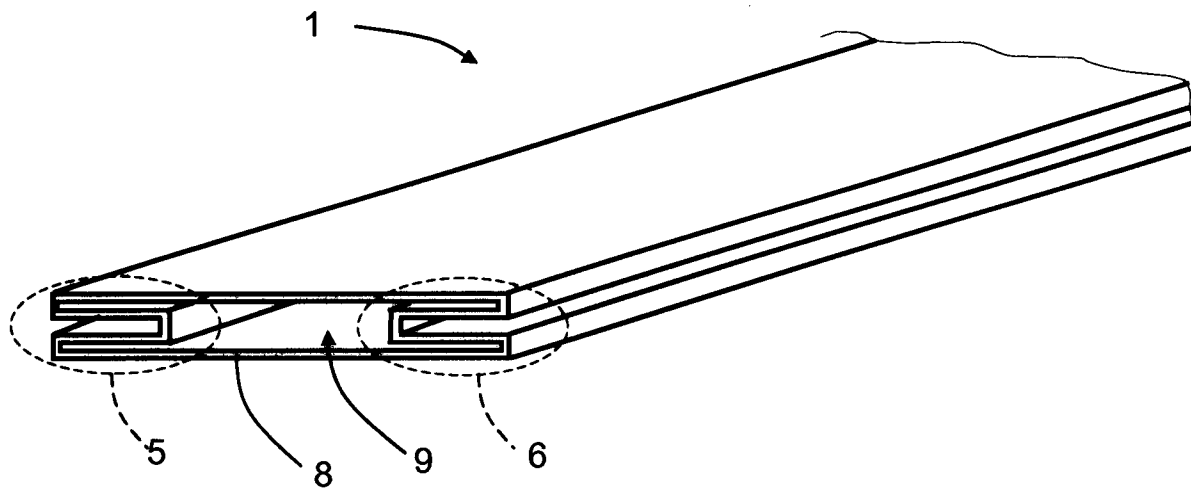


FIG. 4

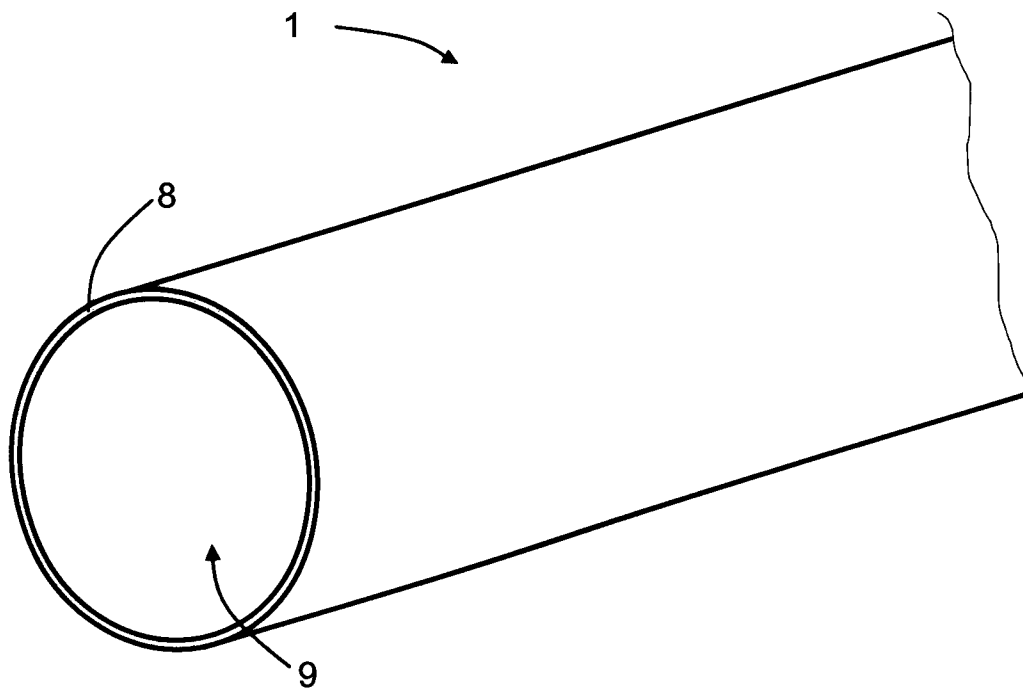
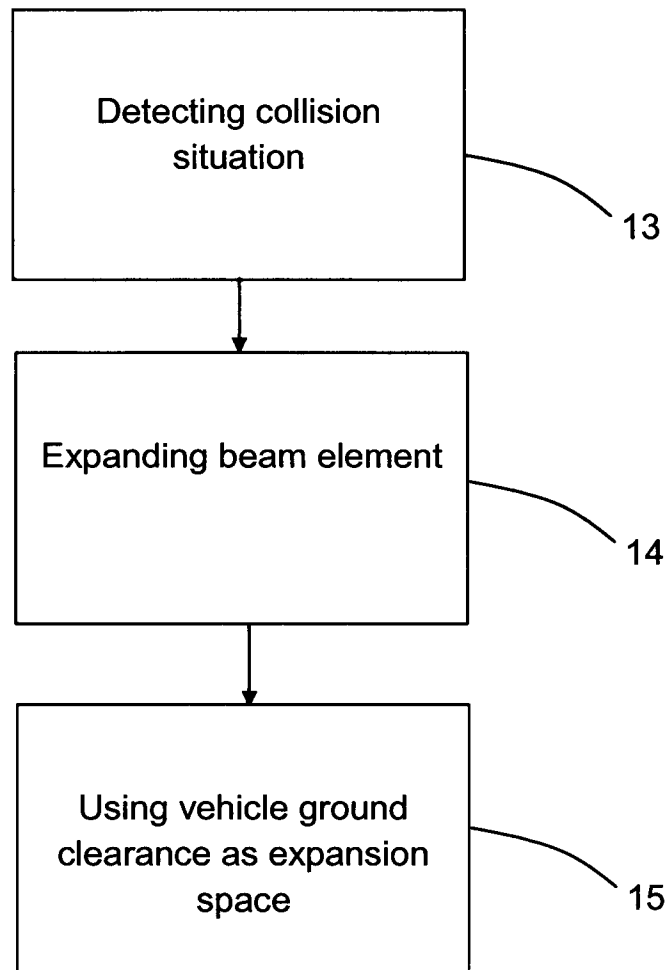


FIG. 5

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FIG. 6

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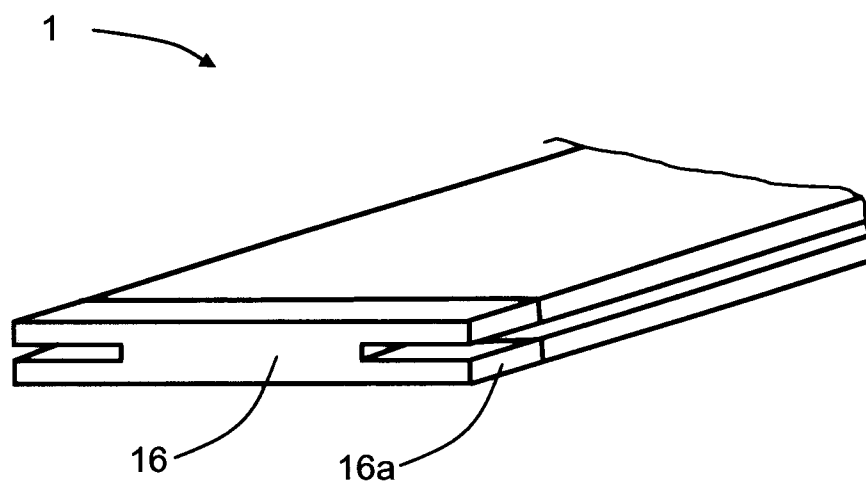


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: B60R, B62D

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

SE, DK, FI, NO classes as above

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 102008039514 A1 (DAIMLER CHRYSLER AG), 25 February 2010 (2010-02-25); whole document --	1-15
A	US 5845937 A (SMITH BRADLEY W), 8 December 1998 (1998-12-08); whole document --	1-15
A	WO 0185527 A1 (ELAION PRODUKTER ET AL), 15 November 2001 (2001-11-15); whole document --	1-15
A	WO 2006120189 A1 (AUTOLIV DEV ET AL), 16 November 2006 (2006-11-16) --	1-15



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Date of the actual completion of the international search

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01-02-2012

Name and mailing address of the ISA/SE

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/000086

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006036184 A (HINO MOTORS LTD), 9 February 2006 (2006-02-09); (abstract) Retrieved from: PAJ database; Original document: whole document --	1-15
A	DE 10316847 A1 (PORSCHE AG), 11 November 2004 (2004-11-11); whole document -- -----	1-15

Continuation of: second sheet

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

International application No.
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