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(54) Title: IMPACT BEAM AND A METHOD FOR MAKING SAME

(57) Abstract: Impact beam 3", in particular a bumper beam for a vehicle and a method for making such a beam. At least a part of the bumper beam 3" has a cross-section where at least one part of the back wall is slanted or curved with regard to its vertical extension. Improved offset crash properties with regard to an offset obstruction 1" before a predefined deformation limit 6' is exceeded.

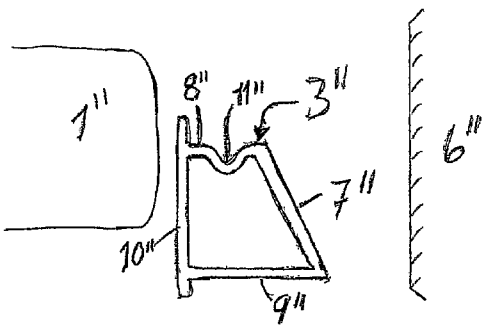


Fig. 3a

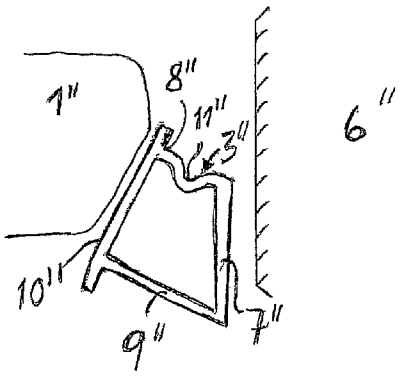


Fig. 3b

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Impact beam and a method for making same

The present invention relates to an impact beam system. In particular the invention relates to an impact beam, such as a bumper, for a vehicle. Further, the invention relates to a method for making an impact beam.

The ability of an impact member to absorb energy will normally be dependent upon many issues. Among these, important physical parameters are the global and local shape of the impact member including its mounting to the vehicle, versus the direction and the location of the load to be absorbed. Many modern vehicles tend to become more and more compact, with less absorbing space available. Even low speed frontal crashes could be very costly to repair, due to the compact arrangement of radiator, AC-cooler, automatic transmission cooler, and other vulnerable components arranged in exposed areas of a vehicle, in particular the frontal part.

Due to certain consumer oriented regulations in some markets, there are defined certain standards regarding low speed crashes and how much damage that should be accepted in such situations.

Recently, it has been put focus on the situation when a crash occurs with a vertical offset hit, i.e. the corresponding impact beams or the similar of two vehicles are located at different vertical levels during the crash. The damages caused to the vehicle(-s) in these types of crash situations could be very expensive to repair, even when occurred at low speed. Further, the introduction and popularity of SUVs (Sport Utility Vehicles) has increased the frequency of offset crashes substantially.

In the prior art, there are known solutions that relates to improving the ability to absorb collision energy at a reasonable package size of the bumper system.

For instance, US 7,066,525 discloses a bumper beam with a "Wishbone Beam" design, which allows bumper contact with an impactor as early as possible in the impact "event". The center section of the bumper is curved in a forward direction outward towards the fascia. This solution relates to less package space or depth needed between the rail ends and the fascia in order to absorb the same amount of energy as a typically mounted

bumper profile. However, it is not shown how this system will work in a vertical offset crash situation.

In accordance with the present invention, it can now be possible to absorb more energy in an offset crash situation without destroying components arranged behind said bumper. This feature can be obtained by a bumper beam having a twisted section and/or a slanted inner wall.

The invention shall in the following be further described by examples and Figures where:

Fig. 1a discloses schematically a bumper beam system in accordance with the invention and an obstruction, seen from above,

Fig. 1b discloses three cross sections of the bumper beam as shown in Fig. 1a,

Fig. 1c discloses a cross section A-A through the bumper system and the impactor as shown in Fig. 1a,

Fig. 2a discloses a cross-section of a prior art beam before being deformed in a crash,

Fig. 2b discloses the cross-section of a prior art beam after being deformed in a crash,

Fig. 3a discloses the cross section A'-A' of the beam shown in Fig 1c before a crash,

Fig. 3b discloses the beam in Fig 3a after crash,

Fig. 4a discloses a second embodiment of a beam cross section before a crash,

Fig. 4b discloses the beam in Fig 4a after crash.

Commonly a bumper beam system comprises a beam supported by two crash boxes fixed to a vehicle, for instance to the longitudinals thereof.
An offset impact between such a bumper beam and one obstruction can create the following main deformations;

1) Local collapse of the bumper's cross section
2) Bending of the beam
3) Twisting of the beam

The two latter deformations will in an impact situation be acting rather global in the bumper beam system, and will be main contributors to the fact that the beam can approach vulnerable components in the vehicle.

It should be understood that in the impact there is the relative velocity between the vehicle and the obstruction that represents the crash energy to be handled by the bumper system. Therefore, the invention relates to all situations where the vehicle and/or the obstruction are/is moving.

In Fig. 1a is shown schematically from above a bumper beam system 2 comprising a bumper beam 3 having two crashboxes 4, 5 fixed to it. The crashboxes are at their opposite ends fixed to the vehicle, for instance to the longitudinals thereof. Further, an obstruction 1 is shown. The maximum compression of the bumper system 2 in the vehicle's longitudinal direction until a certain defined deformation limit 6 in the vehicle has been reached, is denoted "b", see Fig. 1c which discloses a cross section view through line A-A of Fig. 1a. .

Fig. 1b discloses various cross sections A'-A', B'-B' and C'-C' of the bumper beam 3 as indicated in Fig. 1a. The bumper beam of Fig. 1a is symmetric with regard to the cut A'-A' at its mid region, thus only cross sections of one semi section has been disclosed here.

Cross section C'-C' indicates that the bumper beam is of a rectangular shape in the region where it is attached to the crash box 5. In cross section B'-B' somewhere between C'-C' and A'-A', the back wall 7 of the beam is somewhat slanted with an angular position and the upper wall 8 is formed with an indentation 11. In this example the indentation is facing towards the interior space of the beam. However, it should be understood that the indentation may also be facing towards the external space of the beam.

The back wall is slanted to a maximum angular position at the mid region of the bumper, i.e. at cross section A'-A'. Further, the cross section has one lower wall 9 and one front

wall 10 with flanges 12, 13. As will be seen in the Fig., the cross section has a substantial trapezoidal shape.

The variation of the cross sections of the beam across its length can be processed in a forming process. The beam can be twisted and the indentation can be pressed inwards by appropriate tooling.

Alternatively, the blank to be processed is represented by a hollow, extruded profile having a rectangular cross section, that is further processed (preferably by compression) to actual shape. In its processed state, the cross section may or may not have an indentation 11 in at least one of its side walls 8. The indentation may be pressed inwards or outwards.

The method for making an impact beam 3 in accordance with the invention may include the following steps; extruding one profile, preferably cutting the profile to appropriate length, thus producing one blank with two ends and a mid region between said two ends, and where the cross section of the blank comprises at least one upper wall, one lower wall, one back wall and one front wall. Further characteristics of the method may involve that at least one of the upper wall or the lower wall is formed in at least one region of the extension of the blank so that the back wall 7 in the finished impact beam has approached the front wall 10 in this part and thus the back wall 7 will be slanted with regard to its vertical extension.

Alternatively, the extruded profile may have a cross section with a preformed, slanted back wall 7 where the profile is subsequently formed at its two end regions to have a cross section suitable to be attached to crashboxes or the similar. Preferably such cross section should be mainly rectangular, but also other geometrical shapes may be relevant.

In Fig. 2a there is shown a cut through of a prior art bumper beam 3' having a mainly rectangular cross section comprising an upper wall 8', a front wall 10', a lower wall 9' and a back wall 7'.

This view is similar to the view of Fig. 1c, but rotated 90 degrees anti clock wise. Similar to that of Fig. 1c there is shown an obstruction 1' and a deformation limit 6' of the vehicle. This is the situation before an impact has taken place.

In Fig. 2c an impact has taken place and the bumper beam 3' has rotated clock wise due to the offset crash. This is due to a global twisting of the bumper beam. As illustrated, the upper corner of the beam facing the deformation limit in the vehicle, has exceeded this limit.

In Fig. 3a there is shown a bumper beam having the cross-section A-A of the bumper beam shown in Fig. 1c where obstruction 1", bumper beam 3" and deformation limit 6" are resting in a non deformed state. The cross-section of the bumper beam 3" is in this example mainly trapezoidal. In addition, the upper wall 8" of the cross section has one indentation 11". The cross section further comprises a front wall 10", a lower wall 9" and a back wall 7".

As seen in Fig. 3b, which is the situation after a crash causing deformations of the bumper beam in Fig. 3a, it is clearly seen that the trapezoidal shape is rotated as a result from the crash. However, due to the slanted wall facing the deformation limit 6", it has taken a position substantially in parallel with the deformation limit, without exceeding this limit.

The cross-sectional bending stiffness in the section 3' is similar to that of section 3" and 3"', based upon the same overall dimensions.

Figure 4a discloses a second embodiment of a preferred bumper beam cross section. The bumper beam 3"' in this embodiment is of a two section type and have one rectangular part and one substantial trapezoidal part that have one wall in common which in fact is an internal dividing wall 11"' of the all over cross section. One side of the trapezoidal part may have an indentation 8"' formed as a concave side wall, while one inner wall facing towards the car is slanted. The cross section further comprises an upper wall 8"', a front wall 10", a lower wall 9" and a back wall 7".

In the Figure, one obstruction 1"' is located in front of the bumper 3"'. The deformation limit is indicated at 6"'.

Figure 4b discloses the situation shown in Fig. 4a after an impact or crash has occurred. As can be seen, the whole cross section is rotated clockwise, and the slanted wall 7"' tends to be in parallel with the deformation limit 6"'. One effect of the dividing wall is that

the beam is divided into two chambers. This type of beams has good structural properties that make them suitable for impacts.

An offset impact between bumper beam and an obstruction creates twisting of the beam due to torsional forces. With traditional rectangular cross-sections of the bumper beam deformation limit is reached early as indicated in Figure 2a-b. In accordance with the present invention, the beam part facing the deformation limit may be pre-defined to a shape following the deformation limit in the final stage of deformation. For instance a trapezoidal shape with a slanted back wall can be applied. However, other appropriate shapes can be applied for this purpose as well.

In accordance with the present invention, the cross-section of the bumper beam may vary along its length (in the transversal direction of the vehicle). For instance, it may have a pronounced trapezoidal cross-section or being similarly pre-twisted at its mid-section. Further, the beam may have reinforcements such as inserts or thicker profile walls at regions where the desired behaviour in an offset crash situation can be achieved.

It should be understood that the hollow profile blank may be initially manufactured (extruded) with a cross sectional shape having a slanted or curved wall and further successively processed to a more pronounced shape at appropriate region(-s).

In the above examples the described offset impact has hit the bumper beam in its upper region causing a twisting deformation of the beam where the upper back corner of the beam has approached the deformation limit. This is typical for a situation where the bumper system belongs to a small vehicle or passenger vehicle, while the obstruction belongs to a utility vehicle. However, if the bumper system was arranged at an utility vehicle and the obstruction was represented by a passenger vehicle or the like, then the twisting of the bumper beam would have been forced the opposite direction and the cross section should in that event have been designed other wise. In stead of having a upwards/forwards slanting back wall of the beam, this should be designed with a backwards/forwards slanted back wall to enhance the possibility of twisting deformation without reaching the deformation limit.

If simulations or other design criterions show that a curved back wall will be the most universal design due to other forces likely to occur in an impact situation, this should be

given weight in the design study of an impact beam in accordance with the invention. For instance, a convex back wall may overcome the uncertainty factor whether an impact is likely to occur above the twist axis (normally the y-axis of the beam) or below this axis.

The way of carrying out the above mentioned types of embodiments would be obvious for the skilled reader, and is therefore not described further in detail here.

In the above examples there are described impact bumper beams. However, it should be understood that the principles of the invention are not limited to impact bumpers, but would be applicable also in other context where off set impacts may occur.

Preferably the impact beam is made out of aluminium or an aluminium alloy.

Claims

1. Impact beam system, in particular a bumper beam system for a vehicle, where the beam (3) approaches one deformation limit (6) due to twisting deformation of the beam following one impact,
characterised in that
at least a part of the bumper beam (3) has a cross-section where at least a part of the back wall (7) is slanted or curved with regard to its vertical extension to compensate for the twisting deformation of the beam (3).

2. Impact beam in accordance with claim 1,
characterised in that
the back wall (7) of the bumper beam (3) is more slanted or curved in the mid region of the beam than at its ends.

3. Impact beam in accordance with claim 1,
characterised in that
said cross-section is provided with a substantial convex wall facing the deformation limit.

4. Impact beam in accordance with claim 1,
characterised in that
the beam is of a hollow section type.

5. Impact beam in accordance with claim 4,
characterised in that
said cross-section of the bumper beam is substantial trapezoidal where one slanted wall represents the back wall (7) and is facing the deformation limit (6).

6. Impact beam in accordance with claim 4,
characterised in that
said cross-section is a multi-chamber section.

7. Impact beam in accordance with claim 4,
characterised in that
said cross section is of a two chamber type.

8. Impact beam in accordance with claim 4,
characterised in that
said cross-section is of a has one rectangular section and one substantial trapezoidal section.

9. Impact beam in accordance with claim 4,
characterised in that
said cross-section is of a three chamber type.

10. Impact beam in accordance with claim 1,
characterised in that
said cross-section is provided with reinforcements such as inserts or thicker profile walls at regions where the desired behaviour in a crash situation can be achieved.

11. Impact beam in accordance with claim 1,
characterised in that
it is made out of aluminium or an aluminium alloy.

12. Impact beam in accordance with claim 1,
characterised in that
it is made out of an extruded profile.

13. A method for making an impact beam (3) including the following steps; extruding one profile, preferably cutting the profile to appropriate length, thus producing one blank with two ends and a mid region between said two ends, and where the cross section of the blank comprises at least one upper wall, one lower wall, one back wall and one front wall,
characterised in that
at least one of the upper wall or the lower wall is formed in at least one region of the extension of the blank so that the angular position of the back wall (7) in the finished impact beam is altered in this part.

14 method in accordance with claim 13,
characterised in that
the blank is formed at its end regions by the use of a mandrel or the similar.

15 A method in accordance with claim 13,
characterised in that
the blank is formed at its mid region by compressing the at least one of the upper wall (8) or the lower wall (9), and is further represented by an indentation (11).

16. A method in accordance with claim 15,
characterised in that
the indentation is facing towards the interior space of the beam (3).

17. A method in accordance with claim 15,
characterised in that
the indentation is facing towards the exterior space of the beam (3).

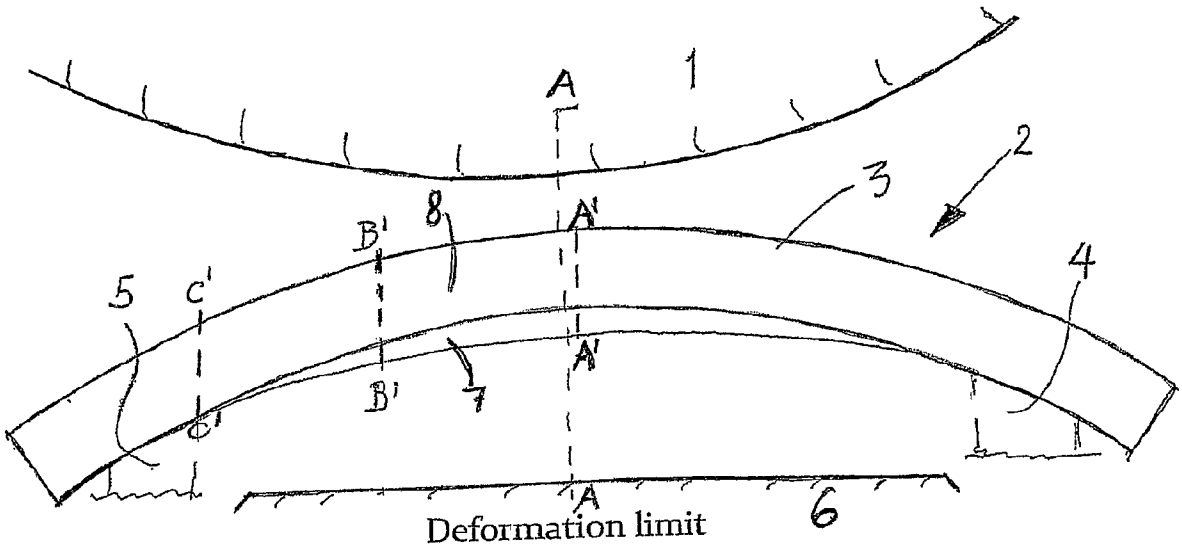


Fig. 1a

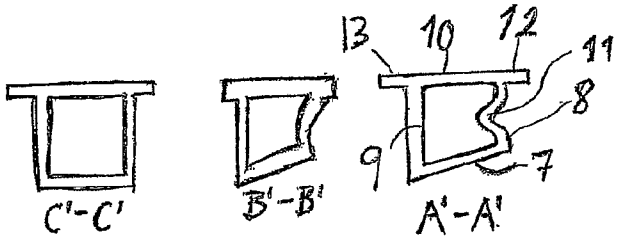


Fig. 1b

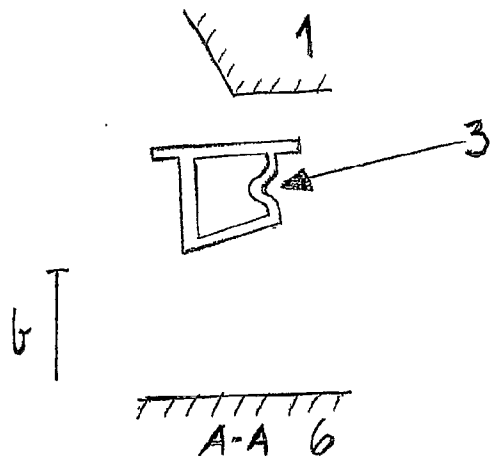


Fig. 1c

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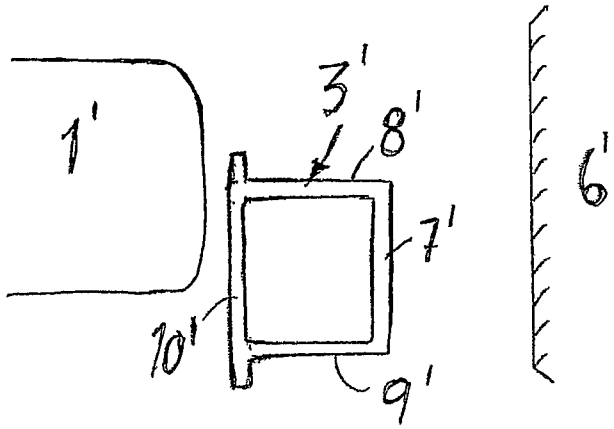


Fig. 2a

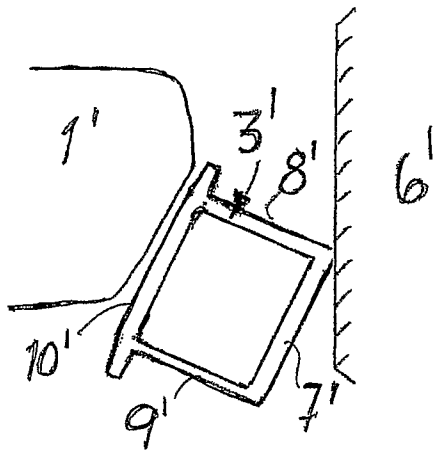


Fig. 2b

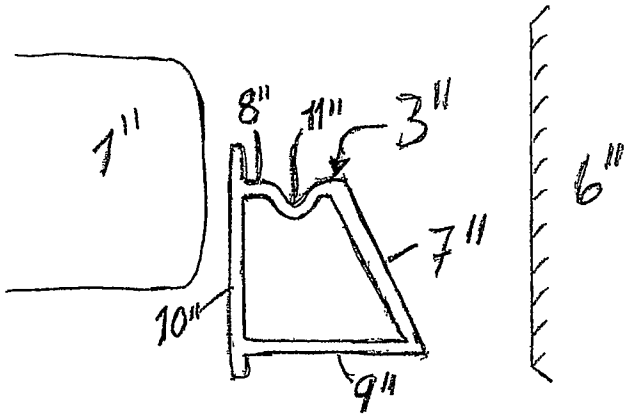


Fig. 3a

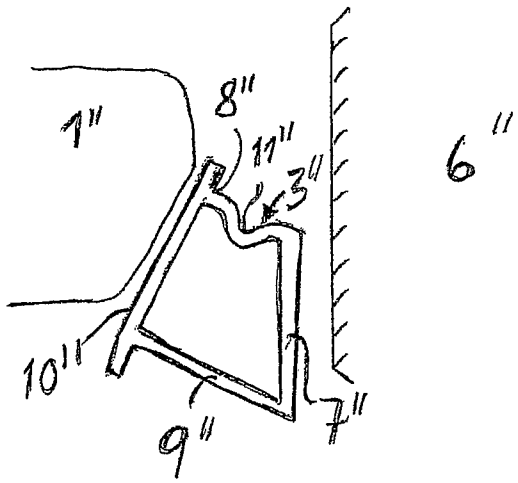


Fig. 3b

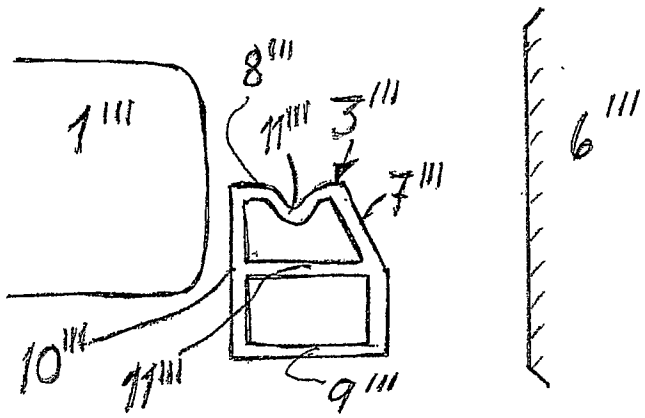


Fig. 4a

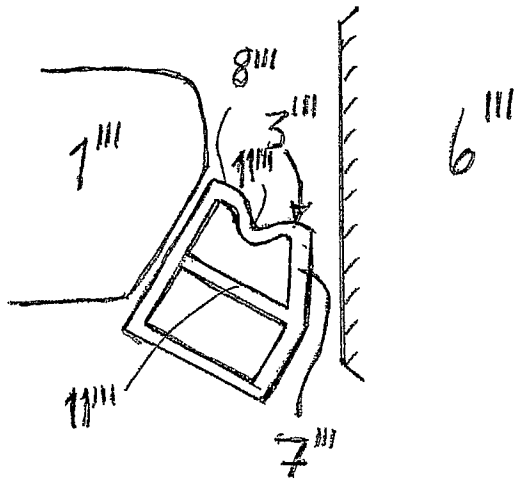


Fig. 4b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2009 000225

A. CLASSIFICATION OF SUBJECT MATTER
B60R 19/02 (2006.01), B60R 19/00 (2006.01)

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)

B60R

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

NO, SE, DK, FI (classes as above)

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

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004/0169380 A1 (JEFF BLADOW, WALTER JÆGER; JEREME FLEEGER) 02 September 2004 (2004-09-02) *the whole document*	1
A	WO 2005/018995 A2 (SHAPE CORPORATION) 03 March 2005 (2005-03-03) *the whole document*	1
A	JP 01022653 A (YAMAGUCHI TAKASHI) 25 January 1989 (1989-01-25) *the whole document*	1

☐ 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

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"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

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"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	Date of mailing of the international search report
20 July 2009	17/08/2009
Name and mailing address of the ISA/ Nordic Patent Institute Helgseshoj Allé 81, DK-2630 Taastrup, DENMARK Facsimile No. +45 43 50 80 08	Authorized officer Nebojsa Markovic Telephone No. +47 22 38 76 22

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NO 2009 000225

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