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(54) **A STRUCTURAL ELEMENT ARRANGED TO FORM AT LEAST A PART OF A SHELL OF A CAR BODY OF A RAILWAY VEHICLE**

EIN STRUKTURELLES ELEMENT DAS ZUMINDEST EINEN TEIL DER HÜLLE DES WAGENKASTENS EINES SCHIENENFAHRZEUGES BILDET

ELEMENT STRUCTUREL CON U POUR FORMER AU MOINS UNE PARTIE DE LA CAISSE D'UNE VOITURE DE CHEMIN DE FER

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Description

TECHNICAL FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a shell according to the preamble of claim 1.

[0002] In conventional manufacturing of a side wall of a car body of a railway vehicle, an external metal sheet which is provided on internal beams in order to increase the stiffness of the metal sheet is used. In order to prevent buckles to occur in the sheet, supporting elements are provided which are connected to the sheet by means of welding. Furthermore, a ventilation layer is provided in connection with the sheet and a thermal insulating layer and finally an internal panel. Such a side wall for a car body is expensive and complicated to manufacture and it has a large thickness, which encroaches on the internal volume of the car body. Furthermore, irregularities easily occur in the sheet as a consequence of internal treatment by, for example, welding during the mounting of said supporting elements to the sheet.

[0003] From DE 38 38 686, EP 544 473 and DE 195 33 532 structural elements are known, which are intended to be used for forming shells of a car body of a railway vehicle. The structural elements in these documents comprise, in addition to the initially mentioned three layers, also reinforcement elements in form of through beams or surrounding beams. Such reinforcement elements have the effect that the structural elements obtain a relatively complicated construction, which increases their manufacturing cost. Such reinforcement beams also increase the weight of the structural elements, which makes its handling more difficult.

[0004] DE 296 08 643 U1 shows a structural element which comprises a portion of a side wall, a roof and a floor of a railway vehicle. The structural element comprises external and internal layers formed by a fibre reinforced plastic material. Said external and internal layers are connected to each other along the edges of the structural element, wherein they enclose an intermediate layer. This structural element comprises longitudinal reinforcement beams at the roof and floor portion of the structural element. Such reinforcement beams lead also in this case to a relatively complicated construction of the structural element. Furthermore, it may be difficult to obtain a completely even and smooth external surface in a fibre reinforced plastic material.

[0005] US 5,784,970 refers to a carriage body frame for rail vehicle, which comprises load-bearing sections in the form of roof struts of aluminium and light-weight composite panels, inserted between the load-bearing sections. The light-weight composite panels consist of a core surrounded by aluminium sheets, which are connected to the core by an adhesive. The light-weight composite panels comprise surrounding connecting sections. The object of this structure is to provide a carriage body frame, which has low weight, high rigidity and good long term

strength properties. The stiffness of the carriage body frame is mainly (not to say nearly fully) provided by the load-bearing sections, not by the light-weight composite panels, which correspond to the structural element in present application. The purpose of the light-weight composite panels is to reduce the weight of the carriage body frame.

[0006] EP 0 375 621 refers to a tiltable hutch container of a road or rail vehicle. The hutch container consists of a floor plate, wall plates and a roof plate. Each plate comprises a core layer surrounded by sheets of aluminium. The plates may be connected to each other by means of an upper profile and a lower profile. Adhesive connections may be used for connecting the plates to the profiles.

[0007] EP 0 354 436 shows a car body of a railway vehicle, which comprises composite panels. The composite panels, comprise a core and surrounding layers, which may be of aluminium. However, the main structural strength (stiffness) of the carbody are provided by framing profiles, whereas the composite panels mainly are used to fill up the space between the framing profiles.

SUMMARY OF THE INVENTION

[0008] The object of the present invention is to provide a shell of the initially mentioned kind, which is inexpensive to manufacture and which has external and internal surfaces of high quality at the same time as it enables a rapid and uncomplicated mounting in the vehicle.

[0009] This object is achieved by a shell as defined in claim 1.

[0010] By such a design, the structural element does not require through beams or surrounding reinforcement beams, wherein the manufacturing of the structural element is considerably simplified. Such a structural element may also be manufactured to a low cost at the same time as it may be made essentially lighter with respect to weight than by prior art technique. Very advantageous is the fact that, the structural element comprises an intermediate layer of a thermal insulating material. Thereby is obtained that no further thermal insulation need to be provided internally in the vehicle. A wall construction may thereby be manufactured essentially thinner than by a conventional construction and encroaches thereby less on the internal volume of the vehicle.

[0011] According to a preferred embodiment of the invention, also the internal layer comprises a metal material. Such a metal material may be steel or aluminium. Preferably, both the external and internal layer comprise sheets of metal which in co-operation with the intermediate layer forms a structural element with such a stiffness that it may constitute a supporting component of a vehicle body. Alternatively only the external layer may comprise a metal material. Thereby, the external layer will be dimensioned so that it will carry the main load of the structural element but it will at the same time be propped and guyed by the remaining layers so that the structural ele-

ment without problem may be used as a supporting component.

[0012] According to preferred embodiment of the invention, said intermediate layer is substantially thicker than said internal and external layers. In order to provide stability to the external and internal layers, the intermediate layer comprises such a stiff material that it supplies stiffness to said structural element. Such a stiff intermediate layer prevents also in an effective way that buckles and deformations occur in the relatively thin external and internal layers. Consequently, such an intermediate layer has two functions, namely to stiffen the external and internal layers as well as to provide thermal insulation.

[0013] According to the invention, said intermediate layer is fixedly connected to the internal and external layers by means of a binder means in the form of an adhesive arranged to work so that said layers are connected over substantially its entire surface. By connecting said layers to each other over substantially the entire surface it is prevented that a local displacement between the layers occurs under load. Thereby, the structural element will constitute a very stable, stiff unit which distributes applied loads substantially over its whole construction. Said adhesive having good adhesive properties. Hereby, the external and internal layers will obtain a very even and fine surface, which has good strength against buckles and deformations.

[0014] According to preferred embodiment of the invention, the external and internal layers of said structural element comprise at least a curved portion. Usually, it is desired that a shell of a vehicle is manufactured with curved portions in order to, for example, decrease the air resistance of the vehicle and to use available loading profile to obtain an aesthetically attractive visual sensation. A structural element according to the present invention, which does not comprise stiffening beams, may in a rather uncomplicated way be manufactured with curved surface portions but may also be performed with a plane surface. Said relatively thin external and internal layers may without problem each be bent to a desired shape individually or during the joining process with the intermediate layer. The intermediate layer may with a suitable choice of material also without problem be manufactured in a desired shape, wherein such a material may be a plastic material. Thereafter, said layers are connected with a suitable adhesive in order to form a structural element, which has desired curved surfaces.

[0015] According to a preferred embodiment of the invention, the structural element comprises fastening devices for equipment in the vehicle. Since the internal layer of the structural element has a flat surface, which also may carry loads, the possibility arises to fasten in the vehicle provided internal equipment in the structural element. For example, fastening channels for seats may be provided in the structural element, such channels may be fastened in the internal layer or provided so that they also extend into the intermediate layer- Further material savings are thereby obtained since there is no need for

supporting elements, for such equipment.

[0016] According to another preferred embodiment of the invention, said structural element forms at least a portion of a side wall or a portion of a roof of a car body of a railway vehicle. The present structural element is very favourable to use in railway vehicles such as in underground railway cars and in railway cars for transportation of people. It is in the first place the side walls of the car body, which are suitable to be comprised by said structural element. By making the walls thinner a greater internal volume for the accommodation of passengers may be obtained. The vehicle car will also be essentially lighter, which fact, i.a., influences the energy consumption in a favourable way. It also favorable to use the present structural element in the roof of the car body, which by this measure obtains a light and uncomplicated construction. To use the structural element in a floor construction of a railway vehicle is also an alternative, which may not be excluded.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In the following, preferred embodiments of the invention are described as examples with reference to the attached drawings, in which:

- Fig 1 shows a plane view of a car body of a railway vehicle comprising a structural element according to the present invention,
 Fig 2 shows schematically a cross sectional view of a structural element according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0018] Fig 1 shows a car body 1 of a railway vehicle, comprising a structural element 2 according to the present invention. The structural element 2 forms at least a part of a side wall of the car body 1 and has openings for windows 3. The structural element 2 may, for example, extend between two door openings 4, of which one door opening 4 is shown in Fig 1. The structural element 2 comprises an external layer 5 of a first piece of material comprising a metal material, an intermediate layer 6 of another second piece of material comprising a thermal insulating material, and an internal layer 7 of a third piece of material. The intermediate layer 6 is arranged to be joined together with the external 5 and the internal 7 layers by means of an adhesive so that the three pieces of material form a structural element 2 in one piece. This structural element 2 is intended to be mounted on the vehicle by means of fastening means, which may be applied to suitable portions of the structural element 2. The fastening means, which may, for example, be rivet joint connections or joint bolt connections, may thereby connect the structural element 2 at the top to the roof of the railway vehicle and at the bottom to a lower frame 9.

Possibly, also fastening means may be applied for connecting the structural element 2 to adjacent side walls.

[0019] Before the mounting of the structural element 2 in the vehicle, fastening devices for internal equipment may be attached to the structural element 2. Such a mounting of, for example, interior details is considerably simpler to perform before the structural element is mounted to the vehicle since a mounting inside the vehicle always leads to a limited mounting space. Equipment, which may be fixed to the structural element 2 internally, is, for example, fastening channels for seats and sound absorbing panels.

[0020] Fig 2 shows schematically a cross sectional view of a structural element 2 according to the present invention. The structural element 2 thus comprises an external layer 5, an intermediate layer 6 and an internal layer 7. Preferably, the external 5 and internal 7 layers consist of metal sheets of, for example, steel or aluminium, which layers essentially supply the supporting properties to the structural element 2. However, it is possible to manufacture the internal 7 layer in other materials such as, for example, fibre reinforced plastic materials. The internal 7 layer may also be performed in a more pliant material, such as plywood, under the condition that the external 5 layer is manufactured in an essentially stiffer material, such as for example, steel. Preferably, the intermediate layer 6 consists of a stiff, thermal insulating material. Such a material may comprise a foam plastic material of PVC, PMI, PEI or PUR. Alternative materials for the intermediate layer 6 are balsa wood and other materials having good thermal insulating properties. Preferably, such thermal insulating materials may be formed in a honey comb structure. The intermediate layer 6, which is substantially thicker than the external 5 and internal 7 layers, is arranged to provide both stiffness and thermal and sound insulating properties to the structural element 2.

[0021] At the edges of the structural element 2, the material of intermediate layer 6 may be in full view or covered by, for example, a plastic material 10, in order to protect the material of the intermediate layer 6 against, for example, damp.

[0022] The present invention is not in any way restricted to the described embodiments but may be varied and modified within the scopes of the claims.

Claims

1. A shell of a carbody of a railway vehicle, comprising a structural element (2) wherein the structural element (2) comprises an external layer (5) comprising a metal material, a stiff intermediate layer (6) arranged to form a thermal insulating layer and an internal layer (7), wherein the stiff intermediate layer (6) is fixedly connected to the external layer (5) and the internal layer (7) by means of an adhesive such that a structural element in one piece is formed,

characterized in that said external layer (5) is of steel, wherein the intermediate layer (6) is fixedly connected to the external layer (5) and the internal layer (7) substantially over its entire surfaces by means of said adhesive such that the structural element constitutes a stable and stiff unit which distributes applied loads substantially over its whole construction, wherein the structural element (2) is arranged to constitute a supporting element of said car body.

2. A shell according to claim 1, **characterised in that** the intermediate layer (6) comprises a stiff foam plastic material.

3. A shell according to claim 2, **characterized in that** the foam plastic material of the stiff intermediate layer (6) is made from polyvinylchloride, polymethacrylic imide, polyether, imide or polyurethane.

4. A shell according to claim 1, **characterized in that** the intermediate layer (6) comprises balsa wood.

5. A shell according to any one of the preceding claims, **characterized in that** said intermediate layer (6) is substantially thicker than said external (5) and internal (7) layers.

6. A shell according to any one of the preceding claims, **characterized in that** said the edges of said intermediate layer (6) are in full view or covered.

7. A shell according to any one of the preceding claims, **characterized in that** the internal layer (7) comprises a metal material.

8. A shell according to any one of the preceding claims 1 to 6, **characterized in that** the internal layer (7) is manufactured in a fibre reinforced plastic material.

9. A shell according to any one of the preceding claims, **characterized in that** the external layer (5) is dimensioned such that it carries the main load of the structural element, whereas the intermediate (6) and internal (7) layers prop and guy the external layer (5).

10. A shell according to any one of the preceding claims, **characterised in that** the external (5) and internal (7) layers of said structural element (2) comprise at least one curved portion.

11. A shell according to any one of preceding claims, **characterized in that** the intermediate layer (6) is manufactured in a shape adapted to the desired curvature.

12. A shell according to any one of the preceding claims, **characterised in that** the structural element (2)

comprises fastening devices for equipment in the vehicle.

13. A shell according to any one of the preceding claims, **characterised in that** the structural element (2) is at least a portion of a side wall of the car body.
14. A shell according to claim 13, **characterized in that** said wall element extends between two door openings.
15. A shell according to any one of the preceding claims 1-12, **characterised in that** the structural element (2) is at least a portion of a roof of the car body.

Patentansprüche

1. Gehäuse eines Wagenkastens eines Schienenfahrzeugs, umfassend ein Strukturelement (2), wobei das Strukturelement (2) eine äußere Schicht (5), die ein Metallmaterial umfasst, eine steife Zwischenschicht (6), die dafür vorgesehen ist, eine wärmeisolierende Schicht zu bilden, sowie eine innere Schicht (7) aufweist, wobei die steife Zwischenschicht (6) durch einen Klebstoff fest mit der äußeren Schicht (5) und der inneren Schicht (7) verbunden ist, so dass ein einteiliges Strukturelement gebildet wird, **dadurch gekennzeichnet, dass** die äußere Schicht (5) aus Stahl besteht, wobei die Zwischenschicht (6) fest mit der äußeren Schicht (5) und der inneren Schicht (7) durch den Klebstoff im Wesentlichen über ihre gesamten Oberflächen so verbunden ist, dass das Strukturelement eine stabile und steife Einheit bildet, die aufgebrachte Lasten im Wesentlichen über ihre gesamte Konstruktion verteilt, wobei das Strukturelement (2) so angeordnet ist, dass es ein stützendes Element des Wagenkastens bildet.
2. Gehäuse nach Anspruch 1, **dadurch gekennzeichnet, dass** die Zwischenschicht (6) ein steifes Schaumkunststoffmaterial umfasst.
3. Gehäuse nach Anspruch 2, **dadurch gekennzeichnet, dass** das Schaumkunststoffmaterial der steifen Zwischenschicht (6) aus Polyvinylchlorid, Polymethacrylimid, Polyetherimid oder Polyurethan hergestellt ist.
4. Gehäuse nach Anspruch 1, **dadurch gekennzeichnet, dass** die Zwischenschicht (6) Balsaholz aufweist.
5. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** die Zwischenschicht (6) wesentlich dicker als die äußere Schicht (5) und die innere Schicht (7) ist.

6. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** die Ränder der Zwischenschicht (6) voll sichtbar oder bedeckt sind.
7. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** die innere Schicht (7) ein Metallmaterial umfasst.
8. Gehäuse nach einem der vorigen Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** die innere Schicht (7) aus einem faserverstärkten Kunststoffmaterial hergestellt ist.
9. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** die äußere Schicht (5) so dimensioniert ist, dass sie die Hauptlast des Strukturelements trägt, während die Zwischenschicht (6) und die innere Schicht (7) die äußere Schicht (5) stützen und halten.
10. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** die äußere Schicht (5) und die innere Schicht (7) des Strukturelements (2) wenigstens einen gekrümmten Abschnitt umfassen.
11. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** die Zwischenschicht (6) in einer Form hergestellt ist, die an die gewünschte Krümmung angepasst ist.
12. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** das Strukturelement (2) Befestigungseinrichtungen für die Ausrüstung in dem Fahrzeug aufweist.
13. Gehäuse nach einem der vorigen Ansprüche, **dadurch gekennzeichnet, dass** das Strukturelement (2) wenigstens ein Abschnitt einer Seitenwand des Wagenkastens ist.
14. Gehäuse nach Anspruch 13, **dadurch gekennzeichnet, dass** sich das Wandelement zwischen zwei Türöffnungen erstreckt.
15. Gehäuse nach einem der vorigen Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** das Strukturelement (2) wenigstens ein Abschnitt eines Dachs des Wagenkastens ist.

Revendications

1. Enveloppe de carrosserie d'un véhicule de chemin de fer, comprenant un élément de structure (2) dans lequel l'élément de structure (2) comprend une couche externe (5) comprenant un matériau métallique, une couche intermédiaire rigide (6) disposée pour

- former une couche d'isolation thermique et une couche interne (7), dans laquelle la couche intermédiaire rigide (6) est raccordée solidement à la couche externe (5) et la couche interne (7) au moyen d'une substance adhésive, de telle sorte que l'élément structurel est formé d'un seul tenant, **caractérisée en ce que** ladite couche externe (5) est en acier, dans laquelle la couche intermédiaire (6) est raccordée solidement à la couche externe (5) et la couche interne (7) sensiblement sur toute ses surfaces au moyen de ladite substance adhésive, de telle sorte que l'élément de structure constitue une unité stable et rigide qui répartit les charges appliquées sensiblement sur toute sa construction, dans laquelle l'élément de structure (2) est agencé de façon à constituer un élément de support de ladite carrosserie.
2. Enveloppe selon la revendication 1, **caractérisée en ce que** la couche intermédiaire (6) comprend un matériau plastique alvéolaire rigide.
 3. Enveloppe selon la revendication 2, **caractérisée en ce que** le matériau plastique alvéolaire de la couche intermédiaire rigide (6) est réalisé à partir de chlorure de polyvinyle, d'imide polyméthacrylique, d'imide de polyéther ou polyuréthane.
 4. Enveloppe selon la revendication 1, **caractérisée en ce que** la couche intermédiaire (6) comprend du bois de balsa.
 5. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** ladite couche intermédiaire (6) est sensiblement plus épaisse que lesdites couches externe (5) et interne (7).
 6. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** lesdits bords de ladite couche intermédiaire (6) sont entièrement à nu ou recouverts.
 7. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la couche interne (7) comprend un matériau métallique.
 8. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la couche interne (7) est fabriquée à partir de matériau de fibre plastique renforcée.
 9. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la couche externe (5) est dimensionnée de telle sorte qu'elle supporte la charge principale de l'élément de structure, tandis que les couches intermédiaire (6) et interne (7) servent d'étais et d'haubans pour la couche externe (5).
 10. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** les couches externe (5) et interne (7) dudit élément de structure (2) comprennent au moins une portion incurvée.
 11. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la couche intermédiaire (6) est fabriquée selon une forme épousant la courbure souhaitée.
 12. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** l'élément de structure (2) comprend des dispositifs de fixation pour les équipements dans le véhicule.
 13. Enveloppe selon l'une quelconque des revendications précédentes, **caractérisée en ce que** l'élément de structure (2) est au moins une portion d'une paroi latérale de la carrosserie.
 14. Enveloppe selon la revendication 13, **caractérisée en ce que** ledit élément de paroi s'étend entre deux ouvertures de portes.
 15. Enveloppe selon l'une quelconque des revendications précédentes 1-12, **caractérisée en ce que** l'élément de structure (2) est au moins une portion d'un toit de la carrosserie du véhicule.

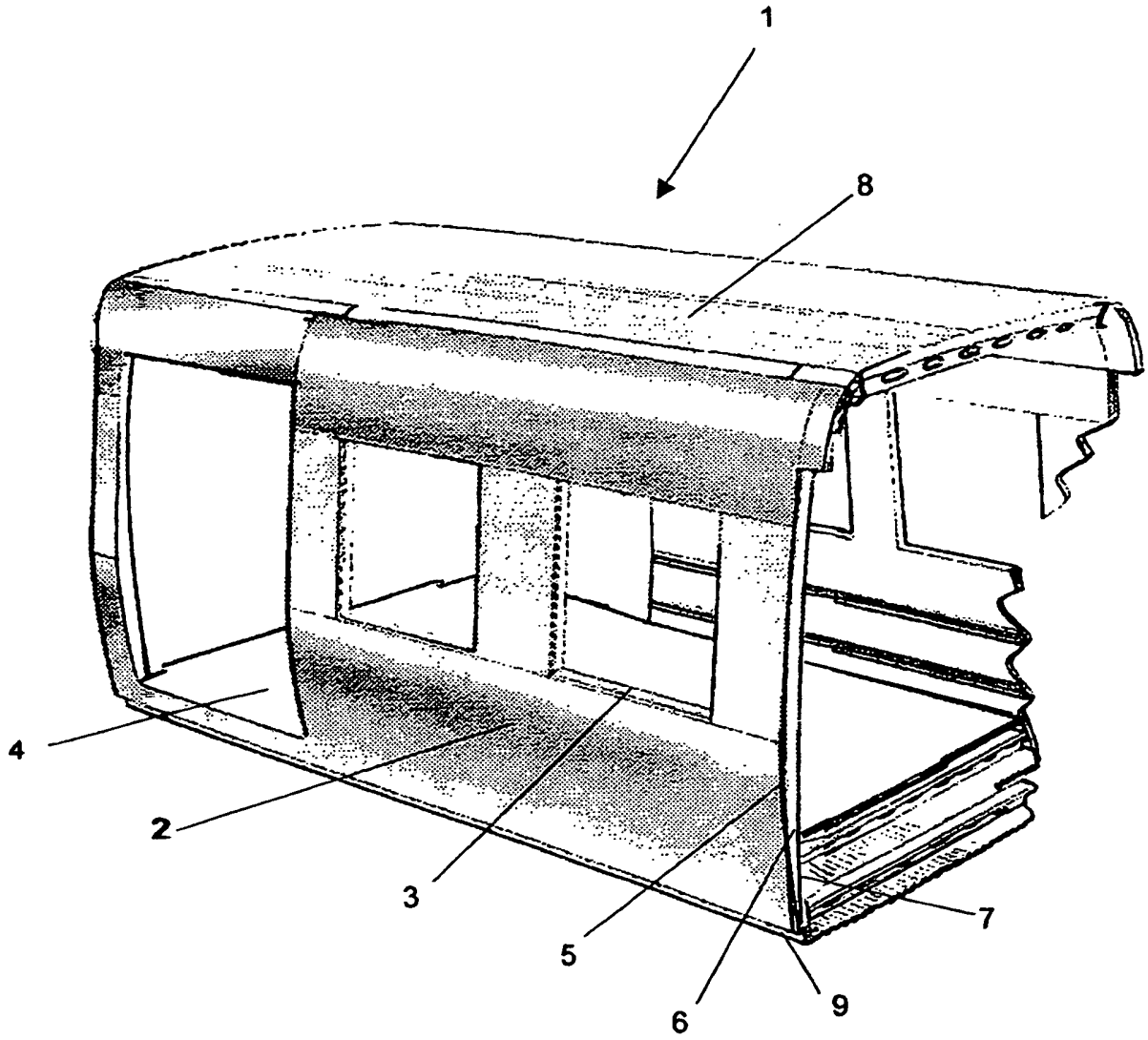


FIG 1

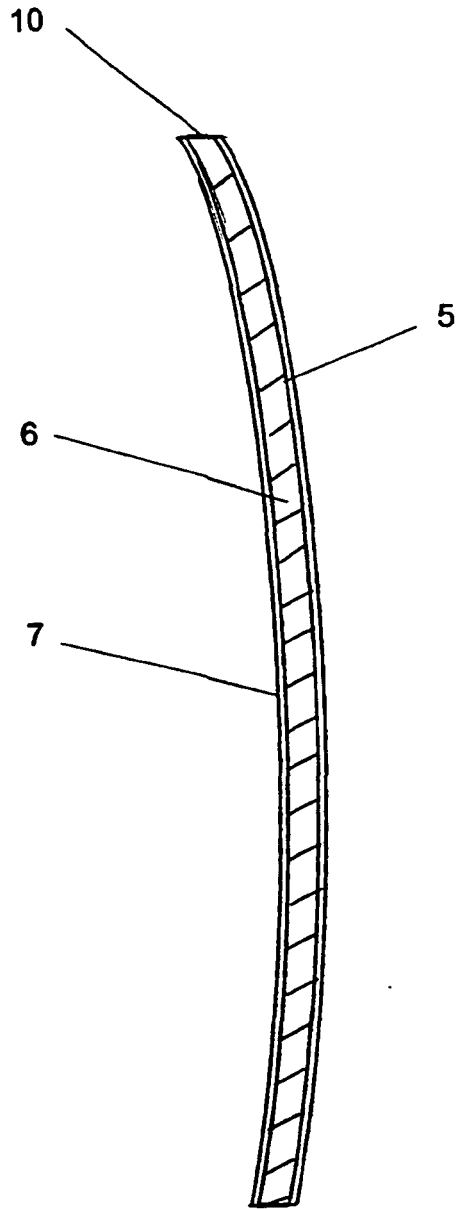


FIG 2