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(54) Title: REINFORCING STRUCTURE COMPRISING A PLURALIT OF BEAMS

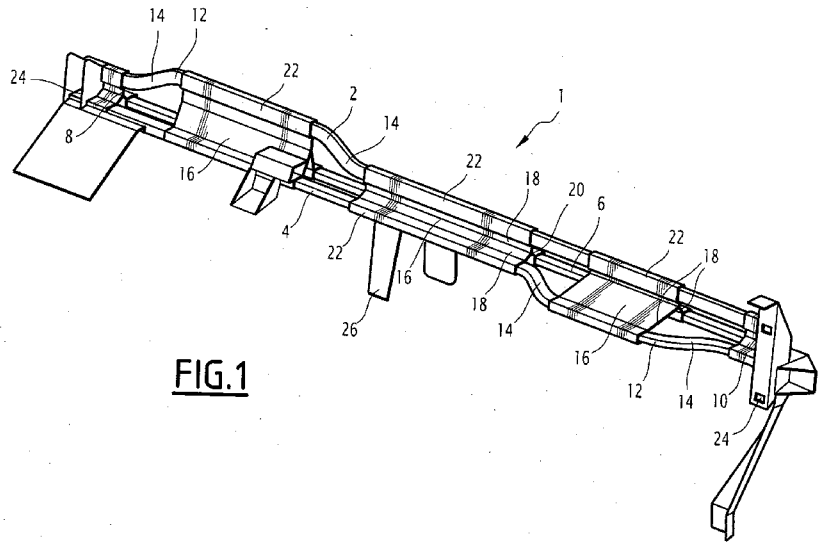

FIG.1

(57) Abstract: A reinforcing structure (1) for a vehicle comprises at least three beams (2, 4, 6) extending along a longitudinal direction and at least one connecting portion by which the three beams (2, 4, 6) are connected together. At least in the connecting portion, the three beams (2, 4, 6) are spaced from each other and define the edges of a polygonal cross-section, and the three beams (2, 4, 6) are connected together by a connection bridge (16) made of synthetic material.

Reinforcing structure comprising a plurality of beams

The present invention relates to reinforcing structure for a vehicle, of the type comprising at least three beams extending according to a longitudinal direction and at least one connecting portion wherein the three beams are connected together.

The invention is more particularly directed to a reinforcing structure forming a crossbeam intended to support an instrument panel in a vehicle, for example an automotive vehicle.

A crossbeam is generally made of one tubular structure extending between two front pillars and carrying attachment organs for various items of the instrument panel, a steering column support for example. Such a tubular element must fulfil several requirements, which can be contradictory : for example, the crossbeam has to be rigid and have an important mechanical strength while it has to be as light as possible, it has to comprise several attachment organs while it has to be flexible in its design to be adapted to its surroundings. Such results are difficult to achieve with a single tubular structure, even if said structure is made of several tubular elements having various geometries and made of different materials adapted to the mechanical strength requirements of the area of the crossbeam in which they extend. Indeed, the assembly of these tubular elements, for example by welding, imposes limitations in the material used and in the geometry of the elements.

EP-2 125 496 discloses a crossbeam comprising two tubular structures parallel to each other and joined together by a connection bridge. However, such an arrangement is still limited in geometry and design and does not permit to obtain a satisfactory stable and rigid structure.

One of the aims of the invention is to propose a reinforcing structure which is very flexible in design and which can be adapted to various strength and geometry requirements.

To that end, the invention relates to a reinforcing structure of the above-mentioned type, wherein at least in the connecting portion, the three beams are spaced from each other and define the edges of a polygonal cross-section, said beams being connected together by a connection bridge made of synthetic material.

According to the invention, each beam can be adapted to particular requirements, for example due to the surroundings of the beam, without imparting on the features of the other beams. Therefore, a great flexibility, both in geometry and mechanical properties, can be achieved. The reinforcing structure is therefore particularly advantageous when it is for example used as a crossbeam for supporting an instrument panel.

According to other features of the reinforcing structure according to the invention:

- the connection bridge comprises arms, each extending from a point located in the polygonal cross-section to respectively one of the three beams ;

- the end of each arm is respectively overmoulded around at least a part of one of the three beams;

- the polygonal cross-section is a triangle, each edge, or summit, of said triangle being formed by one of the three beams ;

- at least one of the beams comprises at least one elbow portion, said elbow portion being farther or closer from the other beams than the rest of said beam;

- at least one connecting bridge is provided to connect the elbow portion to the other beams ;

- at least two of the beams are made of different materials;

- at least two of the beams have different wall thicknesses;

- at least two of the beams have different diameters;

- the end parts of the beams are connected to each other by connection bridges;

- attachment and/or positioning organs are made in a single piece with the connecting bridge;

- the structure comprises more than three beams connected together in at least one connecting portion by a connecting bridge made of synthetic material;

- the synthetic material of the connecting bridge is polyamide (PA) or acrylonitrile butadiene styrene – polycarbonate (ABS-PC); and

- the reinforcing structure forms a crossbeam intended to support an instrument panel of the vehicle.

Other aspects and advantages of the invention will appear upon reading the following description, given by way of example and made in reference to the appended drawings, wherein:

- Fig. 1 is a perspective view of reinforcing structure according to the invention, showing a particular example of design of the reinforcing structure.

- Fig. 2 is a perspective view of a part of a reinforcing structure according to the invention,

- Fig. 3 is a cross-sectional view of the reinforcing structure along axis III-III of Fig. 2.

The following description will be made in reference to a reinforcing structure 1 used as a crossbeam in a vehicle, for example an automotive vehicle. However, it is to be understood that the reinforcing structure according to the invention can have other applications.

The reinforcing structure 1 comprises at least three beams 2, 4 and 6 extending substantially longitudinally between two ends parts 8 and 10, intended to be attached to a right and left front pillars of a vehicle. The reinforcing structure 1 is intended to extend over the width of the vehicle and to support an instrument panel (not shown) and various elements of said panel.

Each beam is independent from the others, meaning that the geometry and mechanical properties of the beam can be selected without imparting on the geometry and mechanical properties of the other beams. Therefore, it is to be understood that the designs shown in the figures are only example of designs and that other design could be selected depending on the requirements of the reinforcing structure 1.

Each beam can be made of a single tubular element or of a plurality of tubular elements assembled together, for example by welding. The material of each tubular element can be selected based upon the rigidity and strength requirements of the area in which the tubular element will extend in the vehicle. For example, if the tubular element has to carry an element of the instrument panel, it can be made in a strong and resistant material, such as steel, and if another tubular element is not particularly solicited, it can be made in a light material, such as aluminium or magnesium in order to lighten the reinforcing structure. Each beam can be made of a single material or of a plurality of materials, for example by joining several tubular elements made of different materials together. At least two of the three beams 2, 4, 6 can be made in different materials, for example steel and aluminium or magnesium.

In a similar manner, the beams can have different dimensions, for example different wall thicknesses and diameters adapted to the mechanical properties wanted for each beam and to the surroundings of the beams. Therefore, if a beam has to be more rigid, it will have a greater wall thickness than the other beams. If a beam is to be surrounded by many elements, its diameter can be reduced relative to the other beams, and so on.

Likewise, each beam can have a particular geometry adapted to its surroundings and to the elements to be attached to the beam. As shown in Fig. 1, beams 2 and 4 can for example each have an elbow portion 12, wherein the beam is bent such that the elbow portion 12 is offset relative to the rest of the beam. In other words, the elbow portion 12 extends along a longitudinal axis substantially parallel to the axis of the rest of the beam. In the embodiment shown in Fig. 1, the elbow portion 12 extends between two bent portions 14 joining the elbow portion 12 to the rest of the beam. However, it is to be understood that the elbow portion 12 can be placed anywhere along le length of the

beam, for example at an end of the beam. In this case, the elbow portion 12 is joined to the rest of the beam by a single bent portion 14.

Other variations of the geometry of each beam can be foreseen. For example, the shape of the cross-section of a beam can vary along the length of the beam. In this case, the beam can for example have a circular cross-section in an area of the beam and a rectangular cross-section in another area. Similarly, each beam can have a varying wall thickness and/or diameter along the length of the beam.

Since there are a plurality of beams 2, 4 and 6, instead of a single beam in a conventional crossbeam, the dimensions of each beam, i.e. its diameter, can be made smaller than the dimensions of the single beam conventionally used. Therefore, the variations of the geometry of the beams, for example by bending, are easier to realize, thereby improving the geometrical flexibility of the reinforcing structure.

The beams 2, 4, 6 are spaced from each other such that they each define the edges of a polygonal cross-section. This means that in cross-section, the reinforcing structure 1 has a polygonal shape and that each beam forms one edge, or summit, of said polygon, as shown in Fig. 3, where the beams 2, 4, 6 forms the edges A, B and C of a triangle ABC, shown in dotted lines in Fig. 3. When the reinforcing structure 1 comprises three beams, the polygonal cross-section is a triangle. When the reinforcing structure 1 comprises more than three beams, the polygonal cross-section is for example a regular polygon comprising as many edges as there are beams. For a reinforcing structure 1 comprising four beams, the polygonal cross-section is therefore for example a rectangle, a square or a diamond. In the embodiment shown in the figures, the cross-sectional triangle is a regular triangle, i.e. an equilateral, isosceles or right angled triangle. In the embodiment shown in Figs 2 and 3, the triangle is an equilateral triangle, which provides a great stability to the reinforcing structure 1. In the area where one of the beams comprises an elbow portion, the triangle becomes an isosceles triangle, as shown in Fig. 1.

In some areas of the reinforcing structure 1, the beams 2, 4 and 6 can be brought closer from one another. They can even be brought in contact in order to reduce the general diameter of the reinforcing structure 1 if it is needed to adapt the reinforcing structure to its surroundings.

For example, the elbow portion 12 of one of the beam can be farther or closer to the other beams than the rest of this one beam, to increase or decrease the space extending between the beams.

To maintain the beams 2, 4, 6 attached together, the reinforcing structure comprises at least one connecting portion wherein a connection bridge 16 connects the beams 2, 4 and 6 together. The beam 2, 4 and 6 are indeed spaced from each other at

least in the connecting portion. Preferably, the reinforcing structure 1 comprises a plurality of connection bridges 16 regularly distributed over the length of the beams 2, 4 and 6 in order to have a rigid and resistant reinforcing structure. In particular, the reinforcing structure 1 comprises at least a connection bridge 16 in a central portion of the reinforcing structure 1 and connection bridges 16 at both end parts 8 and 10 of the reinforcing structure. The reinforcing structure 1 furthermore comprises for example a connection bridge 16 where one of the beams comprises a elbow portion 12, thereby connecting the elbow portion 12 to the other beams, as shown in Fig. 1. The elbow portion 12 is therefore rigidly connected to the other beams, which protects it against deformations by its environment. Other connection bridges 16 can be foreseen depending on the mechanical properties wished for the reinforcing structure.

The connection bridges 16 are each made of a synthetic material, for example a synthetic resin. The connection bridges 16 can be made of various materials, for example a thermosetting or thermoplastic material. The material depends on the requirements regarding the mechanical properties of the connection bridge 16 and more generally of the reinforcing structure, such as the strength needed to support the load imparted by the beams and the vibrational behaviour. As an example, the connection bridges 16 are for example made of polyamide (PA) or acrylonitrile butadiene styrene – polycarbonate (ABS-PC). The different connecting bridges 16 can be made of different materials, depending on the strength of the connection required between the beams in the area of the different connecting bridges. This strength can also be adjusted by adding reinforcing fibres in the material of the connecting bridges for example.

The connection bridge 16 comprises as many arms 18 as there are beams, i.e. three arms 18 in the embodiment shown in the figures. Each arm 18 extends from a point located inside the polygonal cross-section, defined by the beams, to respectively one of the beams.

According to a particular embodiment shown in figures 2 and 3, each arm 18 extends from the geometrical centre 20 of the polygonal cross-section to respectively one of the beams. Therefore, each beam is connected to the centre 20 of the polygonal cross-section via one arm 18 of the connection bridge 16 and the arms 18 are connected together at the centre 20 of the polygonal cross-section.

By geometrical centre 20 of the polygonal cross-section, it is meant the centre of gravity of said cross-section. In the case of a triangular cross-section as shown in Figs 1 to 3, the centre 20 is therefore the point of intersection of the medians of the triangle, i.e. the point of intersection of the lines connecting a summit of the triangle to the centre of the opposite side of the triangle. In the case of a reinforcing structure comprising four beams,

the centre 20 is the point of intersection of the diagonals of the rectangle, square or diamond forming the cross-section of the reinforcing structure 1.

In the figures, the two lower beams have been represented as extending in a horizontal plane. However, it is to be understood that the beams define a plane inclined relative to a horizontal plane, especially when the reinforcing structure is intended to support a steering column which is inclined. In that case, the two lower beams can be inclined relative to a horizontal plane, at least in the area where the steering column is supported.

In order to form the connecting bridge 16 and assemble it to the beams, the connecting bridge 16 is moulded in such a way that the end 22 of each arm 18, opposite the centre 20 of the polygonal cross-section, is overmoulded on the beam to which the arm is connected, as more particularly shown in Fig. 3. In the embodiment shown in the figures, the end 22 of an arm 18 completely surrounds the contour of the beam to which it is connected, thereby forming a strong connection between the connecting bridge 16 and the beams 2, 4 and 6. Alternatively, at least some ends 22 can surround only a part of the beam to which it is connected.

The thickness of the arms 18 and of their ends 22 can be adjusted depending on the strength of the connection required between the beams. For example, the thickness of an arm 18 between the centre 20 and its end 22 is greater than the wall thickness of the end 22 surrounding the beam to which the arm 18 is attached. In a particular embodiment, the thickness of the arm 18 between the centre 20 and its end 22 is substantially 3 mm, whereas the thickness of the end 22 is substantially 1 mm all around the beam.

Attachment organs 24 or positioning organs 26 are for example moulded in a single piece with at least one connecting bridge 16. Therefore, the reinforcing structure 1 is able to receive and support functional elements of the instrument panel to be supported by the reinforcing structure 1. In a particular embodiment, the connecting bridges 16 located at the ends of the reinforcing structure 1 are provided with attachment organs 24 to the front left and right pillars of the vehicle receiving the reinforcing structure 1.

Other elements, such as functional elements of the instrument panel, can be overmoulded on the reinforcing structure 1, outside the connecting bridges 16.

Since the beams are spaced apart from each other, there is a free space between the beams 2, 4 and 6, which can be used to pass wires or air ducts or other elements of the instrument panel through this space. Therefore, the bulk of the instrument panel can be reduced since a new space is created between the beams 2, 4 and 6.

The above-described reinforcing structure 1 is very flexible in geometry, design, shape and mechanical properties and can be precisely adjusted to its surroundings since each beam can be adapted independently from the others.

The reinforcement structure is furthermore simple to produce via the overmoulding of the connecting bridges. The overmoulding furthermore offers a great control over the attachment organs or positioning organs to be added to the connecting bridges or to the reinforcing structure in general.

When each beam is made of a single tubular element, no welding is needed to produce the reinforcing structure. Therefore the rate of production of the reinforcing structure can be improved. Furthermore, the costs of production can also be reduced since the materials used to form the connecting bridges are lower in cost than multiple welding operations needed to produce a conventional reinforcing structure.

CLAIMS

1.- Reinforcing structure (1) for a vehicle comprising at least three beams (2, 4, 6) extending according to a longitudinal direction and at least one connecting portion wherein the three beams (2, 4, 6) are connected together, characterized in that, at least in the connecting portion, the three beams (2, 4, 6) are spaced from each other and define the edges of a polygonal cross-section, said beams (2, 4, 6) being connected together by a connection bridge (16) made of synthetic material.

2.- Reinforcing structure according to claim 1, characterized in that the connection bridge (16) comprises arms (18), each extending from a point located in the polygonal cross-section to respectively one of the three beams (2, 4, 6).

3.- Reinforcing structure according to claim 2, characterized in that the end (22) of each arm (18) is respectively overmoulded around at least a part of one of the three beams (2, 4, 6).

4.- Reinforcing structure according to one of claims 1 to 3, characterized in that the polygonal cross-section is a triangle, each edge, or summit, of said triangle being formed by one of the three beams (2, 4, 6).

5.- Reinforcing structure according to one of claims 1 to 4, characterized in that at least one of the beams (2, 4, 6) comprises at least one elbow portion (12), said elbow portion (12) being farther or closer from the other beams (2, 4, 6) than the rest of said beam.

6.- Reinforcing structure according to claim 5, characterized in that at least one connecting bridge (16) is provided to connect the elbow portion (12) to the other beams (2, 4, 6).

7.- Reinforcing structure according to one of claims 1 to 6, characterized in that at least two of the beams (2, 4, 6) are made of different materials.

8.- Reinforcing structure according to one of claims 1 to 7, characterized in that at least two of the beams (2, 4, 6) have different wall thicknesses.

9.- Reinforcing structure according to any of claims 1 to 8, characterized in that at least two of the beams (2, 4, 6) have different diameters.

10.- Reinforcing structure according to any of claims 1 to 9, characterized in that the end parts (8, 10) of the beams (2, 4, 6) are connected to each other by connection bridges (16).

11.- Reinforcing structure according to any of claims 1 to 10, characterized in that attachment (24) and/or positioning (26) organs are made in a single piece with the connecting bridge (16).

12.- Reinforcing structure according to any of claims 1 to 11, characterized in that it comprises more than three beams (2, 4, 6), connected together in at least one connecting portion by a connecting bridge (16) made of synthetic material.

13.- Reinforcing structure according to any of claims 1 to 12, characterized in that the synthetic material of the connecting bridge (16) is polyamide (PA) or acrylonitrile butadiene styrene – polycarbonate (ABS-PC).

14.- Reinforcing structure according to any of claims 1 to 13, characterized in that the reinforcing structure (1) forms a crossbeam intended to support an instrument panel of the vehicle.

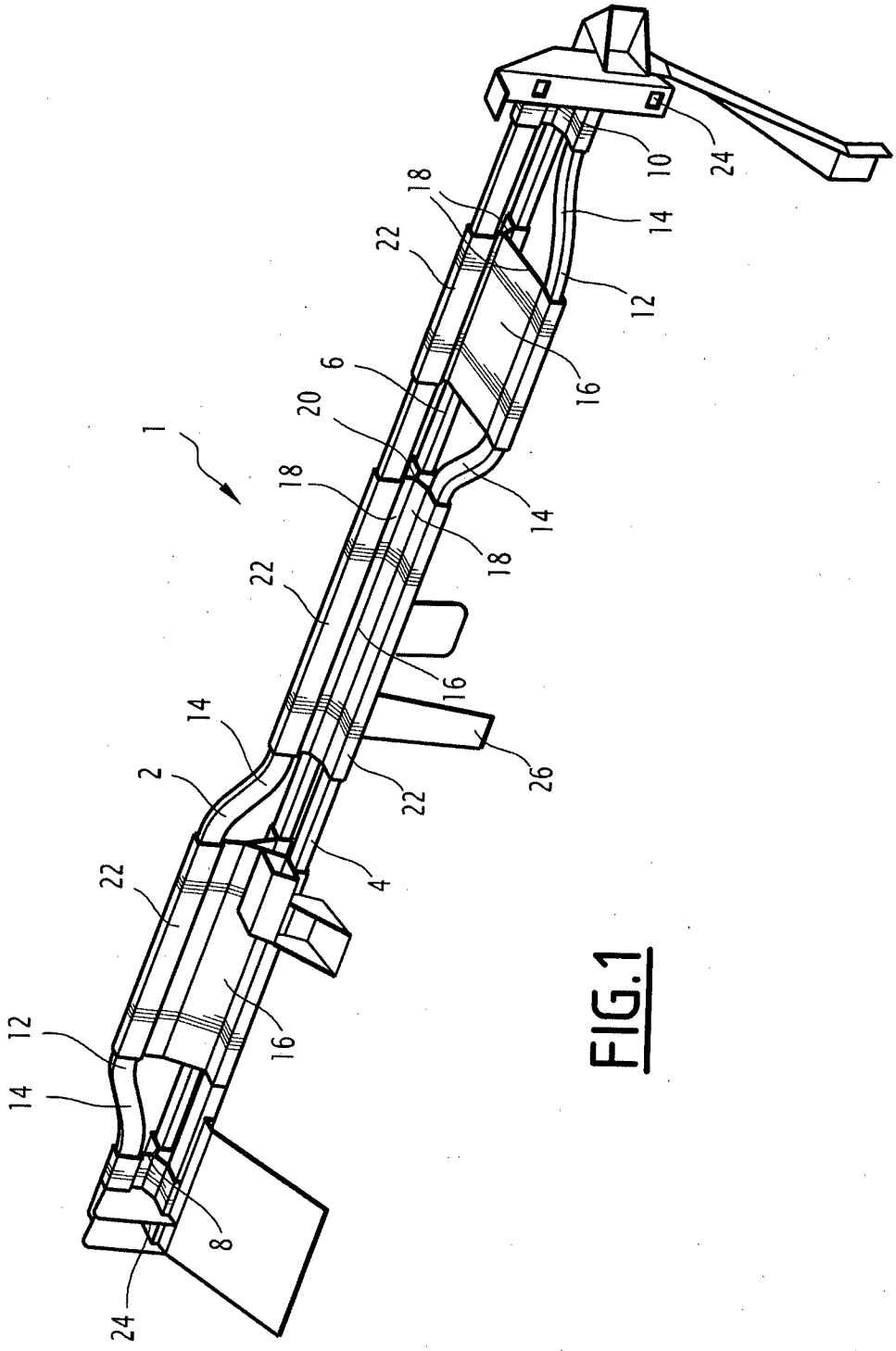

FIG.1

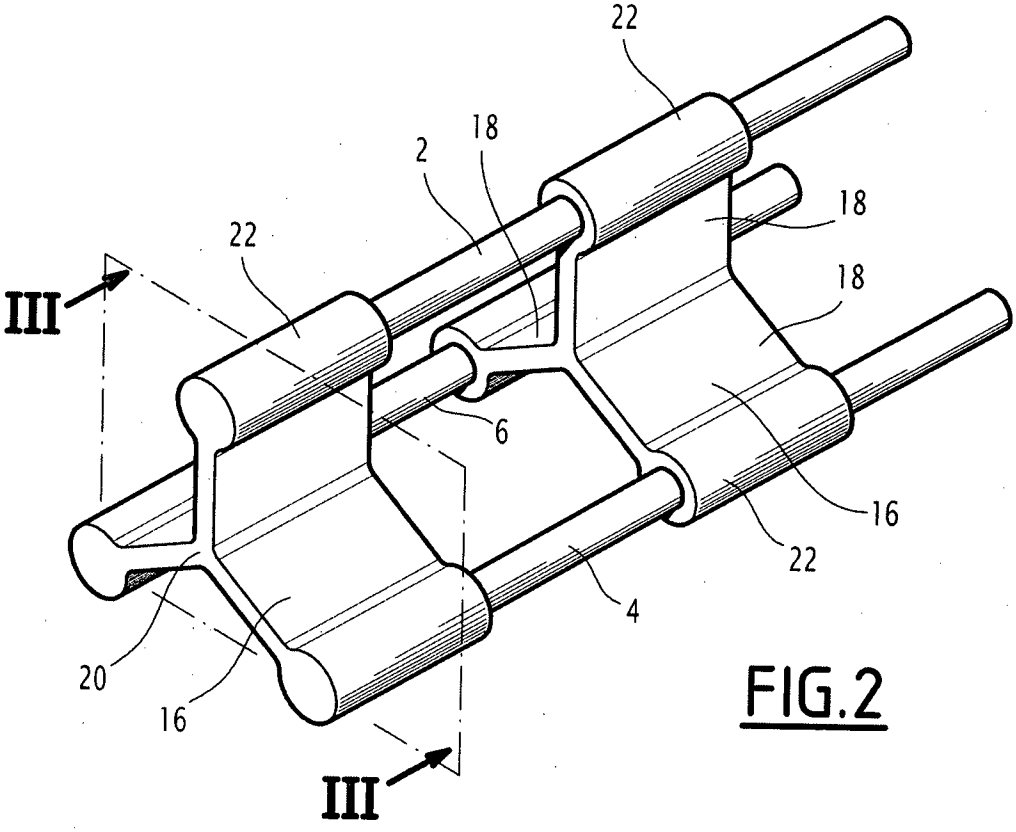

FIG.2

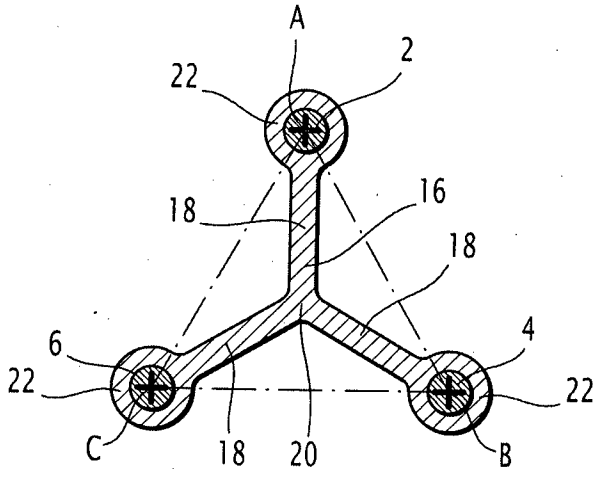

FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2012/000690

A. CLASSIFICATION OF SUBJECT MATTER

B62D 25/14 (2006.01) i

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:B62D 25/-

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)

WPI, EPODOC, CNPAT, CNKI: vehicle, car, automobile, instrument w panel, dashboard?, fascia, cross w section, beam?, tube?, rod?, tubular, reinforce+, polygonal, triangle, geometry, stable, rigid

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 2125496 A1 (FAUR) 02 December 2009 (02.12.2009), see description, paragraphs [0049] to [0051] and figures 6-7C	1-14
A	US 2004178652 A1 (Yoshida et al.) 16 September 2004 (16.09.2004), the whole document	1-14
A	EP 1655209 A1 (ALCN) 10 May 2006 (10.05.2006), the whole document	1-14
A	US 4671536 A (Yoshimura) 09 June 1987 (09.06.1987), the whole document	1-14
A	EP 1035004 A1 (ECIA) 13 September 2000 (13.09.2000), the whole document	1-14
A	US 6203092 B1 (Yoshinaka) 20 March 2001 (20.03.2001), the whole document	1-14
A	US 4682788 A (Yoshimura) 28 July 1987 (28.07.1987), the whole document	1-14

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 June 2013 (25.06.2013)	**11 Jul. 2013 (11.07.2013)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer YOU, Guozhong Telephone No. (86-10) 62085393

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2012/000690

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