composite reinforced material that facilitates weight reduction while being easy to manufacture and maintains the necessary strength of the component.

SUMMARY

[6A] According to various embodiments, a method for forming an overmoulded assembly may be provided. The method may include: conforming a planar body of fibre reinforced material (CFRM) to a shape of a shape defining member, the material comprising continuous fibres in a synthetic matrix and the shape defining member defining an internal volume of a closed cross-section portion of a vehicle reinforcing member; bonding a first edge portion of the CFRM body to a second edge portion of the CFRM body thereby to form, around the shape defining member, the closed cross-section portion of the vehicle reinforcing member; and overmoulding a shell onto the vehicle reinforcing member and a further vehicle reinforcing member to integrally connected the shell and CFRM body, while keeping the shape defining member in the closed-cross-section portion.

[6B] According to various embodiments, a system for fabricating an overmoulded assembly may be provided. The system may include: a shape defining member defining an internal volume of a closed cross-section portion of a vehicle reinforcing member, the vehicle reinforcing member formed, in use, from a planar body of continuous fibre reinforced material (CFRM) comprising continuous fibres in a synthetic matrix; a first mould member, the first mould member and shape defining member being configured to be brought together to with the CFRM body therebetween, to form a closed cross-section portion from the CFRM body, the closed cross-section portion being formed around the shape defining member; a bonding device movably mounted to the first mould member and movable towards the shape defining member in use to bond a first edge portion and a second edge portion of the CFRM body together to form the vehicle reinforcing member; and an overmoulding mould for use in overmoulding a shell onto the vehicle reinforcing member and a further vehicle reinforcing member to integrally connected the shell and CFRM body, while keeping the tapered shape defining member in the closed-cross-section portion.

[7] In an example, a method for forming a vehicle reinforcing member may be provided. The method may include:

conforming a sheet of fibre reinforced material (CFRM) to a shape of a shape defining member, the material comprising continuous fibres in a synthetic matrix and the shape defining member defining an internal volume of a closed cross-section portion of the vehicle reinforcing member; and

bonding a first edge portion of the CFRM sheet to a second edge portion of the CFRM sheet thereby to form the closed cross-section portion of the vehicle reinforcing member.

[8] In an example, a vehicle reinforcing member manufactured using the method described above or elsewhere herein may be provided. The vehicle reinforcing member may include a closed cross-section portion and a seam joining the first and second edge sections.

[9] In an example, a method of manufacturing a reinforcing structural member of a vehicle seat may be provided. The vehicle seat may include a seat portion and a seatback connected to the seat portion by a tilt adjustment mechanism. The tilt adjustment mechanism may include two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the seat portion, one of the two tilt adjustment members being on each of the seat portion and seatback. The method may include:

forming a vehicle reinforcing member of a seat element using the methods described above or elsewhere herein, the seat element being one of the seat portion and seatback; and

attaching one of the two tilt adjustment members to the vehicle reinforcing member for connecting the vehicle reinforcing member to the other of the two tilt adjustment members and thereby to connect the seat portion and seatback.

[10] In an example, a vehicle seat may be provided. The vehicle seat may include:

a seat portion;

a seatback;

a tilt adjustment mechanism connecting the seatback to the seat portion, the tilt adjustment mechanism comprising two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the

seat portion, one of the two tilt adjustment members being on each of the seat portion and seatback,

wherein a seat element, the seat element being one of the seatback and seat portion, comprises at least one vehicle reinforcing member formed using the method described above or elsewhere herein, the at least one vehicle reinforcing member comprising one of the tilt adjustment members movably connected to the other tilt adjustment member thereby to connect the seat portion and seatback.

[11] In an example, a vehicle seat may be provided. The vehicle seat may include:

a seat portion;

a seatback;

a tilt adjustment mechanism connecting the seatback to the seat portion, the tilt adjustment mechanism comprising two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the seat portion, one of the two tilt adjustment members being on each of the seat portion and seatback,

wherein a seat element, the seat element being one of the seatback and seat portion, is formed according to the method described above or elsewhere herein, the at least one vehicle reinforcing member comprising one of the tilt adjustment members movably connected to the other tilt adjustment member thereby to connect the seat portion and seatback.

[12] In an example, a system for fabricating a vehicle reinforcing member may be provided. The system may include:

a shape defining member defining an internal volume of a closed cross-section portion of the vehicle reinforcing member, the vehicle reinforcing member formed, in use, from a sheet of continuous fibre reinforced material (CFRM) comprising continuous fibres in a synthetic matrix;

a first mould member, the first mould member and shape defining member being configured to be brought together to with the CFRM sheet therebetween, to at least partially conform the CFRM sheet to the shape defining member; and

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reinforcing member 200. Presently, the taper extends substantially the full length of the vehicle reinforcing member 200.

[33] The taper assists withdrawal of the shape defining member (see FIGs. 5a to 5d) from the vehicle reinforcing member 200. That withdrawal occurs, in the present instance, in the longitudinal direction of the vehicle reinforcing member 200. Thus the vehicle reinforcing member 200 can be formed about the shape defining member, and partially cured – set, frozen or otherwise rigidified sufficiently to maintain its shape as the second mould member is withdrawn – and the shape defining member is then withdrawn.

[34] A further embodiment of a vehicle reinforcing member 300 is shown in FIG. 3. In this embodiment, a metal fixture 302 is attached to the vehicle reinforcing member 300. The metal fixture 302 enables the vehicle reinforcing member 300 to be attached to another structure. For example, where the vehicle reinforcing member 300 comprises part of a bumper of a car, the metal fixture 302 may facilitate attachment of the bumper to the body or the chassis of the car. Similarly where the vehicle reinforcing member 300 comprises part of a seat portion of a vehicle seat, the metal fixture 302 may facilitate attachment of the seat portion to the seat base, whether or not that seat base comprises a longitudinal adjustment mechanism per FIG. 1. In the present instance, the vehicle reinforcing member 300 comprises part of a seatback of a vehicle seat and the metal fixture is a tilt adjustment member of a tilt adjustment mechanism enabling the seatback to tilt relative to the seat portion of the vehicle seat. In other words, a cooperating tilt adjustment member is provided on the seat portion of the vehicle seat and the tilt adjustment members are movably connected to each other thereby to connect the seat portion and seatback in a manner that permits the latter to tilt relative to the former.

[35] The seatback 400 of which the vehicle reinforcing member 300 comprises a part is shown in FIGs. 4a and 4b. Due to the closed cross-section of the vehicle reinforcing member of the present embodiments, there is no single point, such as an edge, at which load concentrates when compared with open cross-section structural members such as U-shaped or C-shaped members. The closed cross-section of the vehicle reinforcing member 300 thus provides resistance to forces acting on multiple degrees of freedom.

[36] FIG. 4a illustrates the response of the vehicle reinforcing member 300 to torsional force, or a bending moment about a vertical axis (i.e. out of the page on which FIG. 4a is illustrated). Torsional force may occur, for example, during side impact loading of a vehicle or where the seatback is pushed forward. While the vehicle structural reinforcing member may have an elliptical, or substantially elliptical cross-section, or

CLAIMS

1. A method for forming an overmoulded assembly, the method comprising:

conforming a planar body of fibre reinforced material (CFRM) to a shape of a shape defining member, the material comprising continuous fibres in a synthetic matrix and the shape defining member defining an internal volume of a closed cross-section portion of a vehicle reinforcing member;

bonding a first edge portion of the CFRM body to a second edge portion of the CFRM body thereby to form, around the shape defining member, the closed cross-section portion of the vehicle reinforcing member; and

overmoulding a shell onto the vehicle reinforcing member and a further vehicle reinforcing member to integrally connected the shell and CFRM body, while keeping the shape defining member in the closed-cross-section portion.

2. A method according to claim 1,

wherein the method includes forming a tapered vehicle reinforcing member.

3. A method according to claim 1 or 2,

wherein the shape defining member is tapered in a longitudinal direction of the shape defining member,

4. A method according to any one of claims 1 to 3,

wherein the shape defining member defines a tapered internal volume of the closed cross-section portion of the vehicle reinforcing member.

5. A method according to any one of claims 1 to 4, further comprising:

at least partially curing the conformed CFRM body; and

withdrawing the shape defining member from the internal volume of the closed cross-section portion of the vehicle reinforcing member.

6. A method according to any one of claims 1 to 5, wherein conforming the CFRM body comprises contacting a first mould member with the CFRM body and bringing the first mould member and shape defining member together, with the CFRM body therebetween, to at least partially conform the CFRM to a shape of the shape defining member.

7. The method of claim 6, wherein the first mould member comprises a surface disposed at an incline to a vertical direction wherein the step of contacting the first mould member with the CFRM body comprises loading the CFRM body onto the inclined surface.

8. A method according to claim 6 or 7, wherein the first mould member comprises a concave section shaped to cooperate with the shape of the shape defining member, and wherein bringing the first mould member and shape defining member together comprises positioning the CFRM body between the concave section and shape defining member.

9. The method of claim 8, further comprising positioning the CFRM body such that the first and second edge portions protrude outside of the concave section.

10. The method of claim 9, wherein bonding the first edge portion to the second edge portion comprises contacting the CFRM body with a second mould member and third mould

member respectively to bring one of the first edge portion and second edge portion against the shape defining member, the second and third edge portion overlapping each other.

11. The method of claim 10, wherein the third mould member is heated.

12. The method of claim 11, wherein the third mould member is heated to a bonding temperature of the CFRM.

13. The method of any one of claims 10 to 12, wherein the second mould member and third mould member are attached to a reciprocating device, the reciprocating device bringing sequentially the second mould member into contact with the CFRM body, then removing the second mould member from contact with the CFRM body while bringing the third mould member into contact with the CFRM body.

14. The method of any one of claims 1 to 13, wherein vehicle reinforcing member is elongated in a longitudinal direction and the method further comprises withdrawing the shape defining member in the longitudinal direction of the vehicle reinforcing member.

15. The method of any preceding claim, wherein the bonding step comprises bonding the first edge portion and the second edge portion by fusion.

16. The method of any one of claims 1 to 15, further comprising controlling a temperature of the shape defining member thereby to control a rate of curing of the vehicle reinforcing member.

17. The method of claim 16, wherein the step of controlling the temperature of the shape defining member comprising passing coolant and/or radiant through one or more channels in the shape defining member to control a temperature of the shape defining member and thereby control a temperature of the CFRM body.

18. An overmoulded assembly manufactured using the method of any preceding claim, the vehicle reinforcing member comprising a closed cross-section portion and a seam joining the first and second edge sections.

19. A method of manufacturing a reinforcing structural member of a vehicle seat, the vehicle seat comprising a seat portion and a seatback connected to the seat portion by a tilt adjustment mechanism, the tilt adjustment mechanism comprising two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the seat portion, one of the two tilt adjustment members being on each of the seat portion and seatback, the method comprising:

forming an overmoulded assembly of a seat element using the method of any one of claims 1 to 17, the seat element being one of the seat portion and seatback; and

attaching one of the two tilt adjustment members to the overmoulded assembly for connecting the overmoulded assembly to the other of the two tilt adjustment members and thereby to connect the seat portion and seatback.

20. The method of claim 19, wherein the seat element is the seatback, the tilt adjustment mechanism comprises a hinge mechanism on each of two opposed sides of the seatback, one of the hinge mechanisms comprising the tilt adjustment members and the other hinge mechanism also comprising two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the seat portion, the method comprising:

forming the further vehicle reinforcing member in accordance with the method of any one of claims 1 to 17, the vehicle reinforcing member and further vehicle reinforcing member each comprising a tilt adjustment member from the respective hinge mechanism and extending along the two opposed sides of the seatback from the respective hinge mechanism to a point further away from the respective hinge mechanism; and

overmoulding the shell onto the vehicle reinforcing member and further vehicle reinforcing member, to integrally connected the shell, vehicle reinforcing member and further vehicle reinforcing member.

21. A vehicle seat comprising:

a seat portion;

a seatback;

a tilt adjustment mechanism connecting the seatback to the seat portion, the tilt adjustment mechanism comprising two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the seat portion, one of the two tilt adjustment members being on each of the seat portion and seatback,

wherein a seat element, the seat element being one of the seatback and seat portion, comprises at least one overmoulded assembly formed using the method of any one of claims 1 to 17, the at least one overmoulded assembly comprising one of the tilt adjustment members movably connected to the other tilt adjustment member thereby to connect the seat portion and seatback.

22. A vehicle seat according to claim 21, wherein the seat element comprises an overmoulded assembly with two vehicle reinforcing members extending along opposite sides of the seat element from the tilt adjustment mechanism to a point further away from the tilt adjustment mechanism.

23. A vehicle seat according to claim 22, wherein the tilt adjustment mechanism comprises two hinge mechanisms, one hinge mechanism being on each of the opposite sides of the seat element, the tilt adjustment members forming part of one of the two hinge mechanisms, the other hinge mechanism also comprising two movably connected tilt adjustment members moveable relative to each other to allow tilt adjustment of the seatback relative to the seat portion, and wherein each vehicle reinforcing member comprises one of the two tilt adjustment members of the respective hinge.

24. A vehicle seat according to any one of claims 21 to 23, wherein a cross-section of the closed cross-section portion of each vehicle reinforcing members is a substantially elliptical.

25. A system for fabricating an overmoulded assembly comprising:

a shape defining member defining an internal volume of a closed cross-section portion of a vehicle reinforcing member, the vehicle reinforcing member formed, in use, from a planar body of continuous fibre reinforced material (CFRM) comprising continuous fibres in a synthetic matrix;

a first mould member, the first mould member and shape defining member being configured to be brought together to with the CFRM body therebetween, to form a closed cross-section portion from the CFRM body, the closed cross-section portion being formed around the shape defining member;

a bonding device movably mounted to the first mould member and movable towards the shape defining member in use to bond a first edge portion and a second edge portion of the CFRM body together to form the vehicle reinforcing member; and

an overmoulding mould for use in overmoulding a shell onto the vehicle reinforcing member and a further vehicle reinforcing member to integrally connected the shell and CFRM body, while keeping the tapered shape defining member in the closed-cross-section portion.

26. A system according to claim 25,

wherein the system is configured to fabricate a tapered vehicle reinforcing member.

27. A system according to claim 25 or 26,

wherein the shape defining member is tapered in a longitudinal direction of the shape defining member,

28. A system according to any one of claims 25 to 27,

wherein the shape defining member defines a tapered internal volume of the closed cross-section portion of the vehicle reinforcing member.

29. The system of any one of claims 25 to 28, further comprising a second mould member movably mounted to the first mould member and movable, in use, to bring the second mould member into contact with the CFRM body to bring a first edge portion of the CFRM body into conformity with the shape defining member.

30. The system of claim 29, further comprising a third mould member, the second mould member and third mould member being mounted to a reciprocating device attached to the first mould member, the reciprocating device in use bringing the second mould member into contact with the first edge portion, then removing the second mould member from contact with the first edge portion and bringing the third mould member into contact with a second edge portion of the CFRM body to bond the second edge portion to the first edge portion.