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(54) MULTI-BEAM PANEL STRUCTURES

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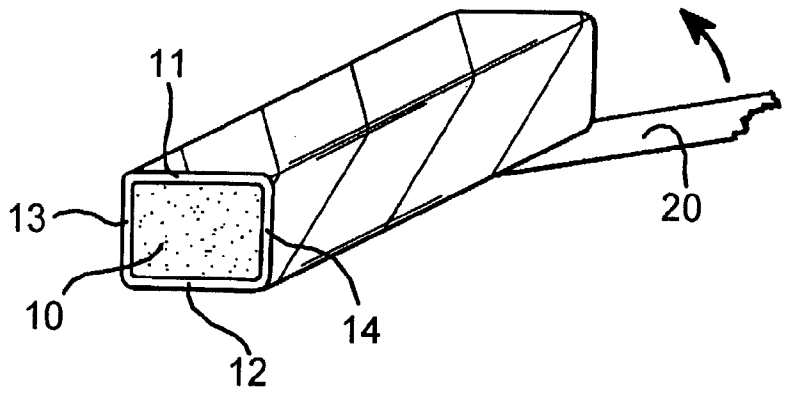
(57) ABSTRACT

A fabricated panel structure such as a boat hull includes a plurality of elongate flexible cores **10** of a low strength foam material which are each individually covered by a respective strip **20** of fibrous material wrapped around each core in a spiral fashion. The covered members are arranged side-by-side sandwiched between inner and outer layers **24** and **26** of fibre-reinforced plastics material which are bonded to the cores.



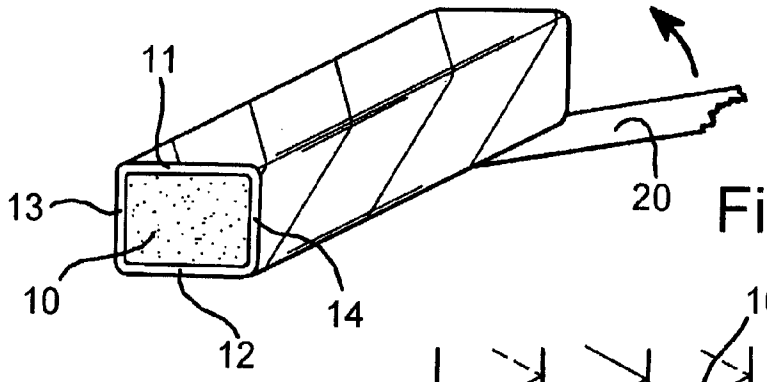


Fig. 1

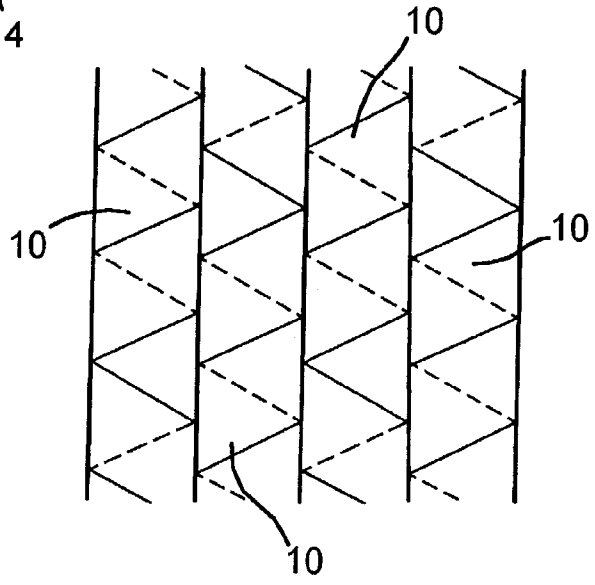


Fig. 2

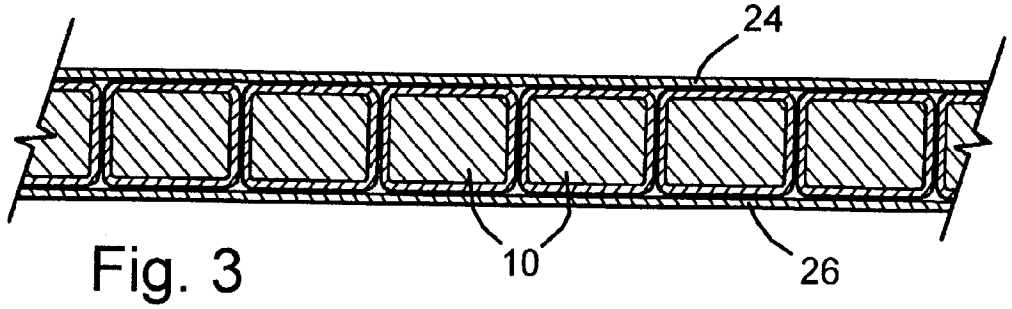


Fig. 3

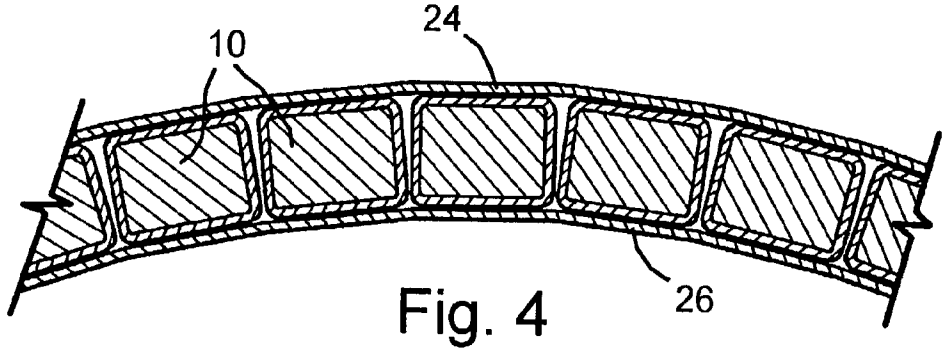


Fig. 4

MULTI-BEAM PANEL STRUCTURES

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to the fabrication of shaped panel structures such as boat hulls using a multi-beam panel construction.

BACKGROUND

[0002] It is known to fabricate shaped structures such as boat hulls from pieces of foamed plastics material sandwiched between inner and outer layers of fibre-reinforced plastics. Such a structure is considerably stronger and stiffer than a simple reinforced resin panel, but there may be a problem of insufficient bonding between the inner and outer skins resulting in structural delamination, particularly when the panels are subject to high levels of stress as encountered in the hull of a power boat for example. Various ways of strengthening the structure have been proposed, including the use of lengths of foam with interlocking edges and incorporating strengthening elements, but these often make it more difficult to form complex shapes such as a boat hull. It has also been proposed to individually cover the pieces of foamed cellular material with layers of fibrous material, but while the bonding may be improved the structural strength of the sandwich structure is not increased significantly.

[0003] For a vertically loaded beam the most economical form of cross section (the section requiring the least amount of material for a given strength or stiffness) is an "I" section. For both vertical and horizontal loads it is a hollow box section.

[0004] The present invention seeks to provide a new and inventive fabrication system which offers improved structural strength whilst at the same time allowing curved shapes to be formed without complicating the construction process or significantly increasing fabrication time.

SUMMARY OF THE INVENTION

[0005] The present invention provides a fabricated sandwich structure such as a boat hull, and a method of fabricating such a structure, which includes a plurality of elongate members each formed of a cellular material and individually covered by a respective layer of fibrous material, the elongate members being arranged side-by-side sandwiched between skins of fibre-reinforced plastics material which are bonded to the layers of fibrous material covering the elongate members, in which each layer of fibrous material is in the form of a strip which is wrapped around the respective elongate member at an angle to the longitudinal direction of the said member.

[0006] The inclined strips covering the opposed side faces of the elongate cellular members form strong cross-braced struts between the inner and outer skins effectively creating a series of adjacent I-beams or hollow box sections arranged side-by-side.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The following description and the accompanying drawings referred to therein are included by way of non-limiting example in order to illustrate how the invention may be put into practice. In the drawings:

[0008] **FIG. 1** is a general view of a structural member as used in the invention;

[0009] **FIG. 2** is a plan view of a number of such structural members arranged side-by-side in the construction of a panel in accordance with the invention;

[0010] **FIG. 3** is a transverse section through a completed panel; and

[0011] **FIG. 4** is a similar transverse section through a curved panel forming part of a boat hull.

DETAILED DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** shows an elongate flexible core member **10** which is suitable for use as a basic structural element for the fabrication of a wide range of shaped panels. The core member is conveniently of a plain substantially rectangular cross-section as shown with opposite inner and outer faces **11** and **12** and perpendicular side faces **13** and **14**. However, it should be noted that other suitable cross-sectional shapes could be used, particularly when forming curved panels for example. The core may be formed of a lightweight flexible and buoyant cellular material such as polyurethane foam, but the invention allows inexpensive cellular materials to be used such as expanded polystyrene. A strip **20** of fibrous material is wrapped around the core in a spiral fashion with the strip disposed at an angle to the longitudinal direction of the core so that the top, bottom and side faces of the core are substantially covered by at least one thickness of the strip **12** throughout their length. It should be noted that the angle of the spiral wrapping to the longitudinal direction of the core is opposite on opposing faces of the core, as indicated by the dashed lines in **FIG. 2**. The strip **20** may include glass fibres, although other fibrous materials could be used including natural and synthetic fibres. The fibres may be randomly distributed or regularly arranged as in a woven fabric. The covering strips can be dry wrapped and held in place by means of an adhesive, by staples, pins etc. They could also be impregnated with resin and cured. A number of such fibre-covered cores **10** are arranged side-by-side with their side faces abutting as shown in **FIG. 2**.

[0013] As shown in **FIG. 3**, the opposite inner and outer faces **11** and **12** of the wrapped cores **10** are covered with respective inner and outer skins **24** and **26** of fibre-reinforced plastics material such as glass fibres impregnated with a curable resin (GRP). A resin or other bonding agent may be applied to the strips **20** before or after assembly to form a strong bond with the inner and outer skins. The opposing strips **20** covering the opposing side faces **13** and **14** of the cores form strong cross-braced struts between the inner and outer skins effectively creating a series of adjacent I-beam or hollow box sections. Thus, although the panel is very lightweight its structural strength is extremely high, even if low strength core materials are used.

[0014] As shown in **FIG. 4**, the panel can readily be formed with a curved shape (transversely and/or longitudinally of the cores **10**) such as may be necessary for the fabrication of a boat hull. The fabric-covered cores **10** are applied around formers or placed in a mould in a known manner to attain the required shapes and relative positions.

[0015] It will be appreciated that the features disclosed herein may be present in any feasible combination. Whilst the above description lays emphasis on those areas which, in

combination, are believed to be new, protection is claimed for any inventive combination of the features disclosed herein.

I claim:

1. A fabricated sandwich structure which includes a plurality of elongate members each formed of a cellular material and individually covered by a respective layer of fibrous material, the elongate members being arranged side-by-side sandwiched between skins of fibre-reinforced plastics material which are bonded to the layers of fibrous material covering the elongate members, in which each layer of fibrous material is in the form of a strip which is wrapped around the respective elongate member at an angle to the longitudinal direction of the said member.

2. A boat hull which includes a fabricated sandwich structure according to claim 1.

3. A method of fabricating a sandwich structure which includes individually covering a plurality of elongate members formed of a cellular material with respective layers of fibrous material, arranging the elongate members side-by-side, sandwiching the elongate members between skins of fibre-reinforced plastics material, and bonding the skins to the layers of fibrous material covering the elongate members, in which each layer of fibrous material is in the form of a strip which is wrapped around the respective elongate member at an angle to the longitudinal direction of the said member.

4. A method according to claim 3, in which the fabricated sandwich structure is incorporated into a boat hull.

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