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(54) Method of forming a structure and structure thus formed

(57) The invention relates to a method of forming an at least partially closed structure by forming from foam material a number of segments (2-5), each corresponding to a part of the structure, and mutually connecting the foam segments.

The foam segments can be mutually connected with interposing parallel thereto of a strengthening part (13) of a different material, the form and dimensions of which correspond with those of the foam segments.

The foam segments can be positioned relative to each other using aligning means (21-24) and mutually connected by glueing, whereafter the thus formed structure can be covered with a finishing layer (36).

The invention further relates to a structure, in particular a ship's hull, manufactured by applying this method.

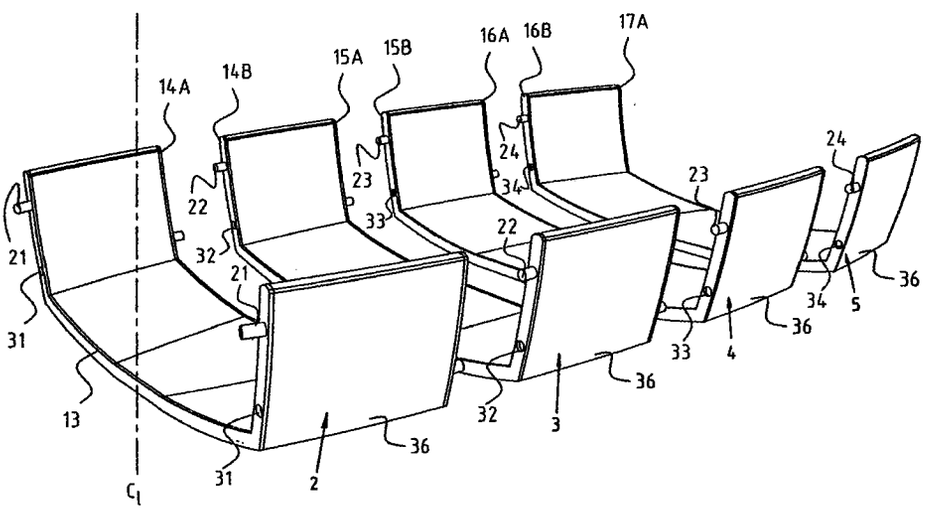

FIG. 2

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Description

The invention relates to a method of forming an at least partially closed structure. The forming of structures is generally time-consuming and costly work since a frame will usually have to be formed first which is subsequently covered with skin panels or wall panels. In addition, methods are known of forming self-supporting structures, wherein skin parts or wall parts are formed directly in the desired shape in a mould and then optionally connected to each other. Such methods require large investment in the moulds used. In structures defining a space which must be protected from outside influences, the structure is often lined with an insulation material after being formed, for instance insulating foam. This is an additional operation which likewise costs time and effort.

The invention therefore has for its object to provide a simplified method of forming a wholly or partially closed structure. According to the invention such a method comprises of forming from foam material a number of segments, each corresponding to a part of the structure, and mutually connecting the foam segments. By making use of segments already displaying the final form of the structure a self-supporting structure can be formed in simple manner. Because this self-supporting structure is further manufactured from foam material, no separate insulation material has to be arranged after forming of the structure. This saves a relatively large amount of construction time, while in addition an efficient structure is obtained because the foam material not only insulates but also fulfils a bearing function.

Preferably applied variants of the methods according to the invention are described in the dependent claims 2-11.

The invention also relates to a structure formed by applying the above described method, in particular a thus formed ship's hull. Such a hull can be manufactured considerably more quickly and simply than a conventional ship's hull which is constructed from frames and shell plating arranged thereon and is therefore relatively inexpensive compared with such a conventional hull. Also in comparison to a conventional plastic ship's hill, which is constructed in its entirety in a mould specially manufactured for that purpose, the ship's hull according to the invention provides the advantage of a rapid and simple construction at low cost.

The invention will now be elucidated on the basis of an embodiment, wherein reference is made to the annexed drawing, in which:

fig. 1 shows a partly broken away perspective view of a ship's hull manufactured by applying the method according to the invention,

fig. 2 is a schematic perspective view of a number of segments of the ship's hull of fig. 1 before assembly thereof,

fig. 3 is a partly broken away perspective detail view of two segments in the assembled situation, and

fig. 4 is a perspective schematic view of a mould for forming a segment of the vessel.

An at least partially closed structure, in the shown example a ship's hull 10 (fig. 1), is formed according to the invention by a number of segments 1, 2, 3, 4, 5, 6, 7, 8 and 9, which each define the shape of a part of hull 10 and are mutually connected with interposing of strengthening parts parallel thereto, in the shown example frames 13, 14, 15, 16, 17, 18, 19 and 20. Segments 1-9 are herein manufactured from a foam material, for instance polyurethane foam, while frames 13-20 are manufactured from another material, for instance wood, a metal such as aluminium or a fibre-reinforced plastic. Both the hull segments 1-9 and the frames 13-20 are manufactured in the desired shape and dimensions, so that the final hull form is obtained in one operation by mutually connecting the segments and frames.

For relative positioning of the segments and frames use can be made of aligning means, for instance dowel pins 21, 22, 23, 24, 25, 26, 27 and 28 which are received in corresponding openings 31, 32, 33, 34 and so on. These dowel pins 21-28 can pass through segments 1-9 and thus form longitudinal reinforcements. In addition, it is also possible after mutually connecting segments 1-9 to arrange separate longitudinal reinforcing elements which extend over a number of segments, for instance in the form of a keel beam 35.

Once the segments 1-9 and frames 13-20 are mutually connected, the thus formed hull 10 can be covered with a finishing layer, which forms for instance the shell plating 36. This finishing layer can be formed from any desired material and can take a relatively thin and light form since the segments themselves are already very strong and rigid. A high-grade plastic such as PVC can for instance be chosen as material for finishing layer 36. Finishing layer 36 can herein be glued against segments 1-9 and frames 13-20, while the frames, if these are embodied in for instance wood, also allow a screw connection. When the frames are manufactured from plastic or aluminium, they can be provided on their periphery with a bent flange to which the finishing layer or skin 36 can be fixed by means of welding, glueing or the like. When the structure 10 forms a ship's hull as in the shown example, a very smooth and optionally growth-resistant material such as for instance a PTFE film can be chosen for the finishing layer 36 of the part 29 of hull 10 which is situated under the water line during use.

In the shown example the segments 1-9 are foamed into the desired shape in a mould 37. This can be seen in fig. 4 where forming of segment 3 is shown. Mould 37 is herein formed by the respective frame halves 14B and 15A and a number of releasable wall parts 39 which are arranged therebetween and which have in negative form the desired outer contour of ship's

hull 10. Frame halves 14B and 15A form with wall parts 39 a space 38 which can be filled with foam. Formed herein in frame halves 14B and 15A are respective openings 32 and 33 which can serve during the foaming as venting apertures and can subsequently be used for arranging dowel pins 22, 23 to connect the thus formed segment 3 to the adjacent segments 2 and 4. The foam material with which segment 3 is formed is adhered to frame halves 14B and 15A so that no special connections are required therebetween. Using a suitably chosen glue the frame halves are finally connected to frame halves bounding an adjacent segment. This is shown in fig. 3, where the glue layer between frame halves 16A and 16B connected respectively to segments 4 and 5 is designated with 16C.

It is also possible to form the segments as shaped blocks of foam material by performing a machining operation, for instance cutting or sawing. The starting point here can be foam material supplied in standard sizes. In this case the frames must be fixed individually to the foam segments, for instance by means of a suitably chosen glue. It is of course not necessary herein to form the frames in halves.

Because the segments and the frames are formed directly into the desired shape, no finishing operation is in principle required after assembly of the segments. Possible recesses, for instance for cables, or systems such as a motor, a passage for a propeller shaft and other types of opening in the hull, can be arranged directly during forming of the segments. In this manner a design can be adapted in simple manner to for instance different drive systems by changing only a few relevant segments. The length of the hull can for instance also be adapted in simple manner by inserting additional segments.

The method according to the invention thus enables rapid and simple assembly of a structure such as for instance a ship's hull from a number of prefabricated segments. The segments can optionally be supplied herein in the form of a construction kit, whereby nonprofessional construction is possible. Because the segments are manufactured from foam material which has excellent insulating properties, separate insulating material no longer has to be arranged, which results in time-saving. The structure can moreover take a comparatively light and thin form since the insulating material contributes to the strength and rigidity thereof. Due to the construction in segments the structure is moreover easily modified. It will otherwise be apparent that, although use is made in the shown embodiment of segments with the same length between which one frame is present in each case, different segment lengths can in practice also be used or a plurality of segments can be mutually connected without arranging a frame therebetween. The placing of frames is herein determined by the anticipated loads on the structure.

Although the invention is elucidated above with reference to a method for manufacturing a ship's hull, it will be apparent that other structures could also be manufactured in this manner. Envisaged here are for instance vehicles such as caravans, campers and the like, or possibly even houses. The scope of the invention is therefore defined solely by the following claims.

Claims

1. Method of forming an at least partially closed structure, comprising of forming from foam material a number of segments, each corresponding to a part of the structure, and mutually connecting the foam segments.

2. Method as claimed in claim 1, **characterized in that** at least a part of the foam segments are mutually connected with interposing parallel thereto of a strengthening part of a different material.

3. Method as claimed in claim 2, **characterized in that** the form and dimensions of the strengthening part substantially correspond with those of the foam segments connected thereby.

4. Method as claimed in any of the foregoing claims, **characterized in that** each segment is foamed into the desired form in a mould.

5. Method as claimed in any of the claims 1-3, **characterized in that** each segment is formed by machining from a block of foam material.

6. Method as claimed in any of the foregoing claims, **characterized in that** the foam segments are positioned relative to each other using aligning means.

7. Method as claimed in any of the foregoing claims, **characterized in that** the foam segments are mutually connected by glueing.

8. Method as claimed in any of the foregoing claims, **characterized in that** after mutual connection of the foam segments, at least one longitudinal strengthening part of a different material is arranged which spans a number of foam segments.

9. Method as claimed in any of the foregoing claims, **characterized in that** after mutual connection of the foam segments the thus formed structure is covered at least partially with a finishing layer.

10. Method as claimed in any of the foregoing claims, **characterized in that** the structure forms a ship's hull.

11. Method as claimed in claims 9 and 10, **characterized in that** the finishing layer forms a shell plating.

12. Structure, in particular a ship's hull, manufactured by applying the method as claimed in any of the foregoing claims.

13. Ship's hull as claimed in claim 12, **characterized in that** the or each strengthening part forms a frame.

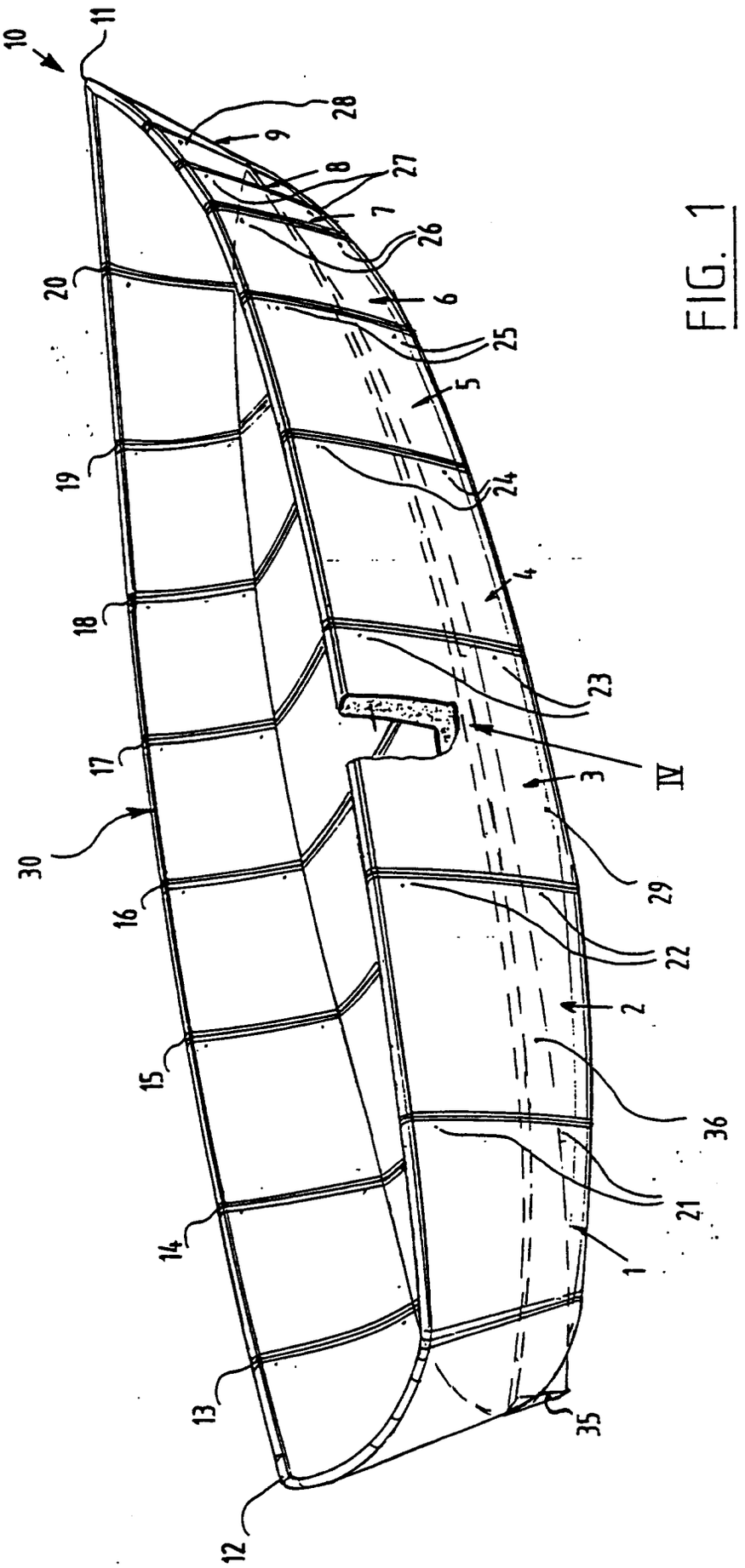
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FIG. 1

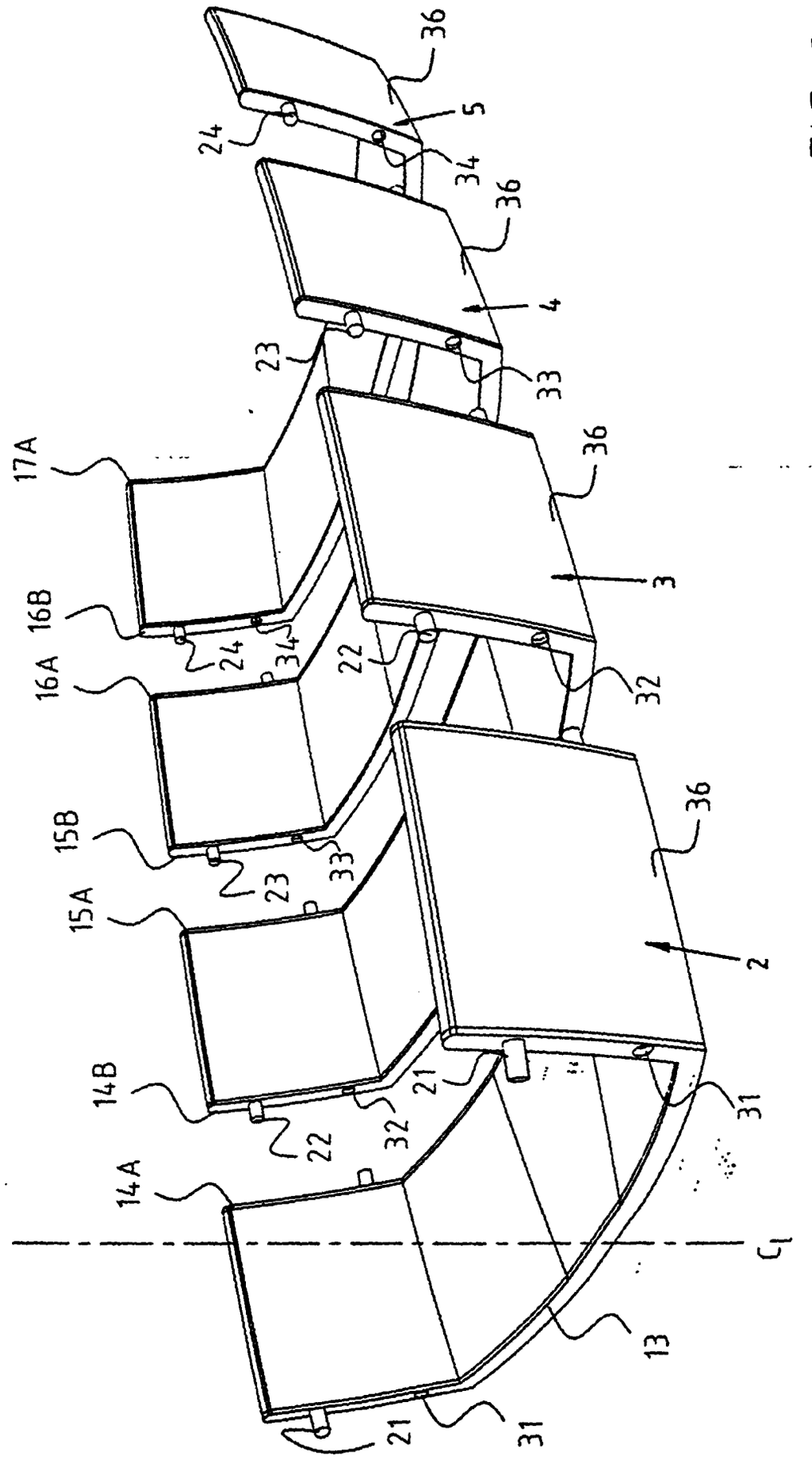
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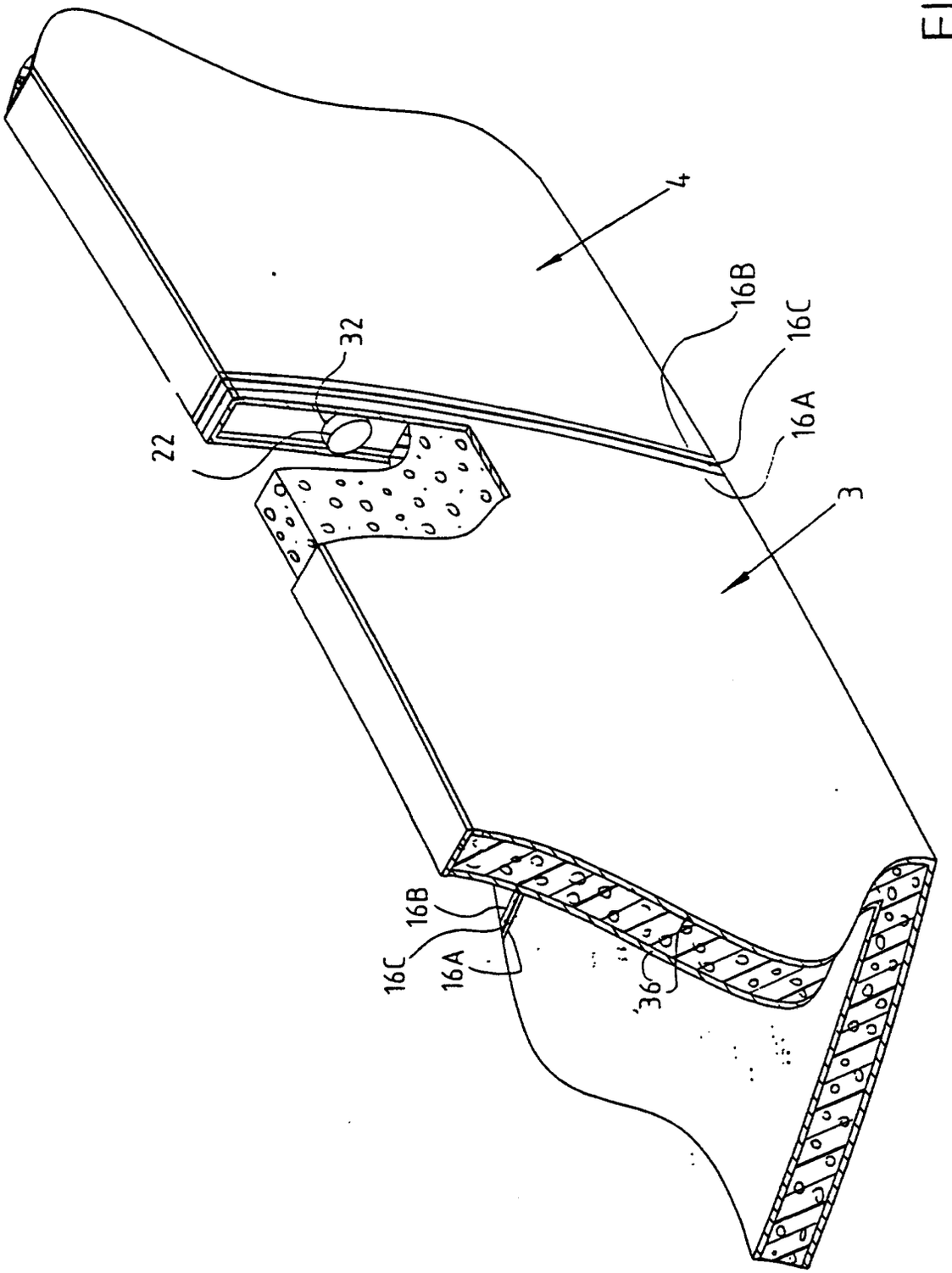
FIG. 2

FIG. 3



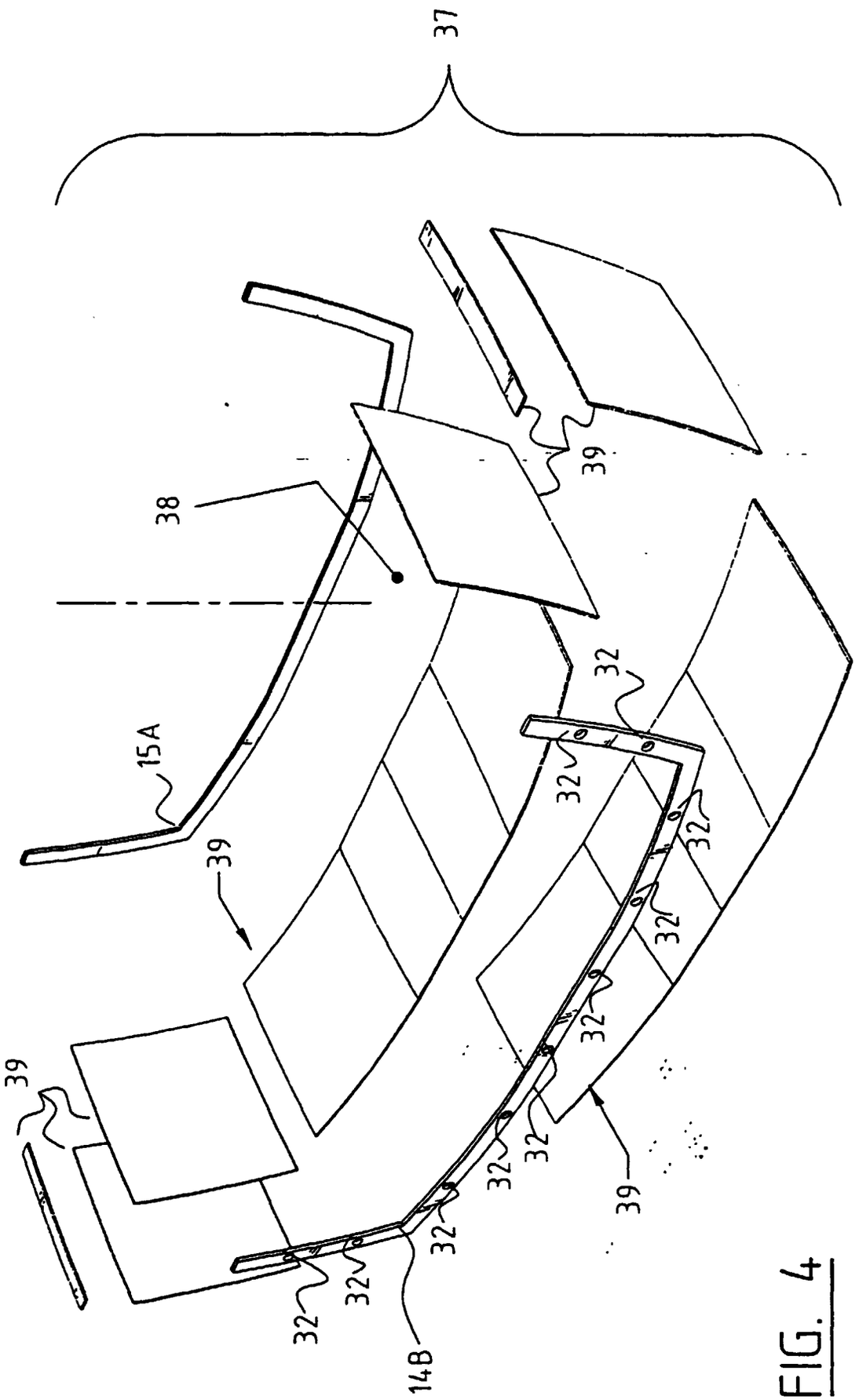


FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 1418

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 3 816 865 A (RAGAN) 18 June 1974 * column 3, line 56 - column 5, line 10; figures 1-13 *	1-3,8,10	B63B3/04 B63B7/04
X Y	US 3 778 528 A (HEIFETZ ET AL) 11 December 1973 * column 4, line 51 - column 5, line 43; figures 1-4 *	1-5 6	
X A	US 3 887 952 A (NICOLL) 10 June 1975 * column 6, line 15 - line 51; figures 1-4 * * column 8, line 9 - line 37 *	1-3,7, 10-13 9	
Y A	US 4 478 167 A (HART) 23 October 1984 * column 4, line 24 - line 29; figures 1-6 *	6 10	
A	US 3 883 911 A (MOORE) 20 May 1975 * abstract; figures 1-7 *	1,8	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B63B E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 August 1998	DE SENA, A

CATEGORY OF CITED DOCUMENTS

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