



(11) Publication number : **0 615 036 A1**

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number : **94301607.1**

(51) Int. Cl.<sup>5</sup> : **E04C 2/42, E04C 2/38, B29C 67/14**

(22) Date of filing : **08.03.94**

(30) Priority : **08.03.93 GB 9304657**

(43) Date of publication of application :  
**14.09.94 Bulletin 94/37**

(84) Designated Contracting States :  
**BE DE FR GB IE IT NL**

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(54) **Improvements relating to floor panels.**

(57) An elongate floor panel (20) comprising a transversely and longitudinally extensive plate part (21) having an upper surface (22) which provides a generally continuous floor surface and depending downwardly therefrom and integral therewith a plurality of longitudinal beam parts (23,23a,23b), the panel having been moulded in one piece by a pultruding operation.

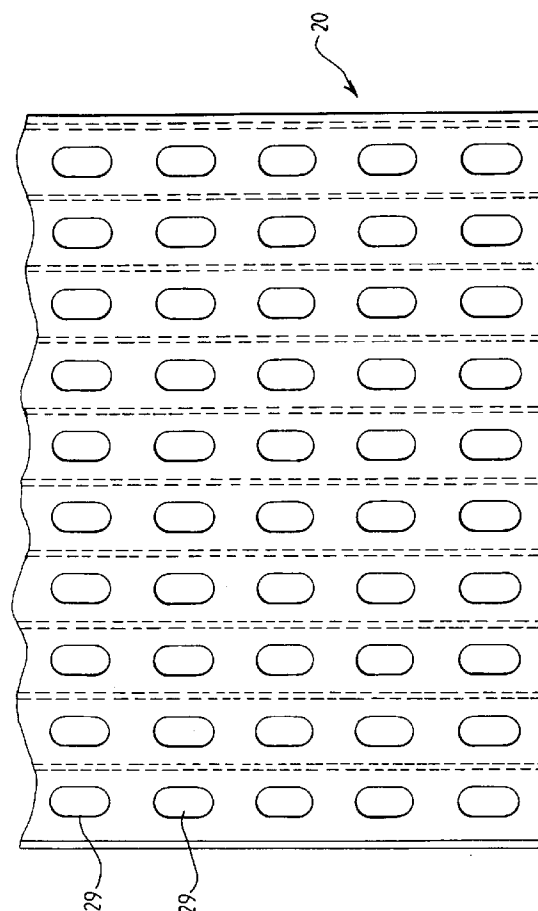


FIG. 1

This invention relates to floor panels, particularly of the kind used in industrial situations, such as in the provision of gratings supported on structural elements, in the provision of walkways, platforms, and access flooring, hereinafter referred to as a floor panel of the kind specified.

One kind of floor panel of the kind specified comprises longitudinal beams, conventionally of T-section secured together at successive positions along the length by transverse bars to provide a transversely and longitudinally extendable grating. This construction is utilised in the provision of open flooring, in which the longitudinal beams bear downward load to provide a grating, whilst the transverse bars are intended primarily to hold the longitudinal beams in the required relative positions. Such a floor panel is disclosed in our UK Patent No. 2036149.

Generally in the provision of such a floor panel, it is desirable to provide the floor panel as large as possible, whilst providing adequate strength and minimal spacing between longitudinal beams. However, a floor panel of this type suffers from the disadvantage that it is necessary to assemble the floor panels, and this is a time consuming operation.

Another floor panel of the kind specified utilises moulded floor panels, the size of which is limited essentially by the size of moulding it is possible to make economically.

According to one aspect of the invention there is provided an elongate floor panel comprising a transversely and longitudinally extensive plate part having an upper surface which provides a generally continuous floor surface and depending downwardly therefrom and integral therewith a plurality of longitudinal beam parts, the panel having been moulded in one piece by a pultruding operation.

Preferably the panel comprises fibre reinforced synthetic plastics material with the fibres aligned or substantially aligned in the longitudinal direction of the panel, thereby improving the strength of the panel.

The pultruding operation causes the fibres to become aligned or more aligned in the longitudinal direction.

The reinforcing fibre may comprise uni-directional rovings to provide properties in the longitudinal direction of the member and continuous strand mat to provide transverse properties.

The plastics material may comprise polyester or vinylester resin and may also comprise at least one of filler, pigments, curing agents and processing aids as appropriate and ultra-violet inhibitor.

The panel may have a surface veil of polyester non-woven fabric which encases the glass fibre reinforcement and provides a layer of resin at the surface of the panel.

The veil may be capable of providing additional protection against ultra-violet degradation, preventing fibre blooming and increasing corrosion resistance.

The plate part may comprise from top surface downwardly,

a surface veil,

a plurality of continuous filament mats,

a filling of uni-directional rovings,

a plurality of continuous filament mats,

a surface veil.

The beam parts may comprise,

a surface veil,

a continuous filament mat,

a filling of uni-directional rovings,

a continuous filament mat

a surface veil.

The filaments and the rovings may comprise glass filaments and rovings respectively.

Preferably the longitudinal beam parts are of inverted T-shape in cross-section, the stem of the T is being integral with the plate part and the head of the T providing oppositely directed flanges at the ends of the beam parts remote from the plate part.

Preferably the upper face of the floor surface is provided with longitudinal ribbing or other protruberences, to improve grip.

Preferably the panel part is provided with a plurality of apertures intermediate the beam parts.

The apertures may be punched apertures.

The panel may be provided with a longitudinally extending groove on one side and a longitudinally extending tongue at the other side whereby the tongue and groove of one panel may interengage with a groove and tongue respectively of the two other adjacently juxtaposed panels to transfer load between the adjacent panels.

The panel may be placed on supports with the beam parts lowermost and engaging the supports and the floor surface uppermost.

In this manner a floor panel may be produced in a more convenient size than by the conventional moulding operation, without the need to carry out an assembly operation.

The generally continuous nature of the floor surface aids the overall strength of the panel, allowing the

longitudinal beams to be provided at increased transverse spacing.

According to another aspect of the invention we provide a method of forming a floor wherein a plastics composition containing filamentary reinforcement is formed by pultrusion into a panel comprising a longitudinally and transversely extensive plate part having a generally continuous floor surface at one face and a plurality of elongated, mutually parallel beam part at an opposite face and wherein the panel is placed on supports with the beam part lowermost and engaging the supports and the floor surface uppermost.

There will now be given a detailed description, to be read with reference to the accompanying drawings, of a floor panel which is a preferred embodiment of this invention, having been selected for the purposes of illustrating the invention by way of example.

In the accompanying drawings:

FIGURE 1 is a plan view showing a portion of the floor panel which is the preferred embodiment of this invention;

FIGURE 2 is an end view of the panel of Figure 1;

FIGURE 3 is a fragmentary enlarged end view of one side of the panel;

FIGURE 4 is a fragmentary enlarged view of the opposite side of the panel;

FIGURE 5 is a diagrammatic cross-section to an enlarged scale showing how a panel embodying the invention is fixed to a support;

FIGURE 5a is a fragmentary perspective view showing the fixing arrangement of Figure 5;

FIGURE 6 is a fragmentary cross-section showing the internal structure of the panel of Figures 1 to 5, and

FIGURE 7 is a schematic perspective view showing a portion of a conventional floor panel.

The floor panel shown in Figure 7 comprises a plurality of elongate bars 10 secured together at spaced intervals by transverse bars 12, the upper limb 11 of the longitudinal beams cooperating together to provide a floor surface having gaps 13 between adjacent longitudinal beams. The panel comprises a transversely and longitudinally extensive plastic part 21.

Conversely, in accordance with the present invention, an elongate floor panel 20 is provided, having been made in one piece by a pultruding operation, from glass fibre reinforced plastics material. The panel 20 comprises a transversely and longitudinally extensive plate part 21 having an upper surface 22 which provides a generally continuous floor surface. Depending downwardly from the plate part 21 and formed integrally therewith are a plurality of longitudinally extending beam part 23, 23a, 23b. Except for first and second end beam parts 23a, 23b respectively, all the beam parts 23 are of the same shape which, in end elevation and in cross-section, is of inverted T-shape each having a vertically downwardly depending stem 24 formed integrally at one end with the plate part 21 and at the lower end a transversely extending head 25.

As best shown in Figures 3 and 4, the first beam part 23a has a configuration so as to provide a longitudinally extending rib or tongue portion 26 whilst the second end beam part 23b has a configuration to provide a longitudinally extending groove portion 27. Accordingly, a tongue portion 26 of one panel 20 can be received within the groove portion 27 of an adjacent panel so that a load can be transferred between adjacent panels.

Suitable clip means may be provided to clip interengaged end beam parts 23a, 23b together or any other suitable means may be provided to join adjacent panels together, or separate joining means may not be provided, reliance being placed on the fixing of the panels to a support structure to maintain the parts in a desired juxtaposition.

The beam parts 23, 23a, 23b provide resistance to deformation of panel part 21 under load.

Elongate ribs 28 are provided on the upper surface 22 to improve grip although, if desired, the other patterns of ribbing or other grip providing means may be provided, or indeed omitted in any particular application.

A plurality of apertures 29 are provided distributed throughout the extent of the plate part 21, as shown in Figure 1. In the present example each aperture 29 is identical and comprises semi-circular longitudinally opposite ends interconnected by parallel side wall parts.

Provision of apertures permits drainage of water from the panel and also reduces the weight of the panel. The apertures 29 are made by punching and each aperture in a row may be punched at the same time and thus a relatively rapid rate of production may be achieved. If desired, suitable sealant may be provided to the walls of the punched apertures.

The panel is arranged to be supported on a support structure 30 with the undersurface 31 of the heads 25 engaging the upper surface of the support structure 30. A fixing clip assembly, shown generally at 32 in Figure 5, is provided to fix the panel to the support 30. The clip assembly 32 comprises a glass fibre reinforced plastic holder plate 33 which engages the upper surface 34 of flanges 35 of the heads 25. A stainless steel bottom clip 36 is clamped beneath a flange 37 of the support structure 30 by a screw 38 and nut 38a, access to the head 39 of the screw being provided through one of the apertures 29. To assemble the fixing assembly the screw 38 is inserted through the holder plate 33 and the stainless steel bottom clip 36 and the nut 38a

engaged with the screw. The assembly is then slid along the flanges 35 to the desired location and then a plodring, not shown, may be positioned on the support 30. The fixing assembly 32 is then slid into position, as shown in Figure 5a and then the screw 38 is rotated with a screwdriver from above through the aperture 29 with nut 38a being prevented from rotation by the configuration of the bottom clip 36.

5 If desired, any other suitable means for holding the panel to a support structure may be provided.

Referring now to Figure 6, the panel, as mentioned before, is made by a pultrusion process. The plate part 21 has the following structure. Starting at the top surface 22, there is a 20g/m<sup>2</sup> chemical resistant surface veil 40 of a polyester non-woven fabric to encase the glass fibre reinforcement and add a layer of resin to the surface. This is to provide additional protection against ultra-violet degradation, to prevent the fibre blooming and increase corrosion resistance.

10 Below the veil are four 600g/m<sup>2</sup> E glass continuous filament mats 41a-d and then a uni-directional E glass roving filling 42. Beneath the roving 42 are two further 600g/m<sup>2</sup> E glass continuous filament mats 44a,b.

The uppermost mat 41a extends downwardly over the side edges 43 of the plate part 21 and over a majority of the tongue part 26 and groove part 27. A further 600g/m<sup>2</sup> E glass continuous filament mat 44c is overlapped by an end part of the mat 41a in the groove 27 and extends around the head 25 of the associated beam part 23b and provides a third mat for the plate portion 21 beneath the mats 44a, 44b. A further similar mat 44d extends around the next adjacent beam part 23 and overlaps an end part 44c' of the mat 44c, the mats 44a, 44b being deflected as shown to make the undersurface 47 of the plate part 21 between the beam parts 23 planar. An end part 44d' of the mat 44d is similarly overlapped by a further mat 44e which extends around the next adjacent beam part 23 and this is repeated across the transverse extent of the panel.

20 A penultimate beam part 23 has a further mat 44f. At the first end beam part 23a, the uppermost mat 41a extends past the majority of the tongue portion 26 and overlaps an end part of a further mat 44g which overlaps an end part 44f' of the mat 44f. A polyester surface veil 40, as described above, extends over the whole of the external surface of the panel including the beam parts.

25 Each beam part 23, 23a, 23b, in addition to the polyester mats 44c - f previously described, comprises uni-direction E glass rovings 45 to fill.

The above mentioned mats and rovings reinforce a suitable synthetic plastics resin such as polyester or vinylester resin which may also comprise pigment, curing agent and processing agent as appropriate, as well as ultra-violet inhibitor to impart resistance to the effects of ultra-violet radiation.

30 If desired the panel may have, for example, three mats above the rovings or may contain more than four and three mats respectively above and below the rovings. If desired more layers of rovings may be provided between different mats. The beam parts may have more mats distributed as desired. The mats and rovings may be made of other suitable material.

35 The panels described hereinbefore have a cross-sectional area of approximately 5200mm<sup>2</sup> and may be 500mm wide, 40mm deep and 6 metres long.

The panel has a weight of approximately 20kgs per square metre which is considerably lighter than the equivalent steel panel, which is of a weight of approximately 81kgs. The above mentioned 20kg weight is the weight prior to the provision of apertures 29. Of course, the weight is further reduced when the panel is thus slotted.

40 The panel of the present invention, being a one-piece construction, has the necessary strength and deflection resistance without any need to assemble individual components, thereby avoiding problems hitherto associated with jointing.

A panel embodying the invention, described hereinbefore, was tested and found to have the following properties:

45	Modulus of Elasticity (Full section)	GPa	30
	Flexural Strength (Full section)	MPa	300
	Short beam shear strength	MPa	30
50	Bearing strength	MPa	200

The strength provided to the plate part 21 by the generally continuous nature that the floor surface improves the overall strength of the panel, allowing the beam parts 23 to be provided at more greatly spaced intervals than floor panels of the assembled type.

55 Thus the invention provides the benefit of a moulded floor panel, with the benefits of an elongate assembled floor panel, without the need for assembly, particularly in that gaps between the longitudinal beams is obviated.

The panel is made by a pultrusion process in which the mats and rovings are fed into a pultrusion die together with the resin, there being means continuously to draw the mats and/or rovings through the die.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

## Claims

1. An elongate floor panel comprising a transversely and longitudinally extensive plate part having an upper surface which provides a generally continuous floor surface and depending downwardly therefrom and integral therewith a plurality of longitudinal beam parts, the panel having been moulded in one piece by a pultruding operation.
2. A panel according to claim 1 wherein the panel comprises fibre reinforced synthetic plastics material with the fibres aligned or substantially aligned in the longitudinal direction of the panel, thereby improving the strength of the panel.
3. A panel according to claim 2 wherein the reinforcing fibre comprises uni-directional rovings to provide properties in the longitudinal direction of the member and/or continuous strand mat to provide transverse properties.
4. A panel according to claim 1 or claim 2 wherein the plastics material comprises polyester or vinylester resin and may also comprise at least one of filler, pigments, curing agents and processing aids as appropriate and ultra-violet inhibitor.
5. A panel according to any one of claims 2 to 4 wherein the panel has a surface veil of polyester non-woven fabric which encases the glass fibre reinforcement and provides a layer of resin at the surface of the panel.
6. A panel according to any one of claims 2 to 5 wherein the plate part comprises from top surface downwardly,
  - a plurality of continuous filament mats,
  - a filling of uni-directional rovings,
  - a plurality of continuous filament mats and/or
  - the beam parts comprise, from one side surface to the other,
  - a continuous filament mat,
  - a filling of uni-directional rovings,
  - a continuous filament mat and/or
 the surface of the panel is provided with a surface veil.
7. A panel according to any one of claims 2 to 5 wherein the filaments and the rovings comprise glass filaments and rovings respectively.
8. A panel according to any one of the preceding claims wherein the longitudinal beam parts are of inverted T-shape in cross-section, the stem of the T is being integral with the plate part and the head of the T providing oppositely directed flanges at the ends of the beam parts remote from the plate part.
9. A panel according to any one of the preceding claims wherein the plate part is provided with a plurality of apertures intermediate the beam parts.
10. A panel according to claim 9 wherein the apertures are punched apertures.
11. A panel according to any one of the preceding claims wherein the panel is provided with a longitudinally extending groove on one side and a longitudinally extending tongue at the other side whereby the tongue and groove of one panel may interengage with a groove and tongue respectively of the two other adjacently juxtaposed panels to transfer load between the adjacent panels.
12. A method of forming a floor wherein a plastics composition containing filamentary reinforcement is formed

by pultrusion into a panel comprising a longitudinally and transversely extensive plate part having a generally continuous floor surface at one face and a plurality of elongated, mutually parallel, beam parts at an opposite face and wherein the panel is supported on supports with the beam part lowermost and engaging the supports and the floor surface uppermost.

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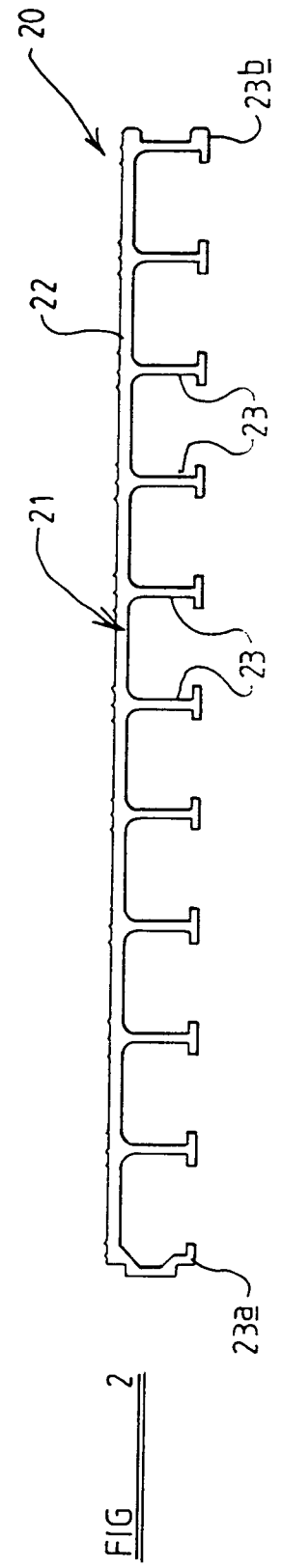
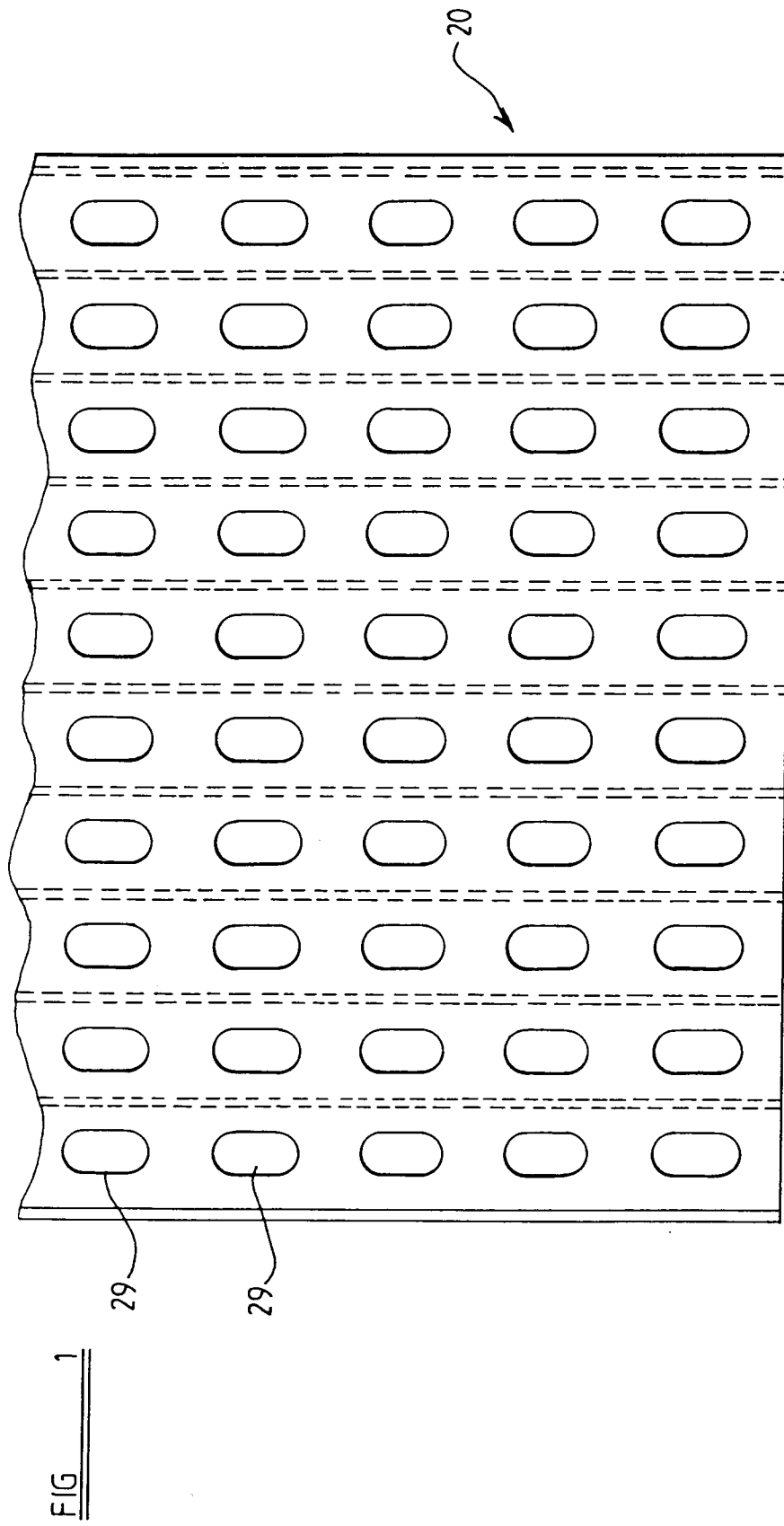


FIG 4

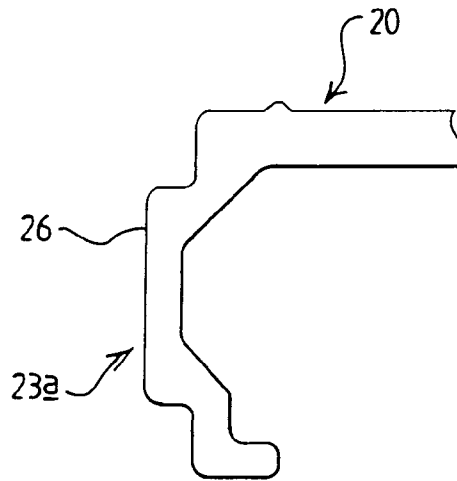
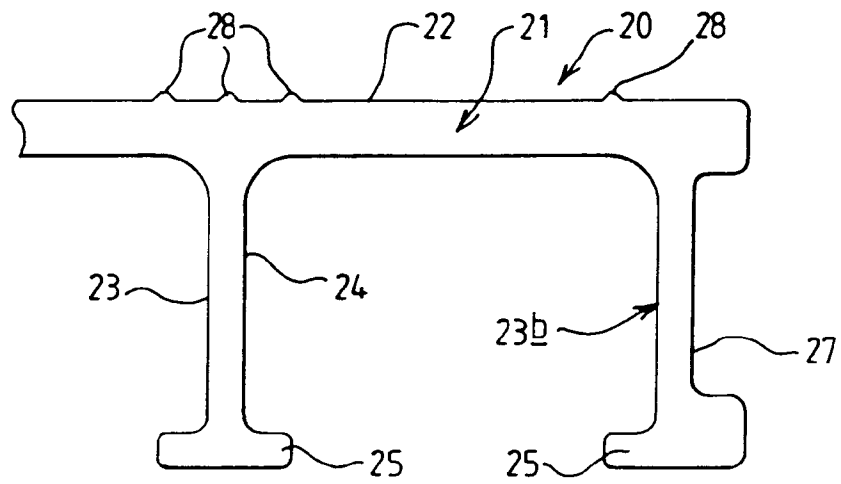
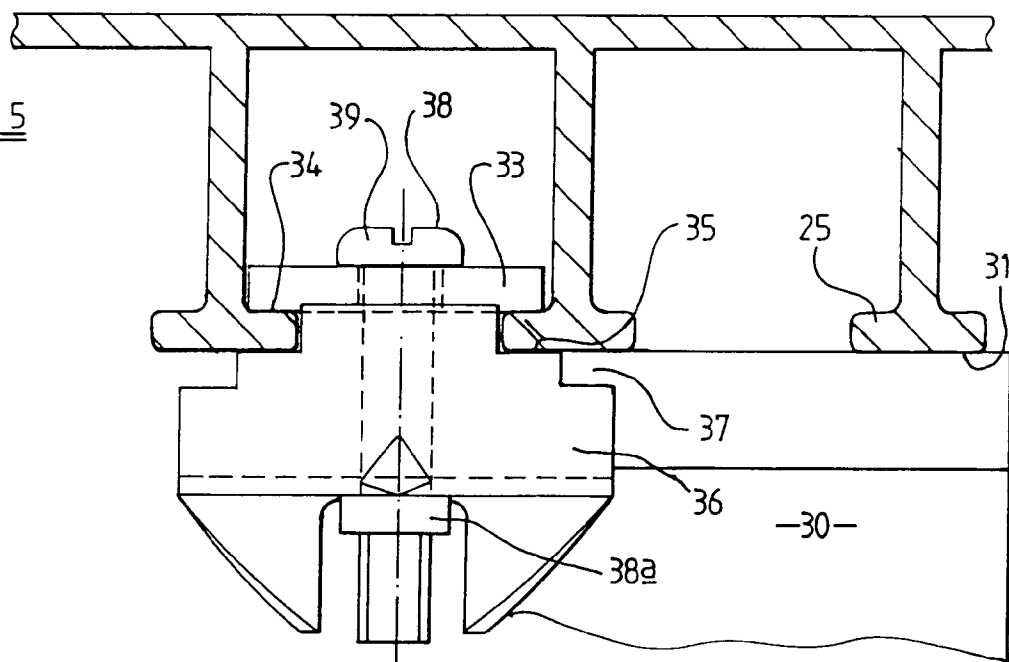


FIG 3

FIG 5





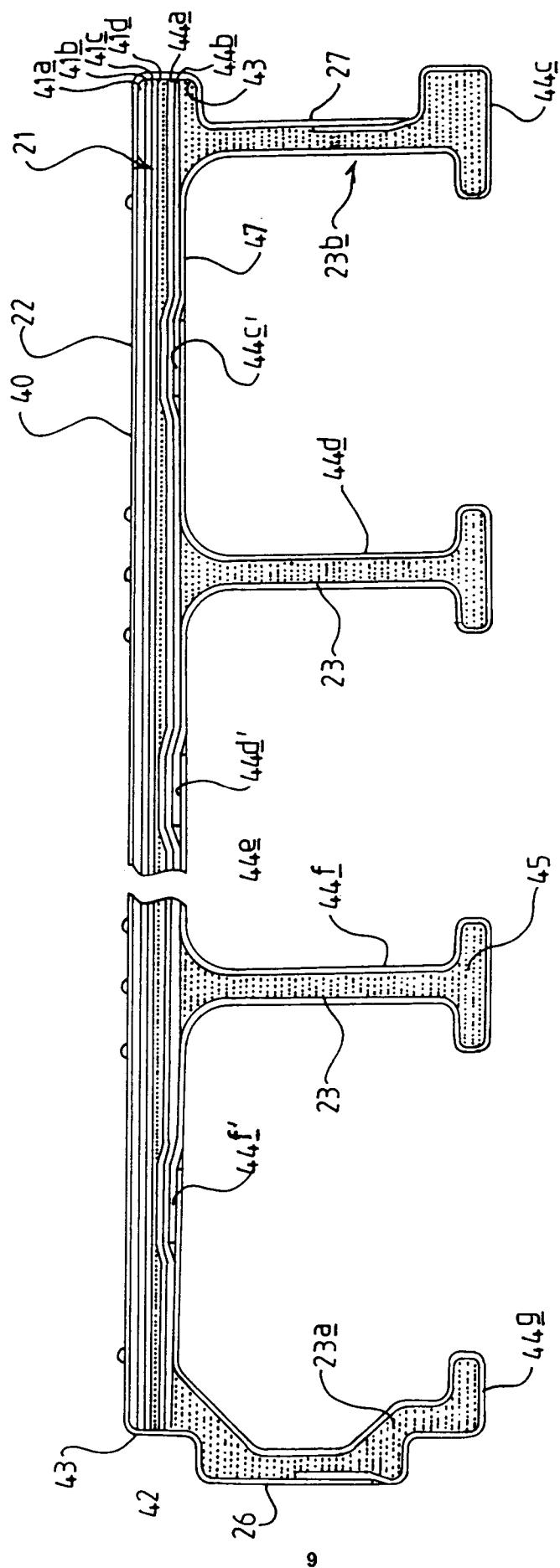


FIG 6

FIG 5a

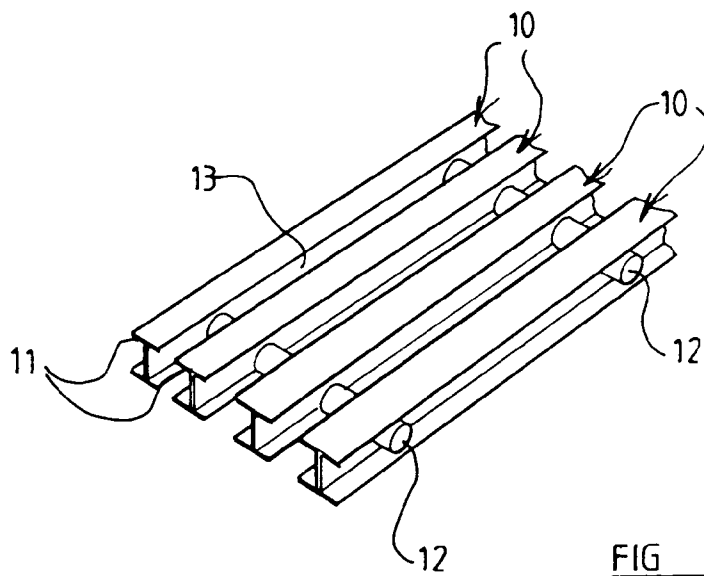
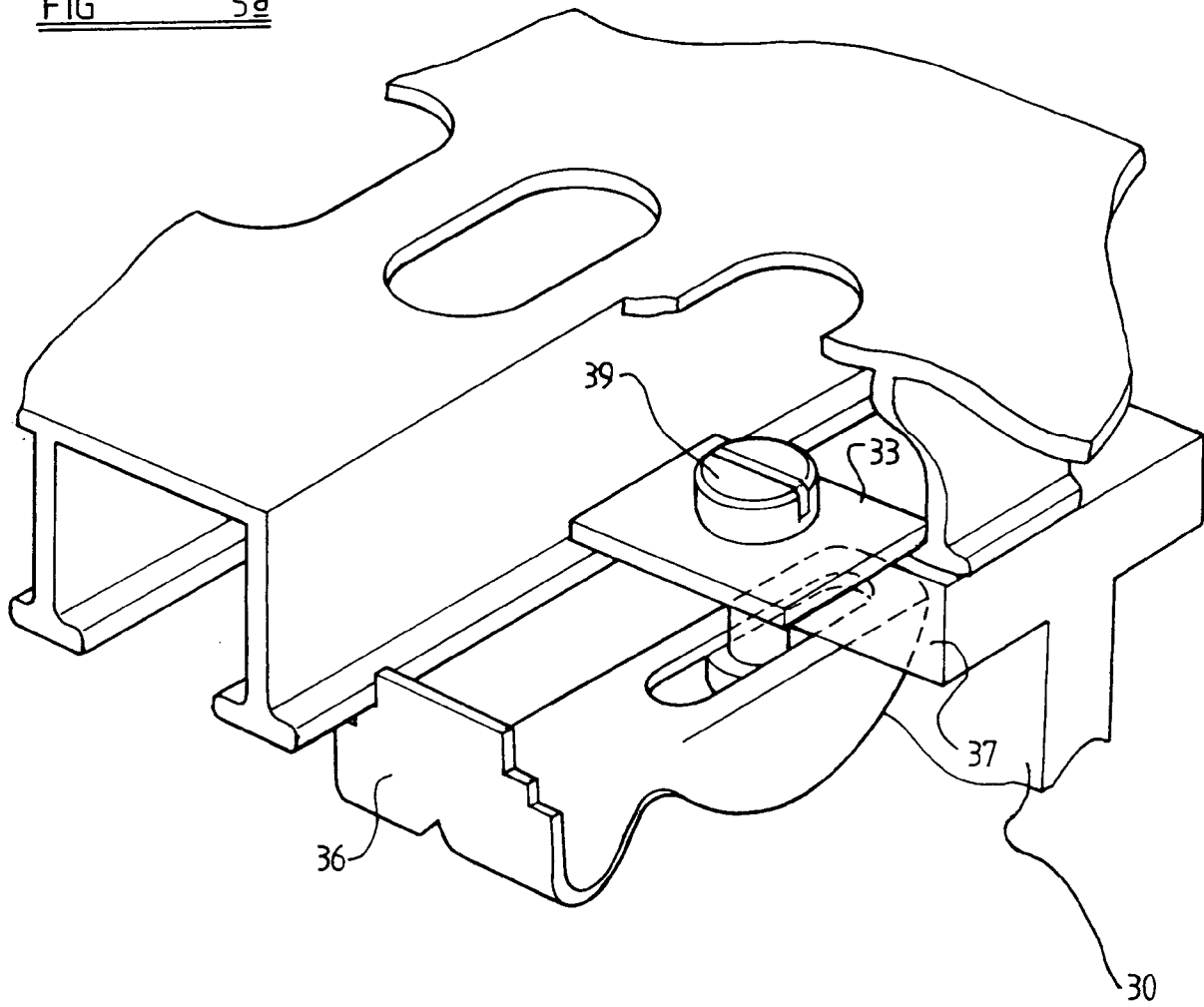


FIG 7



European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
EP 94 30 1607

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.5)
X	CA-A-989 134 (HASSMAN) * page 3, line 2 - page 5, line 13; figures *	1-12	E04C2/42 E04C2/38 B29C67/14
X	EP-A-0 413 500 (MAUNSELL STRUCTURAL PLASTICS) * column 4, line 20 - column 5, line 29 * * column 6, line 28 - line 39; figures 1,4 *	1-12	
X	EP-A-0 108 576 (MAUNSELL & PARTNERS)	1-7	
A	US-A-4 752 513 (RAU ET AL.) * column 6, line 39 - column 7, line 20; figures 1,2 *	5-7	
A	FR-A-2 238 000 (OWENS-CORNING FIBERGLAS) * page 1, line 28 - page 2, line 5; figures 1,2 *	5-7	
A	GB-A-2 190 116 (YASUMOTO MUROOKA) * page 1, line 64 - line 75; figure 2 *	11	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	US-A-4 078 348 (ROTHMAN) * column 5, line 41 - line 46 * * column 6, line 54 - column 7, line 30 * * column 8, line 34 - line 46; figure 4 *	1,12	E04C B29C
A	US-A-4 798 029 (CARLTON) * figure 2 *		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 13 June 1994	Examiner Attalla, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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