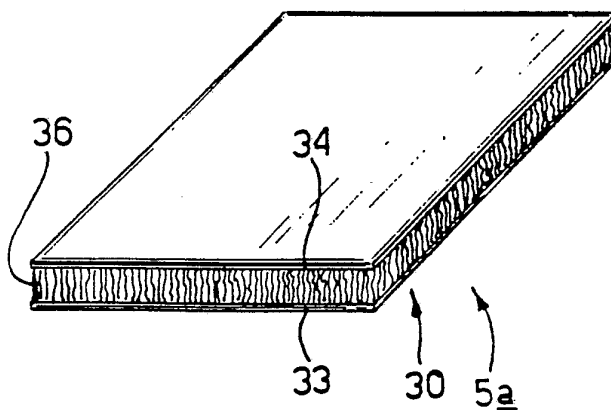


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(54) Title: SECTIONAL HABITATIONAL MODULE



(57) Abstract

A sectional habitational module (1) includes a plurality of interconnected panels (5) defining a plurality of habitable spaces (8). The panels comprise internally a three-dimensional textile (30) formed from two outer textile sheets (33, 34) facing each other and connected together by a plurality of extensible threads (36). The textile (30) is impregnated with a thermosetting resin which is hardened so that the sheets (33, 34) form two flat, rigid, surfaces and the threads (36) extend substantially perpendicularly of the sheets (33, 34) defining an internally hollow structure. The module has extreme lightness associated with sufficient rigidity and is substantially unaffected by bad weather and is easy to assemble.

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SECTIONAL HABITATIONAL MODULETECHNICAL FIELD

The present invention relates to a sectional habitational module.

5

BACKGROUND ART

Sectional habitational modules are known which include a plurality of pressed sheet metal parts which are connected together (for example by bolts) to form a plurality of spaces adapted to be inhabited.

10

These habitational modules have a series of disadvantages: they are rather heavy and difficult to transport, can easily be damaged by atmospheric agents, do not provide good acoustic and thermal insulation and are relatively costly.

15

DISCLOSURE OF INVENTION

The object of the present invention is to provide a habitational module which solves the problems of known habitational modules.

20

This object is achieved by the present invention which relates to a sectional habitational module including a plurality of interconnected panels defining at least one space, characterised in that the panels comprise a layered structure comprising at least one three-dimensional textile formed from two textile sheets facing each other and connected together by a plurality of

25

extensible threads; the three dimensional textile being impregnated with resin.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described with reference to the appended drawings in which:

Figure 1 is a perspective view of a habitational module formed in accordance with the principles of the present invention;

Figure 2 is a perspective view of part of a first type of panel constituting the habitational module of Figure 1;

Figure 3 is a perspective view of part of a second type of panel constituting the habitational module of Figure 1;

Figure 4 is a simplified illustration of a phase in the manufacture of the panel of Figure 2;

Figure 5 is a simplified illustration of a phase in the manufacture of the panel of Figure 3; and

Figures 6 to 11 are transverse sections illustrating several parts joining the panels.

BEST MODE FOR CARRYING OUT THE INVENTION

In Figure 1 a sectional habitational module is generally indicated 1 and includes a plurality of interconnected panels 5 of synthetic material defining a series of spaces 8 designed to be inhabited. The panels 5 are placed with their straight peripheral edges 10 close together and are connected together by profiled metal

sections 15 which join the peripheral parts of the panels 5 firmly together.

5 The panels 5 form the peripheral walls 20, the internal partition walls (not illustrated), the roof 22 and the inner floor (not illustrated) of the module 1 defining a habitation.

10 The panels 5 have a layered structure including a three-dimensional textile impregnated with resin.

Figure 2 illustrated a first type of panel (indicated 5a) which comprises a three-dimensional textile 30 formed from two facing textile sheets 33 and 34 connected
15 together by a plurality of extensible threads 36.

The textile 30 is impregnated with solidified resin so that the sheets 33 and 34 form two flat rigid faces joined together by the threads 36 which extend
20 substantially perpendicularly between the sheets 33 and 34.

The panel 5a is conveniently of the type described and illustrated in Italian patent application number
25 TO-91A000397 filed on 29 May 1991 by the same applicant and the required parts of the content whereof are incorporated herein simply for reference; it is

manufactured by a process (refer to Figure 4) including a first phase in which a layered structure 40, soaked with resin, is inserted between a first die 42 and a second die 43 of a press 45; this layered structure 40 includes the three-dimensional textile 30 and at least one pair of plates 47 and 48 face to face with sheets 33 and 34 of the textile 30 on the outside of the structure 40.

The dies 42 and 43 have means for attaching the plates 47 and 48 to their surfaces and have heating resistors 44 for accelerating the polymerisation of the resin.

In a second phase, the dies 42 and 43 are closed to a certain extent, the three-dimensional textile 30 is pressed between the plates 47 and 48 and the resin impregnating the sheets 33 and 34 distributes itself between the parts in contact and also permeates the threads 36 uniformly.

In a third phase, the plates 47 and 48 are firmly attached to the dies 42 and 43 (for example by means of a vacuum system).

In a fourth phase the dies 42 and 43 are reopened through a predetermined distance within the limit of the natural elastic recovery of the three-dimensional textile 30 due to the action of the combination of threads 36 which tend

to straighten.

In a fifth phase the resistors 44 are activated and heat the outermost parts of the structure 40 causing partial polymerisation of the resin between the plates 47 and 48 and the outer sheets 33 and 34 of the three-dimensional textile 30 while the resin impregnating the threads 36 remains in a substantially plastic state.

10 In a sixth phase, the dies 42, 43 are opened to a predetermined distance to move the sheets 33 and 34 away from each other and extend the threads 36 so as to form a partially hollow structure inside.

15 In a seventh phase the structure is held clamped between the two dies 42, 43 and heated until the polymerisation of the resin is complete.

In an eighth phase, the plates 47 and 48 are released from the surfaces of the dies 42, 43 which are completely opened; finally, the layered structure 40 forming the panel 5a is removed from the press.

The plates 47 and 48 may subsequently be detached mechanically and removed from the layered structure 40.

25 Figure 3 illustrates a second type of panel 5b which

comprises a three-dimensional textile entirely similar to the textile 30 and hence formed from two facing textile sheets 33 and 34 connected together by a plurality of extensible threads 36.

5

In this textile 30, the space between the sheets 33 and 34 is filled with a solidified expanded resin 50 injected between the sheets 33 and 34 themselves under pressure.

10 The panel 5b is conveniently of the type described and illustrated in Italian patent application no 12441-A/90 filed on 26 March 1990 by the same applicants, the required parts of the content whereof are incorporated herein simply for reference; it is formed (refer to
15 Figure 5) by the insertion of a layered structure 51, including at least the three-dimensional textile 30 impregnated with resin, between a first die 52 and a second die 53 of a press 55.

20 The dies 52 and 53 are closed and the expanded resin 50 (or another solidifiable expansible fluid) is injected under pressure between the sheets 33 and 34 which are pressed against the walls of the dies 52 and 53.

25 Subsequently, the dies 52 and 53 are heated to cause the polymerisation of the resin 50 injected between the sheets 33 and 34.

Finally, the dies 52 and 53 are re-opened and the layered structure forming the panel 5b is removed from the press 55.

5 The layered structure 51 may further include two outer textile sheets impregnated with a thermosetting resin and face to face with the sheets 33 and 34 or outer plastics or metal sheets, conveniently with the interposition of an adhesive layer.

10

Figure 6 is a cross-section of a first type of profiled section 15a used to join together two flat panels 5 disposed parallel and adjacent each other; the profiled section 15a has a double-T section and defines two
15 substantially U-shaped, aligned channels 60 housing respected peripheral portions of the panels 5.

Figure 7 is a cross section of a second type of profiled section 15b used to join two flat panels 5 disposed
20 perpendicular to each other; the profiled section 15b has a substantially L-shaped section defining two substantially U-shaped channels 62 at right angles housing respective peripheral portions of the panels 5.

25 Figure 8 is a cross-section of a third type of profiled section 15c used to join two flat panels 5 disposed perpendicular to each other; the profiled section 15c has

a substantially Y-shaped section and defines two substantially U-shaped channels 64 at right angles housing respective peripheral portions of the panels 5.

5 Figure 9 is a cross-section of a fourth type of profiled section 15d used to join to flat panels 5 disposed so that they intersect at an acute angle; the profiled section 15d has an essentially V-shaped section and includes a first wing 67 defining an inclined U-shaped
10 channel 68 housing a peripheral portion of a first panel 5 and a second wing 70 defining an inclined U-shaped channel 71 housing a peripheral portion of a second panel 5.

15 The wings 67 and 70 are joined together by a screw 75 which passes two coaxial consecutive through-holes 76 and 77 formed in respective front portions of the wings 67 and 70; the screw 75 has one end screwed into a hole in a plate 79 which presses against inner portions of the
20 wings 67 and 70.

Figure 10 illustrates a profiled section 15f used to join together three panels 5 (conveniently constituting two side walls and a ceiling portion of the habitational
25 module 1). The profiled section 15f includes a first vertical portion 90 having an essentially L-section and defining two U-shaped channels 92 at right angles and

housing respective peripheral portions of the panels 5, and a second portion 95 firmly fixed to an upper end of the portion 90. This portion 94 has a channel 96 which extends in a horizontal plane perpendicular to the portion 90 and houses peripheral portions of a panel 5 which acts as a ceiling.

It is clear from the above that the present invention solves the disadvantages of known habitational modules since it is very light (and hence easy to transport while being sufficiently rigid), is almost entirely insensitive to atmospheric agents, is sufficiently thermally and acoustically insulating, and is easy and quick to assemble and take apart.

15

It in fact suffices to join the various panels 5 together by means of the profiled sections 15 to form the walls, floors, ceilings, etc. Openings for windows, doors, etc may also easily be formed in the panels 5 with conventional tools.

20

The habitational module 21 may thus be constructed by only two persons who can handle the various panels 5 even without lifting means and without having to make through-holes.

25

Electrical, water and sanitary services may be formed in

a space in the floor foundation which is easily accessible, as shown schematically in figure 11, in which this space 99 is illustrated and defined by a first base panel 100 and a second panel 103 located above and parallel to the panel 100 and serving as a floor. The panels 100 and 103 are connected by a profiled metal section 105 defining two channels 109 and 110 of substantially U-section disposed parallel to each other and housing respective end portions of the panels 100 and 103.

More particularly, the habitational module is to advantage usable to form a readily transportable housing which can be installed, for example, in tourist villages, camp sites, and building yards.

The module is also adapted to provide housing which is substantially temporary but quick to install, and usable for example for housing refugees or populations hit by earthquakes.

Finally it is clear that modifications and variations may be made to the present module without thereby departing from the protective scope of the present invention.

25

The profiled sections 15 for example may have different shapes from those described and may be made equally well

from plastics material or metal. The panels 5, moreover, may also be made with curved profiles (in particular the panels 5b of Figure 3). The panels 5 may have outer coating sheets for decorative purposes. Insulating materials such as, for example, expanded phenolic foams, may be injected into the panels 5a of Figure 2. The panels 5 are always made from fire-resistant material with low toxic omissions in accordance with current standards for materials in the building field.

10

The panels 5 may also have cavities and internal spaces (particularly tubular spaces) for the passage of cables, tubes or metal strengthening elements.

15 Furthermore, with reference to the panel 5a Figures 2 and 4, in order to enhance the difference between the polymerization of the resin impregnating the sheets 33 and 34 of the textile 30 and that impregnating the threads 36, a catalyst may be spread on the surfaces of the plates 47 and 48 which are to contact the impregnated sheets 33 and 34 or directly on the sheets 33 or 34 themselves before the layered structured 40 is placed between the dies 42 and 43.

25 Thus the greater reactivity of the resin in the zones of contact between the sheets 33 and 34 and the plates 47 and 48, which is already increased by the greater

provision of heat, is further increased compared with the reactivity of the resin impregnating the threads 36 by the local presence of a greater quantity of catalyst, and hence the time needed for the resin to polymerise and form a firm connection between the outer contact surfaces of the three dimensional textile 30 is reduced, this firm contact ensuring good extension of the threads 36 in the subsequent phases of progressive opening of the press 45.

Conveniently, a methyl-ethyl-ketone peroxide may be used as the catalyst for a polyester resin, in percentages, for example, of up to 3%, acidic solutions may be used for phenolic resins in percentages, for example, of up to 15%, and amide-based resins may be used for epoxy resins in percentages, for example, of between 30% and 50%.

The panels 5 could also be constituted by a plurality of superposed layers of three-dimensional textiles 30; conveniently a catalyst may be spread between the facing surfaces of these layers, for example between the sheets 33 and 34, to cause local acceleration of the polymerisation of the resin and the firm interconnection of the facing surfaces of the various layers so as to ensure the extension of the threads 36 within the various layers during the phases in which the press is opened progressively.

In addition, the electrical heating resistors 44 for the dies 42 and 43 could be replaced by other means for accelerating the polymerisation of the resin.

CLAIMS

1. A sectional habitational module including a plurality of inter-connected panels (5) defining at least one space (8), characterised in that the panels (5) comprise a layered structure including at least one three-dimensional textile (30) formed from two textile sheets (33,34) facing each other and connected together by a plurality of extensible threads (36), the three-dimensional textile (30) being impregnated with resin.
2. A module according to Claim 1, characterised in that the three-dimensional textile (30) is impregnated with a solidified resin; the sheets (33,34) being stiffened by the resin and the threads (36) extending substantially perpendicularly between the sheets (33,34) forming a partially hollow structure.
3. A module according to Claim 2, characterised in that the panels (5a) are made in a plurality of phases including:
- a first phase in which the layered structure (40) is inserted between first and second dies (42,43) of a press (45); the layered structure (40) including the three-dimensional textile (30) formed from the textile sheets (33,34) disposed parallel to each other and interconnected by the said plurality of threads (36)

extending from the facing surfaces of the sheets (33,34);
at least one pair of plates (47,48) being disposed face
to face with the said sheets (33,34) towards the outside
of the structure (40); at least the three-dimensional
5 textile (30) also being soaked with the resin; the dies
(42,43) having means for fixing the said plates (47,48)
to their surfaces ;

- a second phase in which the dies (42,43) are at
least partially closed and the three-dimensional textile
10 (30) is pressed between the plates (47,48) and the resin
impregnating the sheets distributes itself between the
parts in contact and also permeates the threads (36)
uniformly;

- a third phase in which the plates (47,48) are
15 attached firmly to the dies (42,43);

- a fourth phase in which the dies (42,43) are
reopened through a predetermined distance within the
limit of the natural elastic recovery of the three-
dimensional textile (30) due to the action of the
20 combination of threads (36) tending to straighten
themselves;

- a fifth phase in which the resin present between the
plates (47,48) and the outer sheets (33,34) of the three
dimensional textile (30) is at least partially
25 polymerised while the resin impregnating the threads (36)
remains substantially in a plastic state;

- a sixth phase in which the dies (42,43) are opened

to a predetermined distance to move the sheets (33,34) away from each other and extend the threads (36) so as to form a partially hollow internal structure;

- a seventh phase in which the structure remains clamped between the two dies (42,43) until the resin has completely polymerised;
- an eighth phase in which the plates (47,48) are released from the surfaces of the dies (42,43), the dies (42,43) are opened completely and the layered structure (40) forming the panel (5a) is removed from the press (45).

4. A module according to Claim 3, characterised in that the dies (42,43) are heated to accelerate the polymerisation of the resin; in the fifth phase the dies (42,43), by heating substantially only the outermost parts of the structure, essentially cause only the partial polymerisation of the resin present in the outer sheets (33,34) of the three-dimensional textile (30).

20

5. A module according to any one of the preceding claims, characterised in that the resin is a thermosetting resin.

25

6. A module according to Claim 5, characterised in that, before the first phase, a catalyst is applied between the plates (47,48) and the sheets (33,34) of the

three-dimensional textile (30) in order to cause the local acceleration of the polymerisation of the resin.

7. A module according to one of Claims 3 or 4,
5 characterised in that the resin is a thermoplastics resin.

8. A module according to one of Claims 3 to 7,
characterised in that, in the second phase, the
10 polymerising resin at least partially binds the sheets
(33,34) firmly to the plates (47,48).

9. A module according to one of Claims 3 to 7,
characterised in that it includes a ninth phase in which
15 the plates (47,48) are detached mechanically and removed
from the layered structure (40).

10. A module according to one of Claims 3 to 9,
characterised in that, after the seventh phase, the
20 three-dimensional textile (30) of the layered structure
(40) of the panel (5a) is filled with an expanded resin.

11. A module according to any one of the preceding
claims, characterised in that the layered structure
25 includes a plurality of superposed layers of the three-
dimensional textile (3).

12. A module according to claim 11 as dependent from one of claims 3 to 10, characterised in that, before the said first phase, a catalyst is applied between the facing surfaces of the layers to cause the local acceleration of the polymerisation of the resin.

13. A module according to claim 1, characterised in that the space between the textiles sheets (33,34) is filled with a solidified expanded fluid (50).

10

14. A module according to claim 13, characterised in that the panels (5b) are made in a plurality of phases including:

- a first phase in which the layered structure (51) impregnated with resin is inserted between first (52) and second (53) dies of a press (55); the layered structure including at least the three-dimensional textile (30) formed from the textile sheets (33,34) disposed parallel to each other and interconnected by the plurality of threads (36) extending from facing surfaces of the sheets (33,34);

- a second phase in which the dies (52,53) are closed and the expanded fluid (50) is injected under pressure into the three-dimensional textile (30);

25 - a third phase in which the dies (52,53), by heating the layered structure, cause the fluid (50) injected between the sheets (33,34) to polymerize;

- a fourth phase in which the dies are opened completely and the layered structure forming the panel (5b) is removed from the press (55).

5 15. A module according to claim 14, characterised in that the layered structure (51) includes at least one sheet fixed face to face with the sheets (33,34) of the three-dimensional textile (30).

10 16. A module according to any one of the preceding claims, characterised in that the panels (5) are arranged with their substantially straight peripheral edges (10) close together; the module (1) further including
15 connecting members (15) for coupling with portions of the parallel panels at the said edges (10) to establish a firm connection between the panels (5).

17. A module according to claim 16, characterised in that the connecting members comprise profiled sections
20 (15).

18. A module according to claim 16 or 17, characterised in that the connecting members (15) include recesses (60;62;64;68) for housing the peripheral edges of the
25 panels (5).

19. A module according to any one of the preceding

claims, characterised in that the panels (5) include tubular spaces.

5 20. A module according to any one of the preceding claims, characterised in that the panels (5) constitute at least part of the walls (20) of a habitation.

10 21. A module according to any one of the preceding claims, characterised in that the panels (5) constitute at least part of the roof (22) of a habitation.

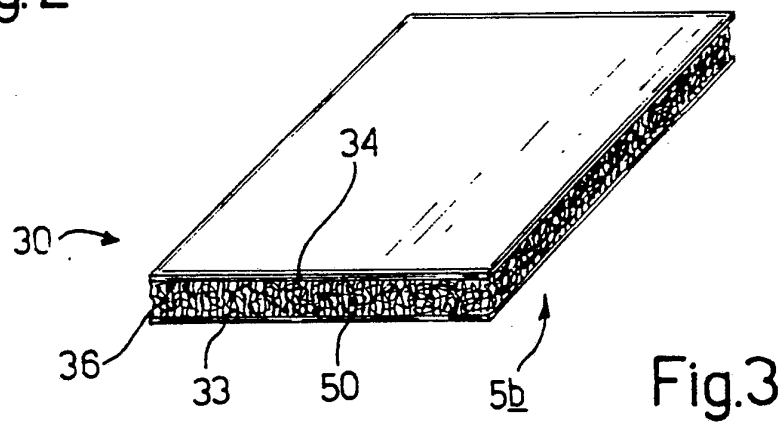
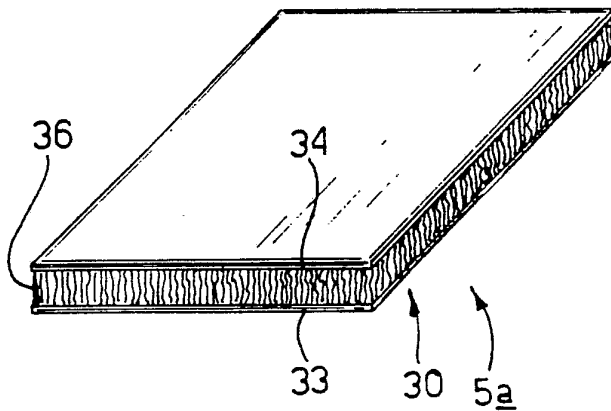
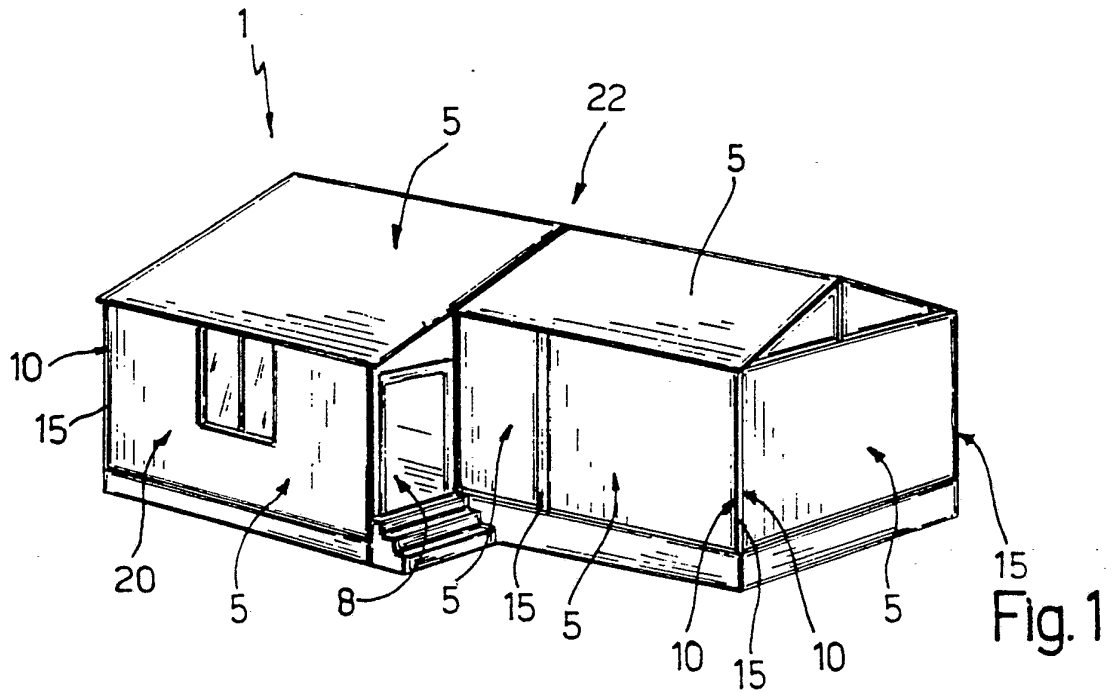
22. A module according to any one of the preceding claims, characterised in that the panels (5) constitute at least part of the floor of a habitation.

15

23. A panel (5) including a layered structure comprising a three-dimensional textile (30) formed from two facing textile sheets (33,34) connected together by a plurality of extensible threads (36), the three-dimensional textile (30) being impregnated with resin, characterised in that it forms at least one component element of a sectional habitational module according to any one of the preceding claims.

25 24. A sectional habitational module and a component panel, substantially as described with reference to the appended drawings.

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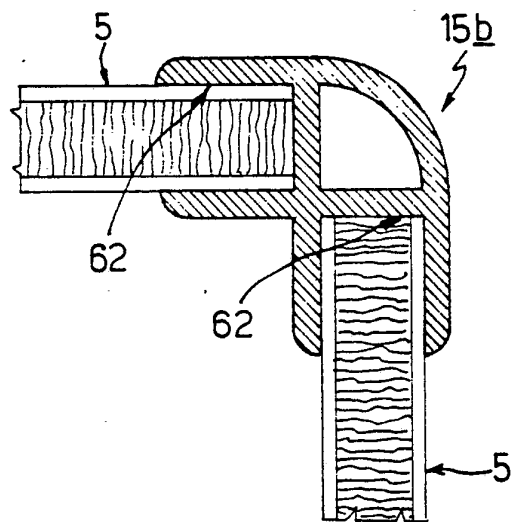
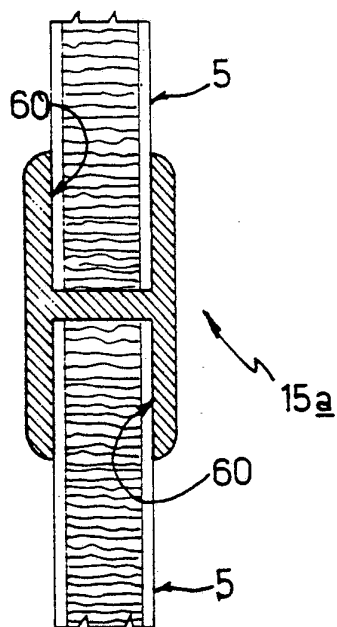
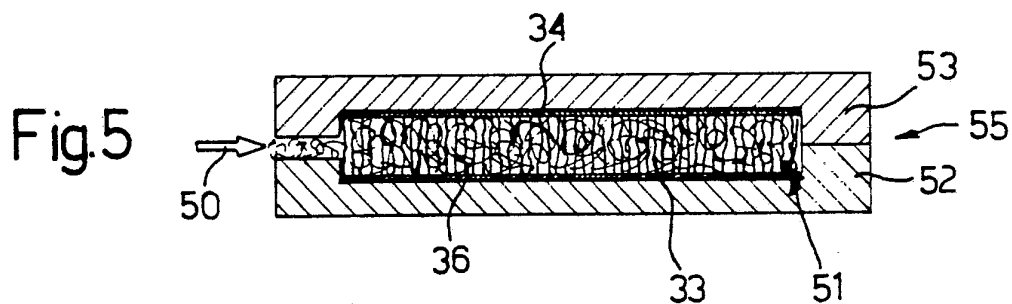
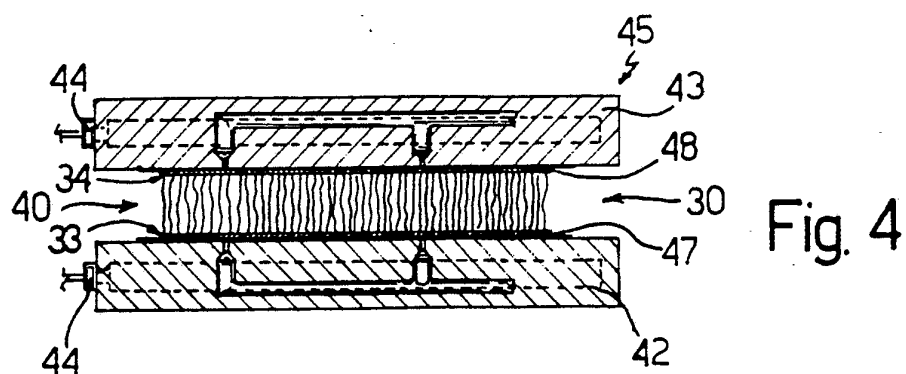


Fig. 6

Fig. 7

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