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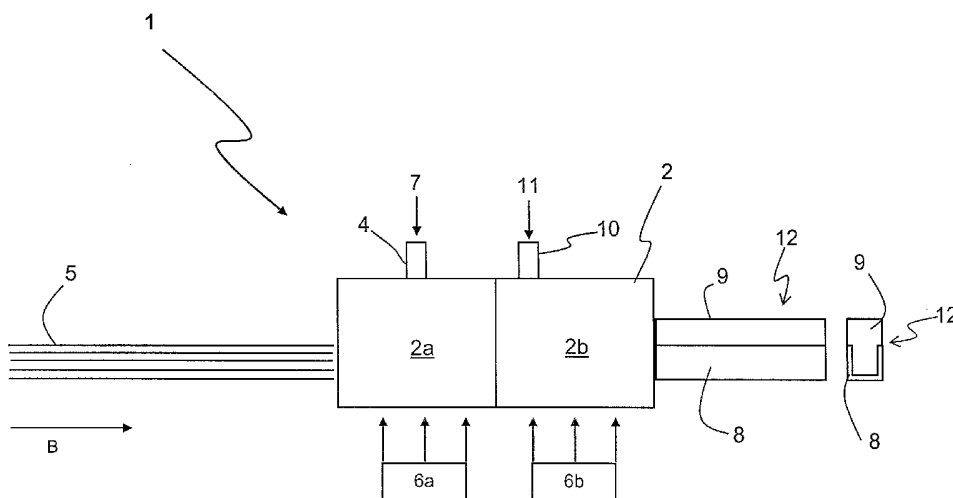
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(54) Title: PART FOAM COMPONENTS



(57) Abstract: A method of manufacturing a part-foam component, the method comprises causing plastic material (7) to pass through die means (2) to form a shaped component, said die means (2) having a first shaped portion (2a) through which the plastic material (7) passes arranged to cause the plastics material (7) to adopt a desired shape, and injecting a foaming resin or a two-part foaming mixture (11) into said die means (2) at a location downstream of said first shaped portion (2a) and forcing the plastics material and foaming resin or two-part foaming mixture through a second shaped portion (2b), causing the foaming resin to solidify to form a foam part or two-part foaming mixture to foam and solidify to form a foam part and forcing the plastics material and foam part out of said die means, whereby the plastics material (8) and foam part (9) form a unitary component (15). The part foam component (15) may be used in the construction of doors, or, for example, in the formation of panels or beams.



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Part Foam Components

This invention relates to components which are partially composed of a foam material,
5 to their method of manufacture and to their use.

A particular, but non-exclusive, use for such components is in the fabrication of doors,
in particular in the fabrication of doors for use in buildings.

10 In our co-pending British patent application (GB 0301358.8) we disclose a method of
manufacturing a door comprising frame members, at least one of which having a
hollow interior, a foam core and facing panels, the method comprising forming a
framework by joining lengths of frame members, adhering panels to the framework and
injecting foam into, or forming a foam in, the cavity so-formed and thereby displacing
15 air from the cavity into the at least one hollow in the at least one hollow frame member.

The method may further comprise providing an aperture in the hollow frame member in
a cavity-facing wall of the member to provide fluid communication between the cavity
and the hollow interior thereof and allowing the foam to flow into the hollow interior from
20 the cavity, thereby providing a further key point to secure the foam core to the
framework.

In one embodiment, the method further comprises securing a pair of structural density
foam 'blocks' or 'planks' (*i.e.* foam with a density greater than 300 kg m^{-3}) to longer
25 frame lengths and securing panels across the framework. Either a high density foam
(*i.e.* a foam with a density of from 100 to $< 300 \text{ kg m}^{-3}$) or a lower density foam (*i.e.* a
foam with a density of $< 100 \text{ kg m}^{-3}$) is injected into the so-formed cavity defined by the

planks and panels, the foam preferably being allowed to flow through a cavity formed in at least one of the shorter lengths to key the foam to the framework.

There are several advantages with providing a structural density plank along the longer edges of the door, for example:

- the total weight of the door can be controlled by introducing foam of a certain density into the so-formed cavity (e.g. low, high or structural density foam);
- lock pockets can be pre-machined before assembly of the framework;
- hinge screws can be screwed through the frame member and into the structural density foam without any further reinforcement being needed.

This invention, however, is applicable in some or all of its embodiments to the fabrication of many other components as will become evident from the following description.

Accordingly, it is an object of this invention to provide a method of forming a part-foam component, a part-foam component and to specific uses of the same.

It is a particular but non-exclusive object of this invention to simplify methods of manufacture of doors. It is a further or more particular object of the invention to reduce production time and/or production costs of door manufacture.

Accordingly, a first aspect of the invention provides a method of manufacturing a part-foam component, the method comprising causing plastics material to pass through die means to form a shaped component, said die means having a first shaped portion through which the plastics material passes arranged to cause the plastics material to

adopt a desired shape, and injecting a foaming resin or a two-part foaming mixture into said die means at a location downstream of said first shaped portion and forcing the plastics material and foaming resin or two-part foaming mixture through a second shaped portion, causing the foaming resin to solidify to form a foam part or two-part
5 foaming mixture to foam and solidify to form a foam part and forcing the plastics material and foam part out of said die means, whereby the plastics material and foam part form a unitary component.

Said die means may be an extrusion die or a pultrusion die, whereby the plastics
10 material is either extruded or pultruded.

The plastics material may be either a thermoplastics material or a thermosetting resin. The foaming resin is preferably a thermosetting foaming resin, such as a polyurethane or phenolic resin.

15

In this specification, the term 'two-part foaming mixture' relates to a mixture of resin and catalyst which causes the resin to foam, the two being mixed immediately prior to injection. The term 'foaming resin' or 'foamed resin' are intended to be identical and relate to a resin which has been foamed (by mechanical (*e.g.* pneumatic) or chemical
20 means and which has risen to its 'free-rise volume'.

Where said die means is a pultrusion die, it is preferable that dry fibres are introduced to the die. Warm plastics material, *i.e.* a warm (*e.g.* above ambient temperature) thermosetting resin or thermoplastics material, may be injected into said die means.
25 Preferably, a downstream part of said die means is heated, the foaming resin or two-part foam mixture preferably being injected into the heated part of said die means.

A further aspect of the invention provides a method of manufacturing a door, the method comprising forming door frame members, comprising at least one first and at least one second frame member and securing structural density foam blocks to the, or at least one of the, second frame member or members, assembling the first and
5 second frame members to form a framework and attaching a panel across each side of the framework.

The method may further comprise forming the frame members by one of pultrusion, extrusion or moulding.

10

In one embodiment, the or each second frame member is formed by pultrusion, the method further comprising locating the pultruded length in a mould and injecting a foamed resin or a two-part foaming mixture into the mould, the foaming mixture forming the structural density foam block. The moulding process may be a continuous process,
15 whereby the pultruded length is pushed or pulled through a mould and the foaming resin injected into the mould as the pultruded length is transported through the mould or a discrete process, whereby a length of pultruded frame member is located within a mould and a foaming resin is injected into the mould to form the structural density foam block.

20

In another embodiment, the method comprises attaching a pre-formed structural density foam block to the second frame member as or after the frame member emerges from the die, say a pultrusion die.

25 In a third embodiment, the method comprises injecting foaming resin or a two-part foaming mixture into a pultrusion die to co-extrude/pultrude the structural density foam block with the pultruded frame member.

In a fourth embodiment, the method comprises pultruding or extruding the second frame member with a hollow portion and injecting foaming resin or a two-part foaming mixture into the hollow portion, the foaming resin or two-part foaming mixture forming the structural density foam block.

The or each first and second frame members may be different or identical.

A third aspect of the invention provides a frame part for a door, the part comprising a plastics frame member and a structural density foam block secured thereto.

The method may further comprise injecting a second foaming resin or a two-part foaming mixture into the cavity defined by the panels, framework and structural density block or blocks. Preferably, the resin or foaming resin is injected into the cavity through an aperture formed in the framework.

The second foaming resin or two-part foaming mixture may be of low density ($< 100 \text{ kgm}^{-3}$), high density ($100 - 300 \text{ kgm}^{-3}$) or structural density ($> 300 \text{ kgm}^{-3}$).

Preferably, the method also comprises forming one or more holes along the length of one or more first member, say by drilling or punching. The or each hole may provide a fluid transfer passageway, say an air or an air and foam transfer passageway.

A further or more specific aspect of the invention provides a method of forming a door, the method comprising forming a framework from at least one first and one second hollow member, the or at least one of said second hollow members having a structural density foam block secured thereto, adhering panels to the framework to define a

cavity, the or at least one first hollow member comprising at least one aperture on an inner facing wall for communication between the hollow interior thereof and the cavity, injecting a foaming resin or two-part foaming mixture into the cavity and displacing air from the cavity into the hollow interior via said at least one aperture.

5

The method may comprise a preliminary step of forming the members by pultrusion or extrusion.

Preferably, one or more of the first and second members are formed with an elongate
10 hollow body having a base wall, opposed side walls and a top wall and, if present, the or each hole is in the base wall.

One or more of the first members may be formed with an injection aperture, extending across the member, through which the foam material is injected. Preferably the
15 injection aperture extends through a blank which is of such a shape and size that, once removed and the foam set, a cavity is formed which can accept a lock or other door furniture.

The method may further comprise injecting more foam into the cavity than the cavity
20 can accept, the excess flowing into and at least partially around the framework to provide an extra key to secure the foam to the framework.

Preferably, the foam material is formed from a polyurethane or phenolic resin.

25 "Structural density" is defined as a density of greater than 300 kg m^{-3} . The foams in this invention may have a density of greater than 300 kg m^{-3} to about 800 kg m^{-3} , preferably from 300 to 500 kg m^{-3} .

In other embodiments, the foam may set at a high density, say from 100 to 200 kg m⁻³, or at a lower density.

- 5 A further aspect of the invention provides a door formed using, in part or entirely, any of the above-defined methods.

Preferably, the frame member comprises an extension portion comprising a cavity in which a weather seal is receivable. The member preferably comprises a pair of
10 spaced-apart extension portions, each comprising a cavity in which a weather seal is receivable.

The or each member may also comprise an elongate cavity in which a male portion of a part of a hinge is receivable.

15

The method may further comprise machining a portion of the second frame member to provide a site to locate an item, for example the second member may be machined to provide a lock pocket in the second member, the pocket extending into the structural density foam block.

20

Preferably, all of the plastics parts are formed from materials having similar coefficients of thermal expansion to prevent thermal expansion mis-match therebetween, in use. Advantageously, the plastics materials are thermosetting materials, each having a coefficient of thermal expansion of less than 80×10^{-6} m/m °C.

25

In order that the invention may be more fully understood, it will now be explained by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of conventional pultrusion apparatus;

Figure 2 is a schematic view of a pultrusion apparatus according to the invention;

5 Figure 3 is sectional view of a component according to the invention;

Figure 4 is the view of Figure 3 indicating the location of a machined cavity;

Figure 5 is a sectional view of a second component according to the invention;

Figure 6 is a plan view of a door formed from components according to the invention; and

10 Figure 7 is a part sectional view of a door formed according to the invention.

Referring to Figure 1, there is shown conventional pultrusion apparatus 100, comprising a resin bath 101 and a pultrusion die 102 provided with a pre-former 103 and having a resin injection port 104.

15

Elongate, continuous fibres 105 (which may be, for example, glass, carbon or aramid, Terylene, Nylon or hemp fibres) are conveyed in the direction of arrow A through the resin bath 101 where they are wetted by the resin and then through the pre-former 103 and into the die 102 which is heated, as indicated by arrows 106. The fibre bundles 105
20 pick up sufficient resin to, usually, provide about a 60:40 fibre:resin mix which is pre-formed into the desired shape by passing the resin-fibre mix through the pre-former 103.

As an alternative to using the resin bath 101, resin, as indicated by the arrow 107, may
25 be injected into the die 102 through the injection port 104 where it is forced, under pressure, to flow around 'dry' fibres (*i.e.* fibres which have not passed through a resin bath to become wetted fibres).

In either case, heat is applied (as indicated by arrows 106), the heat (about 120 to 150 °C) causing the resin to polymerise, and a pultruded length 108 is drawn from the die 102, conventionally using a hand-over-hand or belt conveyor. The pultruded length
5 comprises elongate fibres retained within a matrix of thermoset plastics. As shown, the length is formed into a substantially U-shaped channel.

As is known, thin-walled pultrusion techniques allows complex shapes to be produced. The so-formed shapes have good strength-to-weight characteristics and can be used in
10 a variety of situations. For example, in our co-pending patent applications nos. EP 02250175.3 and EP 02256602.0 (published as EP 1223289 and EP 1298277 respectively) we disclose pultruded members which are used to fabricate members used in the construction of doors.

15 Referring now to Figure 2, there is shown modified pultrusion apparatus 1 according to the invention, comprising a two-part pultrusion die 2, having a first part 2a provided with a resin injection port 4 and a second part 2b provided with a foam injection port 10.

Dry, elongate fibres 5 are conveyed in the direction of arrow B into the first part 2a of
20 the die 2. Warm resin at a temperature of about 20 to 35 °C is injected, as indicated by the arrow 7, into the first part 2a of the die 2 through the resin injection port 4. The resin wets the fibres and flows around the shape of the die to provide a pre-form shape. The die 2a is heated, as indicated by arrows 6a, to about 120 to 135 °C to cause the resin to polymerise. The so-formed shape is drawn into the second part 2b of the die which
25 is heated to or maintained at a temperature of about 35 °C (as indicated by arrows 6b).

A foaming resin or two-part foaming mixture, as indicated by arrow 11, is injected into the second part 2b of the die 2 through injection port 10. The die 2 is shaped to cause the foam to be brought into contact with the pultruded length and the whole 12 emerges from the die 2 with a pultruded length 8 connected and secured to an
5 'extruded' foam part 9.

The die 2 will necessarily be longer than the prior art die 102. The heating 6b may be accomplished using the latent heat of the polymerisation stage in part 2a of the die 2. The die may comprise an extension part to allow the resin and foam to stabilise.

10

As shown, the pultruded length 8 is of substantially U-shaped form and a portion of the foam part 9 is located within the channel, the whole 12 forming a rectangular block (it will, of course, be appreciated that the shape of the whole 12 and of the component parts 8, 9 is illustrative only).

15

In the field of door manufacture, the above-discussed method can be used to fabricate a component 15 (comparable to part 12 above) comprising a frame member 20 with a structural density plank 30 secured thereto, as shown in Figure 3. The frame member 20 has a substantially rectangular hollow body portion 21 comprising a base wall 22, a
20 pair of opposed side walls 23, 24 and a top wall 25. Extending from the side walls 23, 24 are a pair of opposed arms 26, 27, each of which is provided with an indent 28 in the facing surfaces. A pair of extension portions 251, 252 extend from the top wall 25, each providing a socket into which a portion of a weather seal is insertable. The top wall is rebated to form a recess 253.

25

The volume of foaming resin which is injected into the effective cavity within the die 2, coupled with the expansion characteristic of the foam 30, is such that the foam exerts

pressure on the base wall 22 and side walls 26, 27 of the pultruded frame member 20 to ensure that it sets and is retained therein. Furthermore, the foam 30 expands into the indents 28 thereby providing a key site to ensure retention of the foam 30 within the arms 26, 27 of the frame member 20.

5

Once the component 15 has been formed it can be cut to suitable sized lengths and parts thereof can be machined. Figure 4 shows a component with the intended location of a lock pocket 40. The frame member 20 is cut away, as indicated at 29, and the foam 30 is machined away to form an elongate recess 40 into which a lock may be mounted.

10

As has been disclosed in our previously filed and co-pending European patent application (published as EP 1298277), the extension portions 251, 252 of the frame 20 may be removed to provide a site for a hinge (not shown). A foot of the hinge is locatable in recess 253.

15

Typically, the foam 30 will be of structural density (*i.e.* of a density $> 300 \text{ kgm}^{-3}$). When foam of structural density is used, the lock and of hinge parts can be retained by screwing through the frame member 20 and into the foam 30. Such structural density foams have a screw retention capacity in excess of 2.5 kNmm^{-2} , which is in excess of that of softwood and close to that of hardwoods. Thus, the 'door furniture' can be attached to the door directly and without need of extra reinforcement.

20

In place of using the co-pultrusion/extrusion apparatus 1 as described above, conventional pultrusion apparatus 100 as shown in Figure 1 may also be used. For example, once the length of frame member 20 is pultruded, it is cut to length and then that length is placed in a mould (not shown), the inner surfaces of the walls 26, 27 and

25

top wall 22 providing an 'effective' part mould surface, which form a 'complete' mould in concert with mould surfaces of the mould. Foaming resin or a two-part foaming resin mixture is injected into the mould to form a block of foam 30.

- 5 Figure 5 shows a further component 50' which is identical to that shown in Figure 3, with the exception that the side walls 26' and 27' are extended to form an enclosure 31'. Once the length has been pultruded (using conventional pultrusion equipment 100 as shown in Figure 1), one end of the length thereof is blocked and foaming resin or a two-part foaming resin mixture is injected into the enclosure 31'. The foaming resin,
10 once set, forms a foam block 30'. As before, it is possible to pre-machine the length of frame member to provide a lock pocket 40.

To fabricate a door, four lengths of component 15, 15' maybe joined together to form a rectangular framework. Panels may be adhered across the major faces of the so-
15 formed framework. The cavity, defined by the framework and the panels, may be filled with a foam material or by other solid materials.

Figure 6 shows a framework formed from two lengths of component 15 and two frame members 20, the components 15 forming the longer sides of the rectangular framework
20 40. The two lengths of frame member 20 forming an intended upper 20A and lower 20B part of the framework 40, a cavity 50 being defined by the framework 40.

The intended upper frame member 20A is provided with a plurality of holes 200 drilled or punched in the base wall 22 thereof. The holes 200 provide fluid communication
25 between the cavity 50 and the hollow interior of the frame member 20A. The intended base member 20B is provided with a through-hole 201, providing communication between the cavity 50 and the outside of the door.

To fabricate a door, panels 55 are adhered across the major faces of the framework 40 thereby substantially enclosing the cavity 50, the faces of the panels 55 being flush with the outermost part of the frame member 20. Foam is injected through through-hole 5 201 into the cavity 50. Air is displaced from the cavity 50 through the apertures 200 and into the hollow interior of the frame members 20. Displaced air will either flow out of the hollow interiors at the points where two frame members 20 are joined or through a bespoke hole formed in the intended lower part of the door, which would also provide a point of egress for any condensation formed on the internal surfaces of the door 10 (condensation may be formed along the hollow interiors of the frame members 20, especially if the so-formed door is to be used as an external door for a building. Such doors are often differentially heated, e.g. during the summer, the outside facing face is heated by the sun whilst the internal facing face is cooler and during winter the outside facing face is cooled by the ambient conditions whilst the internal facing face is heated 15 by central heating systems or the like. Because the doors are often not perfectly sealed, there is a slight passage of air into and out of the framework, thereby providing an opportunity for condensation to form on the hollow interiors of the frame members 22).

20 As is seen in Figure 7, it is typical to slightly over fill the cavity with foam 60 to cause the foam to enter the hollow interior of the frame members 20A via the aperture 200, thereby providing further key sites for the foam within the door structure. Typically, 60% of the cavity will be filled with foaming resin, the remaining 40% of the space being taken up by the foam as it sets, which expands to fill the volume and in most cases 25 some of the hollow interior of the frame member 20A.

The free-rise density of the foam 60 can be chosen as appropriate for the intended location and use of the door. For example, the foam may be of low density, high density or structural density. In other embodiments, the cavity may be filled with "solid" material such as rock wool or other known fillers. The higher the density of the foam
5 used, the more resistant the door will be to piercing and bludgeoning blows.

Because of the use of structural density foam blocks which form the periphery of the door along the longer edges, the density of the foam 60 filling the majority of the cavity
50 need not be as high. In this way, the total weight of the door can be carefully
10 controlled to be appropriate for the use to which the door is intended to be put and suitable to the intended location of the door.

It will be appreciated that whilst we have shown the cavity 50 to be a single unitary cavity, it need not be. For example, a structural density foam block may be provided
15 which is horizontally disposed and which connects the two foam blocks 30 of the longer side components 50 then this way, adequate support can be provided for a letter box or other door furniture and further bracing can be provided which ensures the door has adequate rigidity.

20 It is most preferred that thermosetting plastics materials are used for all of the plastics components for the doors. Using such materials reduces the likelihood of thermal mismatch between the components in use (there may be significant variations in the temperature to which opposed sides of a door are exposed, one side being heated by the sun, the other being cooled by air conditioning, for example).

Some typical thermal expansion coefficients of materials which may be used in the methods above to fabricate door components (as well as other part-foam components), are found in Table 1.

5

Table 1.

Material	Coefficient of thermal expansion (m/m °C)
Glass reinforced polyester (30% glass) ^a	20×10^{-6}
Vinyl ester + 28% glass fibres ^a	12×10^{-6}
Phenolic resin + 28% glass ^a	23×10^{-6}
Pultruded polyester (~60% glass) ^b	10×10^{-6}
Polyurethane foam (300 kgm ⁻³) ^c	50 to 80 $\times 10^{-6}$

10

^a Panel material 55; ^b Frame member material 22; ^c Foam material 30, 30', 60.

Other frame, panel and foam materials may be used.

15 Whilst the above description concentrates on the fabrication of doors and components therefor, it will be appreciated by the skilled addressee that the inventive apparatus as shown in Figure 2 can be used to fabricate a wide variety of articles. For example, other panels and structural members can be fabricated with the advantage that foam of certain density can be used, thereby controlling the weight of the article when finished,

20 the pultrusion process providing excellent strength-to-weight characteristics. Also, injecting foam into a pultruded enclosure (as per Figure 5) to form a component may find use in the construction of panels and other structural members. Structural members which may be fabricated using the techniques disclosed herein are beams and panels, such as cladding, flooring and roofing panels.

25

Structural frame members made according to the invention, say members having enclosed foam, may replace steel beams in steel frameworks (e.g. in steel frameworks for buildings). The density of foam will be chosen to be sufficient to allow direct connection of such beams without the use of interposed connection members which
5 are otherwise required in steel frameworks.

If it is further required to strengthen any section, panel or beam made in accordance with this specification, glass or other fibres or rovings can be added to the foam. The addition of rovings and/or elongate continuous fibres will strengthen the foam and
10 reduce the coefficient of thermal expansion. Addition of such rovings and/or fibres may also make panels suitable for use where explosion resistant panels are required.

It will also be appreciated that extrusion equipment can be used in place of the conventional pultrusion equipment.

Claims

1. A method of manufacturing a part-foam component, the method comprising causing plastics material to pass through die means to form a shaped component, said die means having a first shaped portion through which the plastics material passes arranged to cause the plastics material to adopt a desired shape, and injecting a foaming resin or a two-part foaming mixture into said die means at a location downstream of said first shaped portion and forcing the plastics material and foaming resin or two-part foaming mixture through a second shaped portion, causing the foaming resin to solidify to form a foam part or two-part foaming mixture to foam and solidify to form a foam part and forcing the plastics material and foam part out of said die means, whereby the plastics material and foam part form a unitary component.
2. A method according to Claim 1, wherein said die means is an extrusion die or a pultrusion die, whereby the plastics material is either extruded or pultruded.
3. A method according to Claim 1, wherein said die means is a pultrusion die, the method comprising introducing dry fibres into said die means.
4. A method of manufacturing a door, the method comprising forming door frame members, comprising at least one first and at least one second frame member and a securing structural density foam to the, or at least one of the, second frame member or members, assembling the first and second frame members to form a framework and attaching a panel across each side of the framework.

5. A method according to Claim 4, comprising forming the frame members by one of pultrusion, extrusion or moulding.
6. A method according to Claim 4, wherein the or each second frame member is
5 formed by pultrusion, the method further comprising locating the pultruded length in a mould and injecting a foamed resin or a two-part foaming mixture into the mould, the foaming mixture forming a structural density foam block.
7. A method according to Claim 6, wherein the pultruded length is pushed or
10 pulled through a mould and the foaming resin injected into the mould as the pultruded length is transported through the mould.
8. A method according to Claim 4, 5 or 6, wherein the second frame member is located within a mould and a foaming resin is injected into the mould to form the
15 structural density foam block secured thereto.
9. A method according to Claim 4, comprising attaching a pre-formed structural density foam block to the second frame member as or after the frame member emerges from the die.
20
10. A method according to Claim 4, comprising injecting foaming resin or a two-part foaming mixture into a pultrusion die to co-extrude/pultrude the structural density foam block with the pultruded second frame member.
- 25 11. A method according to Claim 4, the method comprising pultruding or extruding the second frame member having a hollow portion and injecting foaming resin

or a two-part foaming mixture into the hollow portion, the foaming resin or two-part foaming mixture forming the structural density foam block.

12. A method according to any of Claims 4 to 11, further comprising injecting a
5 second foaming resin or two-part foaming mixture into the cavity defined by the panels, framework and structural density block or blocks.

13. A method according to Claim 12, comprising injecting the second resin or
foaming resin into the cavity through an aperture formed in the framework.

10

14. A method according to any of Claims 4 to 13, comprising forming one or more
holes along the length of the or one of the first frame member or members.

15. A method according to any of Claims 4 to 14, comprising forming the first and
15 second members with hollow portions and forming the or at least one first hollow member with at least one aperture on an inner facing wall for communication between the hollow interior thereof and the cavity, injecting a foaming resin or two-part foaming mixture into the cavity and displacing air from the cavity into the hollow interior via said at least one aperture.

20

16. A method according to Claim 15, wherein the, one or each first and second
frame members are formed with an elongate hollow body having a base wall,
opposed side walls and a top wall, the or each aperture being present in the
base wall of the first member.

25

17. A method according to any of Claims 4 to 16, comprising injecting more second
foaming resin or two-part foaming mixture into the cavity than the cavity can

accept, the excess flowing into and at least partially around the framework to provide an extra key to secure the foam to the framework.

18. A method according to Claim 17, wherein the second foaming resin or two-part
5 foaming mixture is either of low density ($< 100 \text{ kgm}^{-3}$), high density ($100 - 300 \text{ kgm}^{-3}$) or structural density ($> 300 \text{ kgm}^{-3}$).

19. A method according to any of Claims 4 to 18, further comprising machining a
10 portion of the second frame member to provide a site to locate an item.

20. A method according to Claim 19, further comprising pre-machining the
structural density foam block to provide a site in which part of the item is
locateable.

15 21. A frame member (15; 15') to form a part of a door, the part comprising a plastics
frame member (20; 20') and a structural density foam block (30; 30') secured
thereto.

22. A part-foam component (12; 15; 15'), comprising a pultruded length of plastics
20 material (8; 20; 20') to which a structural density foam block (9; 30; 30') is
secured.

23. A door (40) comprising a plurality of frame members (20; 20a; 20') secured
together to form a framework, at least one of said frame members having a
25 structural density foam block (30; 30') secured thereto, panels (55) secured to
the framework across opposed major faces of the door (40), the cavity (50)

defined by the framework, frame members (20; 20a; 20') and structural density foam block (30) being filled with a filler material (60).

24. A door (40) according to Claim 23, wherein the filler material (60) is foam
5 having either a low density ($< 100 \text{ kgm}^{-3}$), high density ($100 - 300 \text{ kgm}^{-3}$) or structural density ($> 300 \text{ kgm}^{-3}$).

25. A door (40) according to Claim 24, wherein at least one of the frame members
10 (20a) comprises a hollow interior and the foam (60) extends into the hollow interior.

26. A door (40) according to Claim 24, wherein at least one of the frame members
(20a) comprises an aperture (200) which provides fluid communication between
the cavity (50) and the hollow interior.

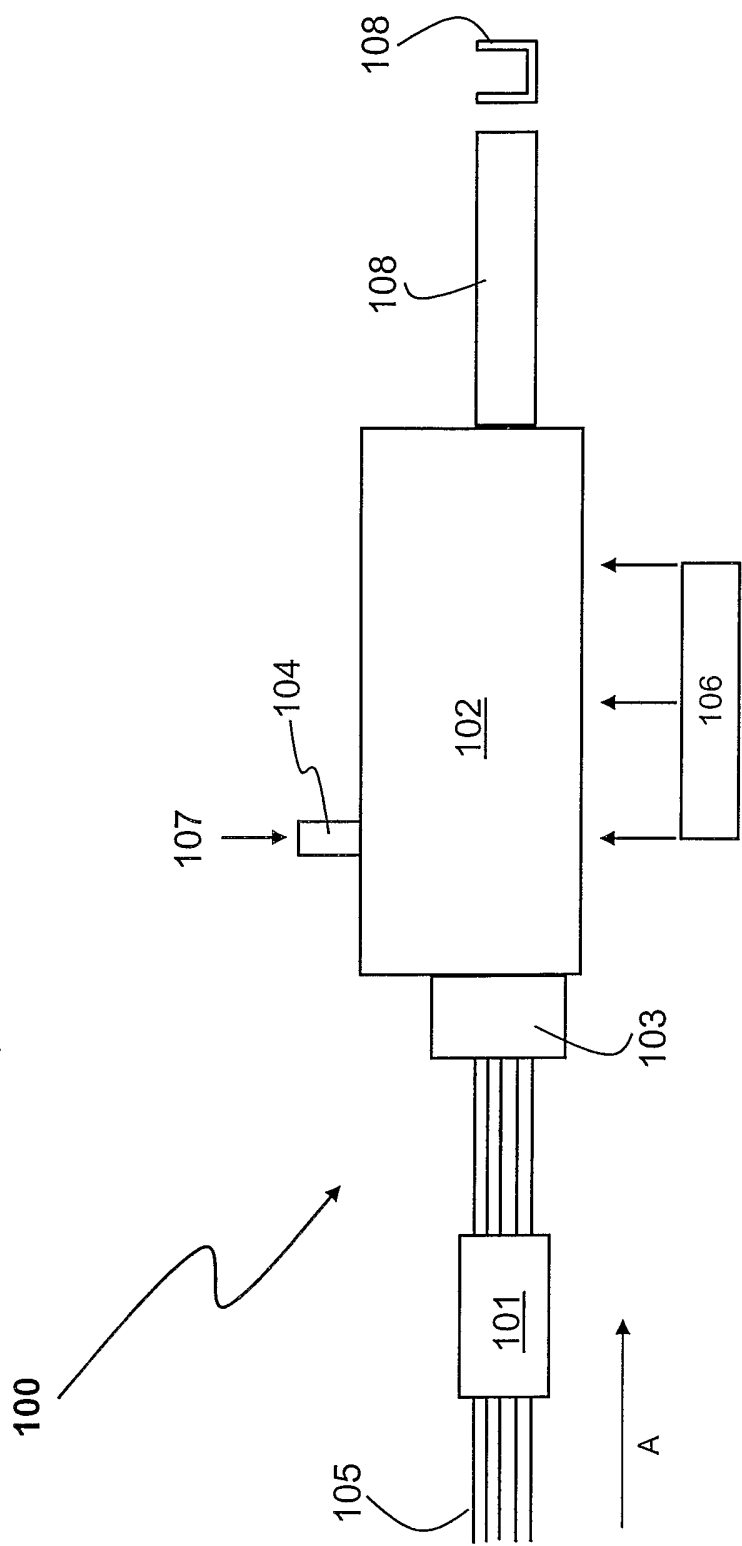


Figure 1
(Prior Art)

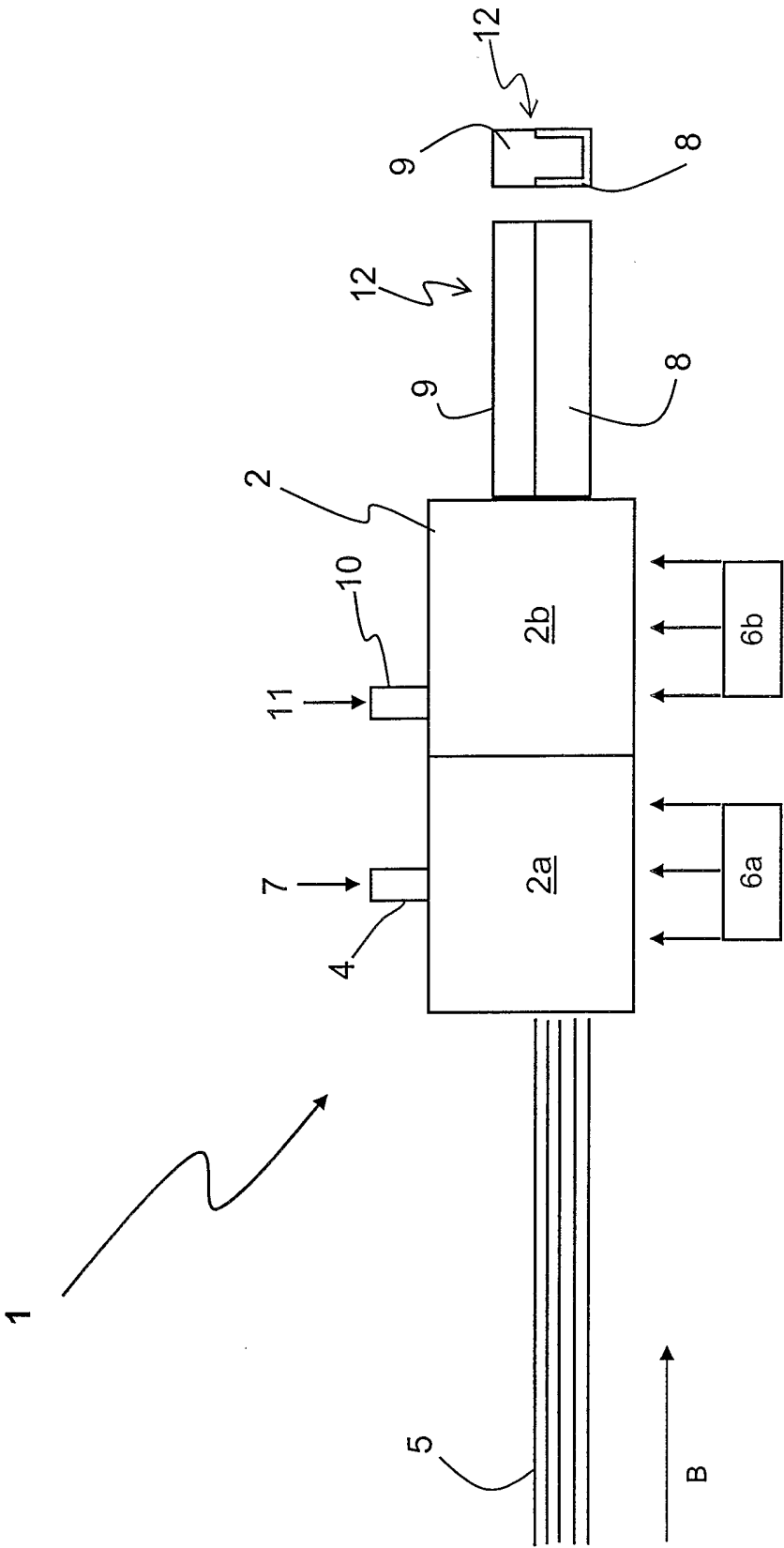
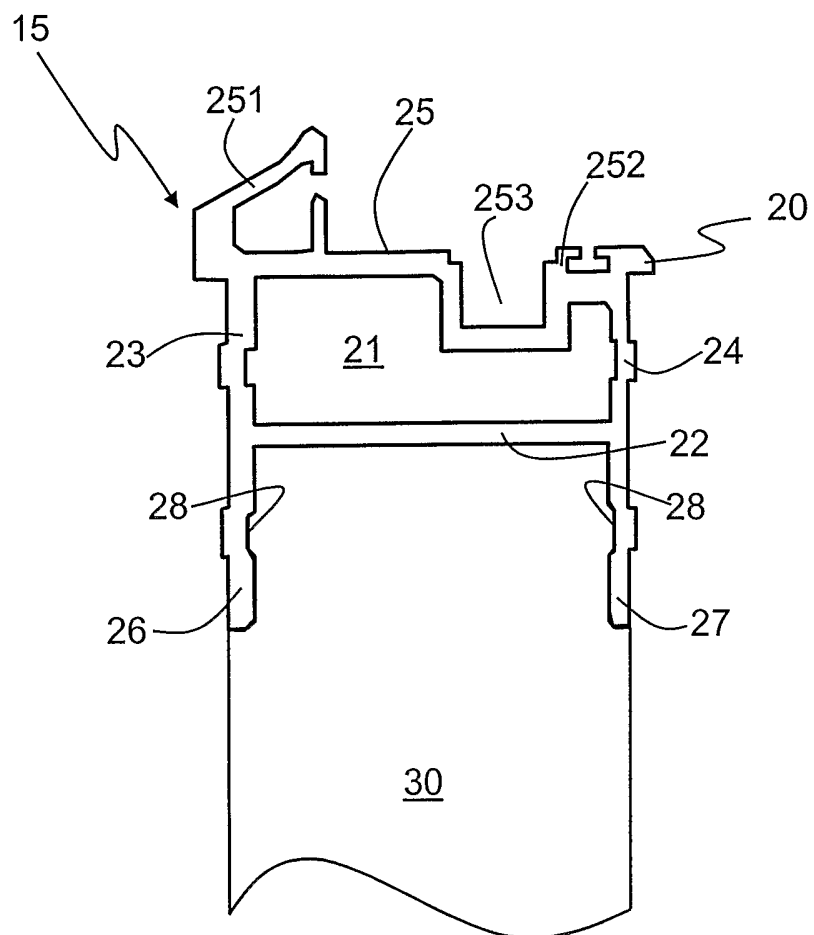


Figure 2

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Figure 3

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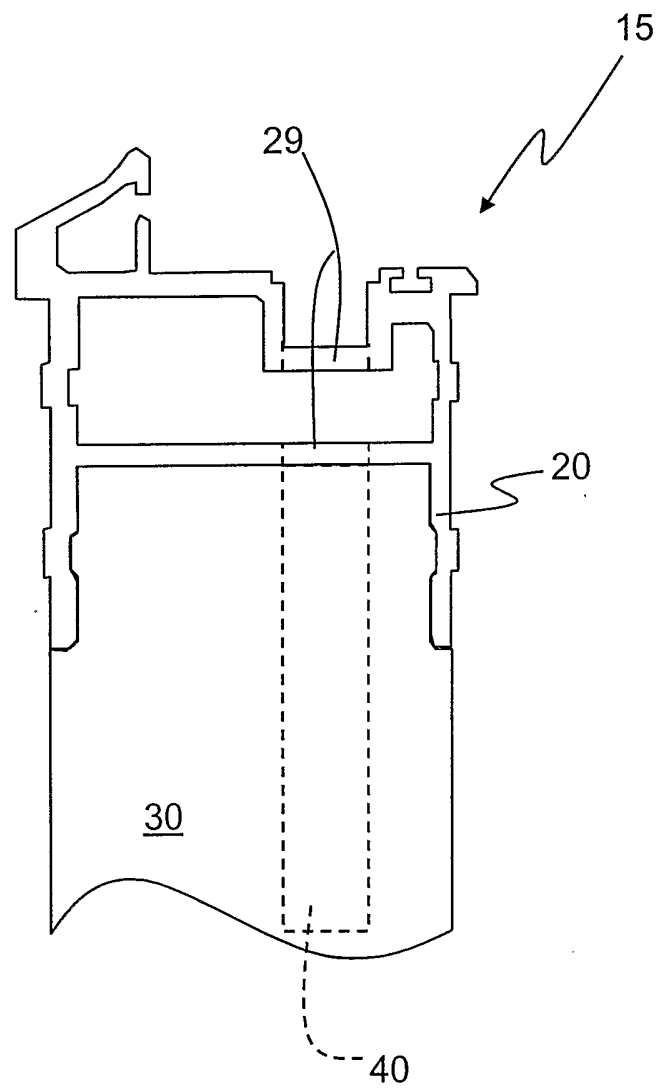


Figure 4

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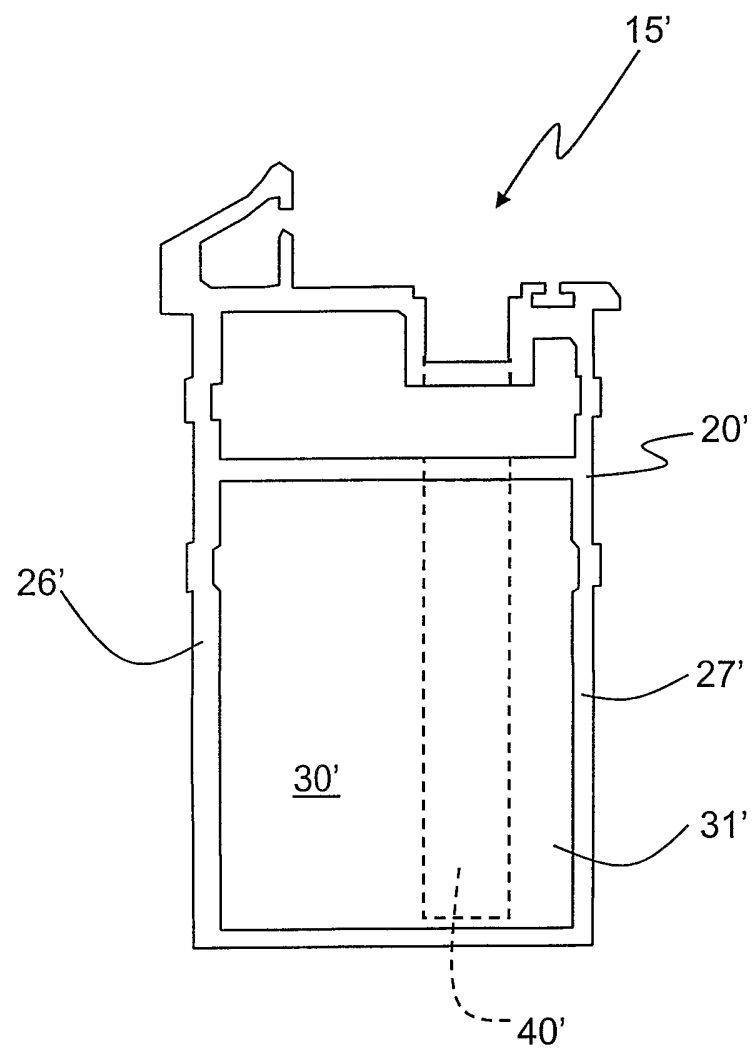
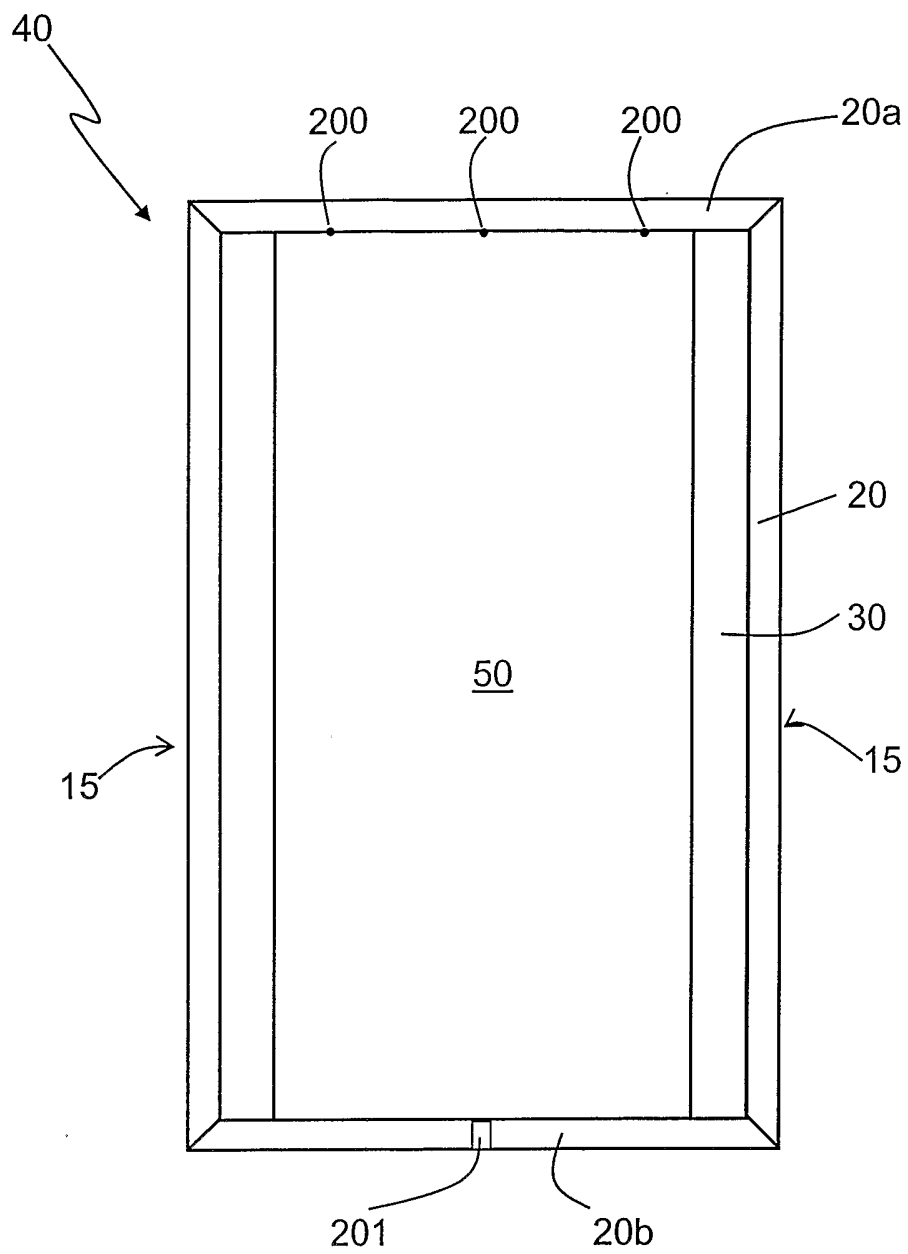


Figure 5

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Figure 6

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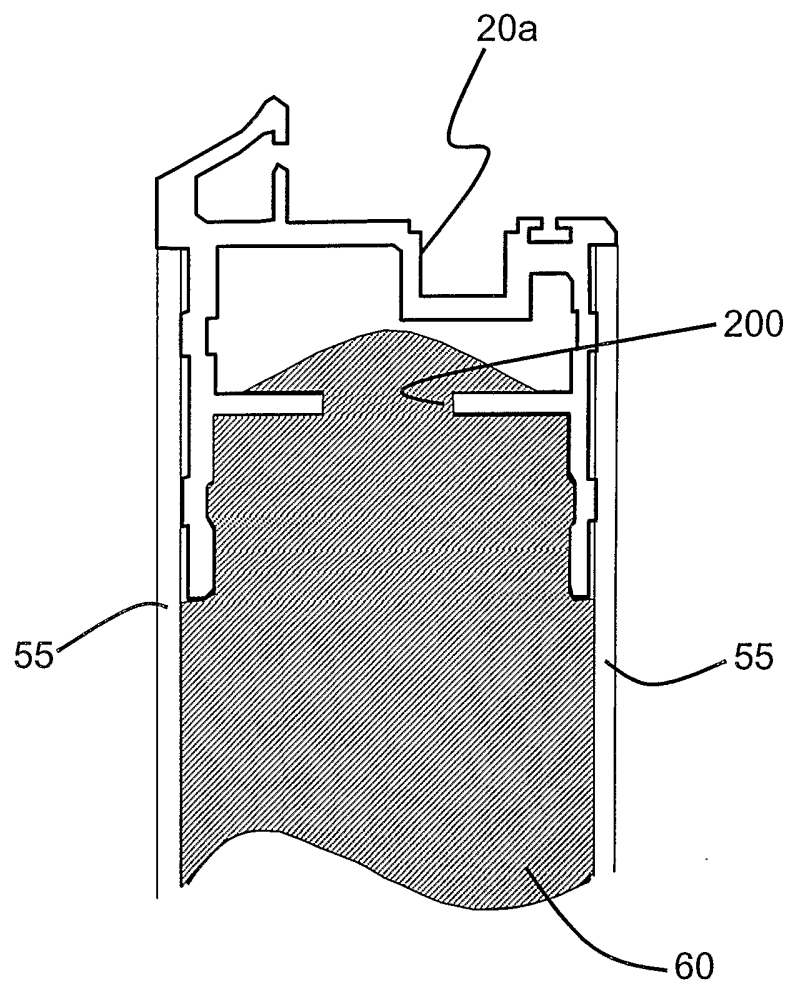


Figure 7