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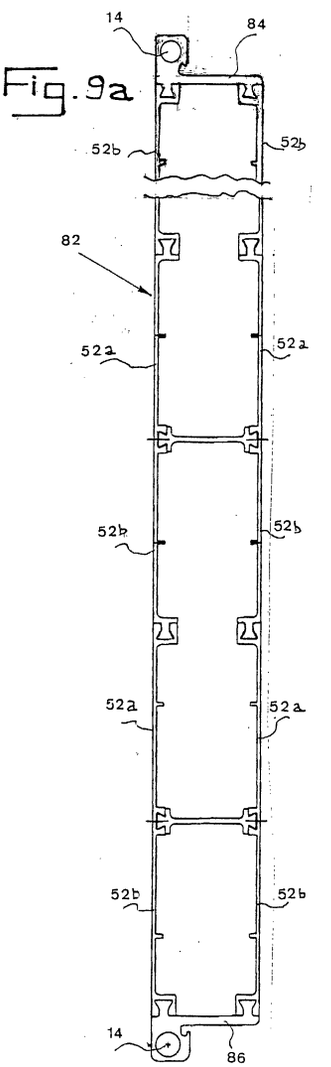
(54) Modular doors

(57) The invention provides a modular door (82) formed from a plurality of inter-linked elements, comprising two end elements (84,86), at least one of which is provided with integral hinge-attachment means (14), and two series of inter-linked panels (52a,52b), a first series forming the inner facing major surface of the door and a second series forming the outer facing major surface of the door, wherein the panels are further provided with connector means along at least one of the major surfaces thereof, the arrangement being such that each of the panels can be installed in its respective series with the connector means facing outwards for the attachment of facing panels thereto, or can be installed in its respective series with the connector means facing inwards for attachment to a reinforcing element inserted between the two series of inter-linked panels and interconnecting the same via the connector means.

Fig. 9a



EP 1 229 206 A2

Description

[0001] The present invention relates to a building door construction using extrusions.
More particularly, the invention provides a light-weight modular door wherein height, width, face-panels and other features can be readily modified.

[0002] Due to architectural demands, manufacturers of building doors are faced with a demand to supply small quantities of a large variety of doors. Manufacturing economics however demand the exact reverse of this state of affairs - large quantities of a small variety. At a time when most doors were made of wood, glass or iron in small workshops, the problem was not significant. Today, many doors are factory made of plastics, metals or combination thereof, small production quantities are of much concern.

[0003] Metal extrusions have long been in use as door frames, and to a lesser extent as the material forming the main door panels. Plastic extrusions are mainly used for door panels. The intricate shapes which are easily produced by the extrusion process have been well utilized for purposes such as providing steps, for holding flexible seal elements, to produce decorative features and for interlinking. However extrusion dies - particularly the multi-part dies needed for producing hollow shapes - are moderately expensive. When a required die is available, there are additional costs in setting up the extrusion press to use said die. For these reasons, small quantities of an extrusion are not economically produced. The extrusion process does however become very attractive for larger quantities, as the produced shape requires little or no machining and any waste metal can be recast into ingots. Surface finish of extrusions is of a quality to require no further work for use in a door, unless color is to be added. Practically all metal extrusions used in prior-art doors are of aluminium alloy, typically grade 6063-T5.

[0004] As is known, there are many different ways of door construction, and each type of door structure has some suitable application. Factors affecting the choice of construction method are appearance quality required, exposure to the weather or indoors use, requirements regarding soundproofing, heat insulation, resistance to deliberate breakage, weight limitations if any, frequency of door use, locally available manufacturing materials, manufacturing facilities available, number of doors to be manufactured and of course cost targets.

[0005] A review of recent patents provides a representative view of the state of the art.

[0006] In US Patent no. 5,060,711 Fimbell discloses a modular door panel structure including metal upper and lower rails. Vertical stiles and intermediate mullions define an open framework. Multi-component plastic clad insulation panes are retained in the framework by locking strips.

[0007] Kyle et al. disclose a process for making an insulated door in US Patent nos. 5,125,155 and 5,177,868. The front panel is made of an embossed steel sheet, the center is a polystyrene core, the back surface is a further steel sheet and hot-melt adhesive and pressure and pinch rollers are used to secure the assembly.

[0008] A method for constructing a modular door is disclosed by Paquin et al. in US Patent no. 5,339,522. The front and rear panels are each formed of modular elements made of stamped metal. Internally the door comprises wood boards, gaps being foam filled.

[0009] Shaner et al propose using a PVC door frame in US Patent no. 5,445,208. A rigid polyurethane core between two plastic skins stabilizes the structure.

[0010] Jella discloses a sectional door panel in US Patent no. 5,509,457. The panel comprises formed sheet metal skins with an insulating material therebetween. The panels have edge locating means which is helpful in assembling an overhead door such as is used in a residential garage.

[0011] The same type of door, but comprising a series of long hinged panels, is disclosed by Leist et al. in US Patent no. 5,555,923. Connecting bars are used to interconnect the long panels, which are formed from a plurality of sub panels.

[0012] All parts of the door may be stored and transported in small packages.

[0013] Prior art door constructions do not make full use of the extrusion process to produce doors that can be readily altered.

[0014] It is therefore one of the objects of the present invention to obviate the disadvantages of prior art doors and to provide a construction which utilizes the extrusion shape to provide options such as changing the decorative front panels.

[0015] It is a further object of the present invention to provide a light-weight sound-insulating door by the use of magnesium extrusions.

[0016] Yet a further object of the present invention is to provide a door panel built from a very small number of different extruded shapes so that the quantity of each shape required becomes economically competitive.

[0017] The present invention achieves the above objects by providing a modular door formed from a plurality of inter-linked elements, comprising two end elements, at least one of which is provided with integral hinge-attachment means.

[0018] Two series of inter-linked panels form door surfaces. A first series forms the inner facing major surface of said door and a second series forms the outer facing major surface of said door.

[0019] A first panel in each of said series is connected to the end element provided with integral hinge-attachment means, and a last panel in each of said series is connected to the other end element, to together form the major and said side surfaces of the modular door.

[0020] The panels are further provided with connector means along one, or even both of the major surfaces thereof, the arrangement being such that each of said

panels can be installed in its respective series with said connector means facing outwards for the attachment of facing panels thereto, or can be installed in its respective series with said connector means facing inwards for attachment to a reinforcing element inserted between said two series of inter-linked panels. The panels can be interconnected via said connector means.

[0021] In a preferred embodiment of the present invention there is provided a modular door wherein said plurality of elements comprise magnesium, aluminium or steel extrusions inter-linked by means of dovetail joints without the use of fasteners.

[0022] In a most preferred embodiment of the present invention there is provided modular door wherein said two series of inter-linked panels are each composed of a long and a short panel assembled in abutting relationship to each other, whereby the height of the door can be varied.

[0023] Similarly, according to the present invention there is provided a modular door as defined above wherein said lower profile may be height-adjusted to reduce the gap between the floor and said modular door.

[0024] Yet further embodiments of the invention will be described hereinafter.

[0025] It will thus be realized that the novel door construction of the present invention serves to ease transport and storage problems by allowing the door parts to be packed in moderately sized packages. In some countries there is a further advantage regarding import/export - while customs duty may apply to an assembled door, the components could qualify as raw materials and be free of duty or be charged a reduced rate.

[0026] The door construction of the present invention avoids the use of joining methods such as welding, riveting and screwed fasteners. Each of these methods cause surface blemishes which need to be covered or removed from doors intended to have good appearance.

[0027] Magnesium has been used only rarely for construction of building doors. Possibly architects are unaware of its advantages, and manufacturers have been over-concerned with considerations of fire safety and material cost. However the fire hazard applies only to finely divided powder; appropriate care taken during manufacturing operations will obviate the problem. Regarding comparative material costs, it is an error to consider only the cost per kg; when considering material cost on a cost per cubic centimeter basis for equivalent strength, the material costs little more than aluminium. The extra cost is expected to be recouped by the lower handling and transport costs. Magnesium further offers surprising additional benefits in the present application. The material's sound deadening properties are excellent, an important advantage for building doors. Furthermore, it's low modulus of elasticity combined with a low specific weight means that a magnesium panel is less likely than an aluminium panel to sustain a dent as a result of a light collision with a furniture corner or other rigid item. A heat conductivity factor 30% lower than aluminium is also advantageous.

[0028] Good appearance is usually a prime requirement for a door used in residential buildings. Magnesium alloys and aluminium alloys generally require anodizing if good appearance is to be maintained for the long-term. Well-known surface protection methods are available for magnesium where necessary. The standard treatment is pickling in a mixture of nitric acid and sodium dichromate to form a protective film on the metal. Painting thereafter is carried out only if needed to meet a specific color requirement.

[0029] Steel is a metal not usually known for the manufacture of extrusions. However, the situation has changed since the introduction of the Ugine Sejournet process, wherein billets heated in a salt bath are discharged on to an inclined surface covered with powdered glass which then serves as a lubricant, as described in British Patents nos. 607,285 661,555 and 663,357. Billets are heated to about 1200° C and are extruded at high speed, 400 - 730 fpm.

[0030] The invention will now be described in connection with certain preferred embodiments with reference to the following illustrative figures so that it may be more fully understood.

[0031] With specific reference now to the figures in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

[0032] In the drawings:

FIG. 1 is a non-detailed plan view of a preferred embodiment of the door according to the invention, the structural panels being installed with the connector means facing outwards, to hold decorative facing panels;

FIG. 2 is a perspective view of the door wherein the structural panels are installed with the connector means facing inwards, to hold reinforcing elements;

FIG. 3 is a detail view of a dovetail joint, shown before assembly, used to interconnect the panels;

FIG. 4 is a fragmented perspective view of a modular door wherein the first and second end elements are identical;

FIG. 5 is an elevational view of an embodiment fitted with a lock assembly;

FIG. 6 is a perspective view of an internally insulated door;

FIG. 7 is a perspective view of a door offering two height options;
FIG. 8 is a perspective view of an embodiment provided with an upper step profile;
FIG. 9a is a plan view of a door provided with thin first and second end elements which are identical;
FIG. 9b is a perspective view of an embodiment provided with a lower brush;
FIG. 10 is a plan view of a curved door; and
FIG. 11 is a plan detail view of the embodiment seen in FIG. 1;

[0033] There is seen in FIGS. 1 and 11 a modular door 10 formed from a plurality of inter-linked elements.

[0034] A first of a pair of end elements 12 is provided with an extruded circular aperture 14 serving as integral hinge-attachment means.

[0035] The main faces of the door 10 are made of two series of inter-linked structural panels 16, the panels being vertical when assembled.

[0036] With regard to the panel 16, this numeral in the present text refers to all panels, 16a, 16b, 16c, 16d.

[0037] As seen clearly in FIG. 11, In the present embodiment interlinking of the panels 16 is effected by providing both edges of about 50% of the panels 16a with a projection, such as a circle 18 supported by an extension 20 thinner than the circle diameter. The remaining panels 16b are provided along both edges with a hollow 22 into which the circle and its supporting extension can fit into.

[0038] The first series forms the inner facing major structural surface 24 of the door, while the second series forms the outer facing major structural surface 26 of the door 10, pending the addition of decorative facing panels 32.

[0039] The first panel 16c in each of the series is connected to the first of the pair of end elements 12. The last panel 16d in each of the series is connected to the second end element 28, which will be fitted with the door handle and lock seen in FIG. 5.

[0040] Assembly of these components together form the major and the side surfaces of the modular door 10.

[0041] As seen in the figures, all panels 16 are further provided with connector means 30 along one of the major surfaces thereof. In the present figure each of the panels 16 are installed in its respective series with the connector means 30 facing outwards. The connector means 30 are used in the present embodiment for the attachment of decorative facing panels 32 thereto.

[0042] Advantageously the elements 12, 16, 28 are metal extrusions inter-linked by means of joints without the use of fasteners.

[0043] The preferred metal for manufacturing the extrusions is magnesium alloy, the advantages explained previously being dent resistance, sound-deadening, low transportation costs and low heat conduction. However, other materials such as aluminium, steel or plastics can be used depending on architectural requirements.

[0044] With regard to the rest of the figures, similar reference numerals have been used to identify similar parts.

[0045] Referring now to the door 34 seen in FIG. 2, the same components are used as described with reference to FIGS 1 and 11, except that decorative facing panels are not included in the present embodiment.

[0046] The panels 16 are installed with the connector means 30 facing inwards. This allows attachment to a reinforcing element 36 inserted between the two series of inter-linked panels 16 for rigidizing the door 34 if needed.

[0047] FIG. 3 illustrates a detail of a modular door wherein the panels 40 to be inter-linked are to be connected by a dovetail form, a male section 38a to interlink with the female section 38b.

[0048] End elements 12, 28 and connector means 30 (seen in FIG. 1) are also provided with dovetails.

[0049] In the present embodiment, each panel 40 has one female edge 38b and one male edge 38a. Thus a single extrusion shape is all that is required for manufacturing all the panels 40.

[0050] With regard to the end elements 12, 28 seen in FIG. 1, separate extrusion dies are needed when the single panel 40 as described is used. The reason for this is that if the end element 12 has male dovetails, the end element 28 must have female dovetails. There is however some cost compensation for this, in that the second end element 28 is a more simple and lighter profile than end element 12, because no hinge aperture is required and the metal surrounding the hinge aperture is also saved.

[0051] Seen in FIG. 4 is a modular door 42 wherein the first and second end elements 44, 46 are provided with integral hinge-attachment means 14. The door 42 can thus be hung from either major edge 48, 50, provided that no apertures are pre-cut for installation of a lock and latch. The manufacturing advantage lies in the fact that the two end elements 44, 46 are made from the same extrusion die. The redundant hinge aperture 14 is invisible in when the door is installed.

[0052] As explained with reference to FIG. 1 regarding the panels 16, the panels 52 are of two types. About 50% of the panels 52a have a male dovetail form on both edges, and the remaining panels 52b have a female dovetail form on both edges. An even number (usually 4 or 6) of panels are used along each face of the door.

[0053] To meet the demand for different door widths, the panels 52 are made available in different widths. A wide variety of door widths can be constructed from 4 or 6 panels when as few as 3 different widths of panel are used in various combinations.

[0054] Referring now to FIG. 5, there is depicted a detail of modular door 54 wherein one 56 of the two end elements is provided with apertures 58 suitable for the insertion therein of a lock , latch and handle assembly 60.

[0055] Factory cutting of such apertures 58 is executed with the proper tools available, and is much preferable to on-site cutting. It is of course necessary for the manufacturer to know the basic outer dimensions of the lock, latch and handle assembly 60 which the door purchaser intends to use.

[0056] FIG. 6 shows a modular door 62, further provided with fire, heat and sound insulation material 64 between the two series of inter-linked panels 16. Where required, the insulation material 64 may comprise ceramic and high-strength textile materials to provide ballistic protection.

[0057] If the insulation material 64 is to be supplied by the factory as a separate item, slabs of rigid plastic foam are supplied which are inserted during door assembly on site.

Where the door is to be supplied factory assembled, a polyurethane foam is injected in the factory to fill the space between the front and rear panels.

[0058] FIG. 7 illustrates a modular door 66 wherein the two series of inter-linked panels are each composed of one long 68 and one short panel 70 assembled in abutting relationship to each other. Stability of the door 66 is maintained by positioning length divisions adjacent to a continuous portion of the extruded long panel 68. The height of the door 66 can thus be reduced by removal of the short panels 70. The end elements 12, 28 are length-reduced , and the door is reassembled. Where several doors are so treated, the surplus pieces can be collected for recycling.

The panels can of course be divided up into 3, 4 or more unequal lengths to provide as many height options as are required by buyers.

[0059] Seen in FIG. 8 is a modular door 72 further including an upper step profile 74, extending along the upper edge 76 of the door. When assembled, the step 78 abuts the entablature. The upper step profile 74 has slots 80 to allow inter-linkage with each end element 12, 28 and with the structural panels 16.

[0060] Referring now to FIG. 9a, there is depicted a modular door 82 provided with thin first and second end elements 84, 86, which are identical. The door 82 can be hinge supported from either edge.

[0061] The thin elements 84, 86, dovetail into female inter-linked structural panels 52b, and when replacing the hollow end elements 12, 28 seen in FIG. 1, provide further options with regard to the width of the door, and lower extrusion costs by avoiding hollow extrusion dies. Due to the identical form of the dovetail pairs in the thin elements 84, 86, the circular aperture 14 serving as integral hinge-attachment means may be positioned close to either door face simply by reversing the profile end-to-end during assembly.

[0062] The lower profile 84 may be height-adjusted as required to reduce the gap between the floor 92 and the modular door 82.

[0063] FIG. 9b shows an embodiment of a lower profile 94 holding a brush air seal 96, the lower profile 94 being held to the door 98 by corner brackets 100. The problem of obstructions regarding FIG. 9a thus does not apply to the present embodiment. Brush seals are proven means to eliminate under-door drafts.

[0064] FIG. 10 shows a curved modular door 102. Such doors are occasionally required to match the shape of the building which is to be served thereby.

[0065] The door 102 is similar to that seen in FIG. 2, except that the two series of inter-linked panels 104a, 104b are curved. The panels forming the larger radius 104b are slightly longer than panels 104a forming the inner radius. However the end elements are identical, as seen in FIG. 4.

[0066] FIG. 11 shows details which have been described, but not seen clearly with reference to FIG. 1.

[0067] It will be evident to those skilled in the art that the invention is not limited to the details of the foregoing illustrative embodiments and that the present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. A modular door formed from a plurality of inter-linked elements, comprising two end elements, at least one of which is provided with integral hinge-attachment means, and two series of inter-linked panels, a first series forming the inner facing major surface of said door and a second series forming the outer facing major surface of said door, a first panel in each of said series being connected to said end element provided with integral hinge-attachment means, and a last panel in each of said series being connected to said other end element, to together form the major and said side surfaces of said modular door, wherein said panels are further provided with connector means along at least one of the major surfaces thereof, the arrangement being such that each of said panels can be installed in its respective series with said connector means facing outwards for the attachment of facing panels thereto, or can be installed in its respective series with said connector means facing inwards for attachment to a reinforcing element inserted between said two series of inter-linked panels and interconnecting the same via said connector means.

2. A modular door according to claim 1, wherein said inter-linked panels are connected by a dovetail form.

3. A modular door according to claims 1 or 2, wherein said inter-linked panels are provided in various widths.

4. A modular door according to any one of the preceding claims, wherein said two end elements are provided with integral hinge-attachment means and are identical.

5. A modular door according to any one of the preceding claims, wherein said plurality of elements comprise metal extrusions inter-linked by means of dovetail joints without the use of fasteners.

6. A modular door according to claim 5, wherein said metal is selected from the group comprising magnesium, aluminium and steel.

7. A modular door according to any one of claims 1 to 4, wherein said plurality of inter-linked elements comprise plastic extrusions.

8. A modular door according to any one of the preceding claims, wherein one of said two end elements is provided with apertures suitable for the insertion therein of a lock and handle assembly.

9. A modular door according to any one of the preceding claims, further provided with ballistic protection material between said two series of inter-linked panels.

10. A modular door according to any one of the preceding claims, further provided with fire and sound insulation material between said two series of inter-linked panels.

11. A modular door according to any one of the preceding claims, wherein said two series of inter-linked panels are each composed of at least one long and one shorter panel assembled in abutting relationship to each other, whereby the height of said door can be varied.

12. A modular door according to any one of the preceding claims, further including an upper step profile, extending along the upper edge of said door, said upper step profile inter-linking with each of said plurality of inter-linked elements.

13. A modular door according to any one of the preceding claims, further including an lower step profile, extending along the lower edge of said door, and inter-linking with each of said plurality of inter-linked elements.

14. A modular door according to claim 13, wherein said lower profile may be height-adjusted to reduce the gap between the floor and said modular door.

15. A curved modular door according to any one of the preceding claims, wherein said two series of inter-linked panels are curved.

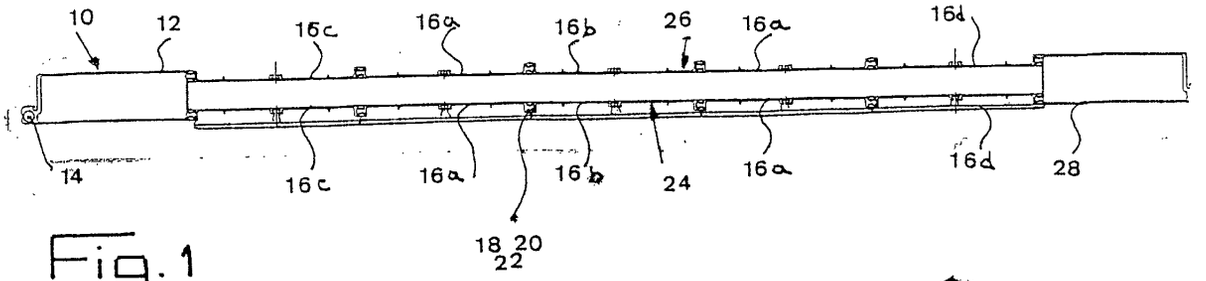


Fig. 1

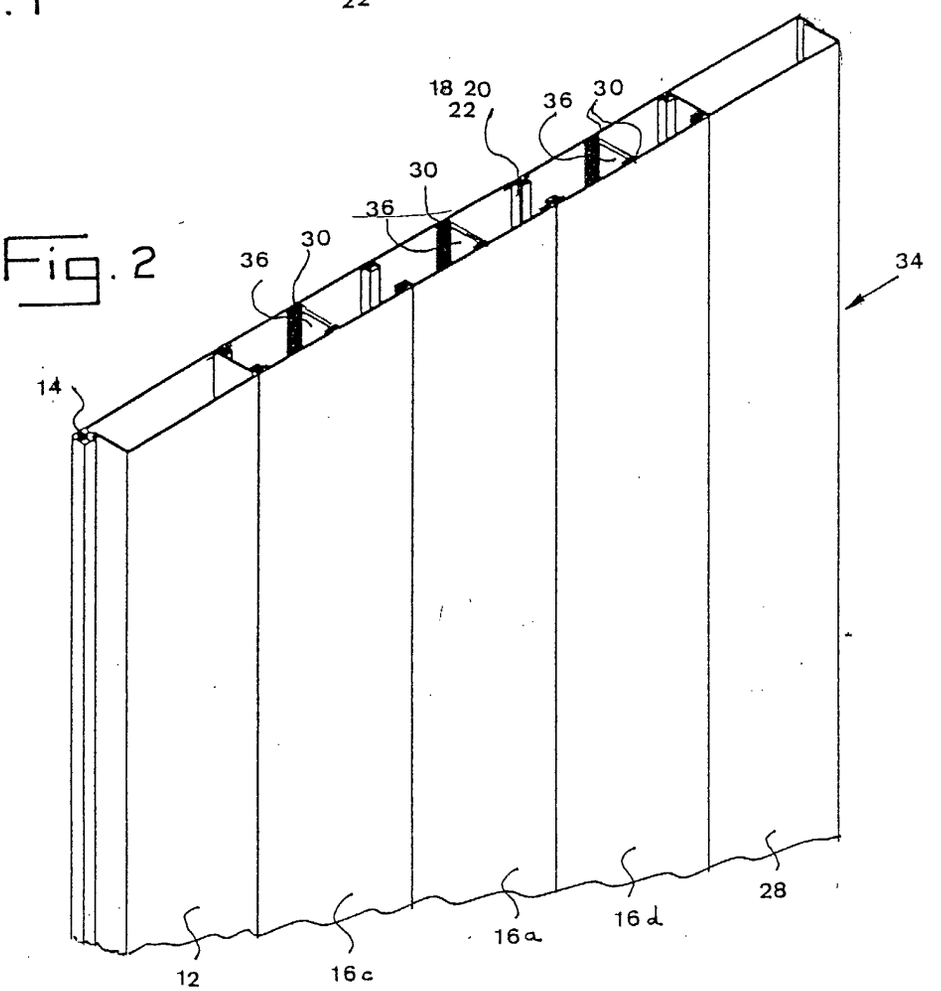


Fig. 2

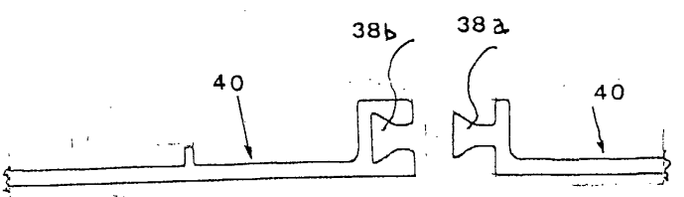


Fig. 3

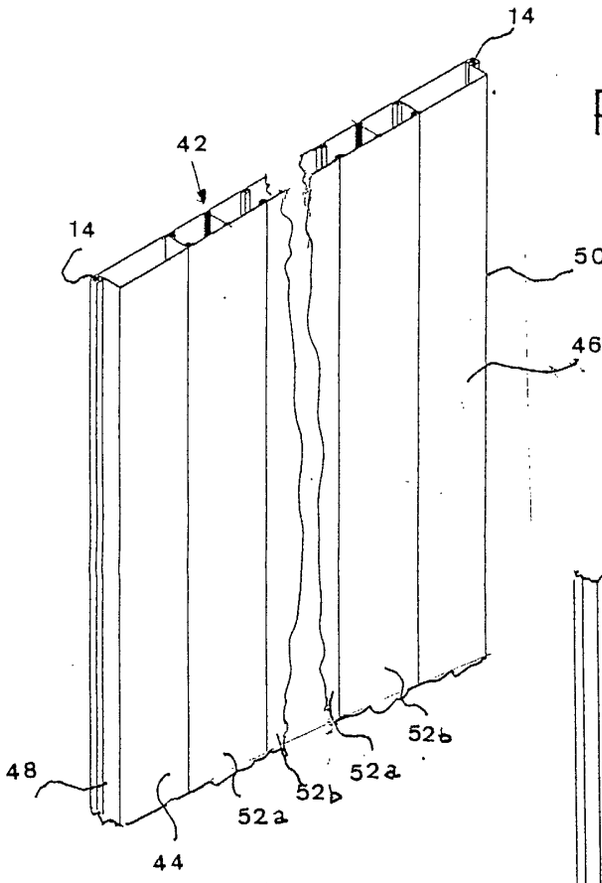


Fig. 4

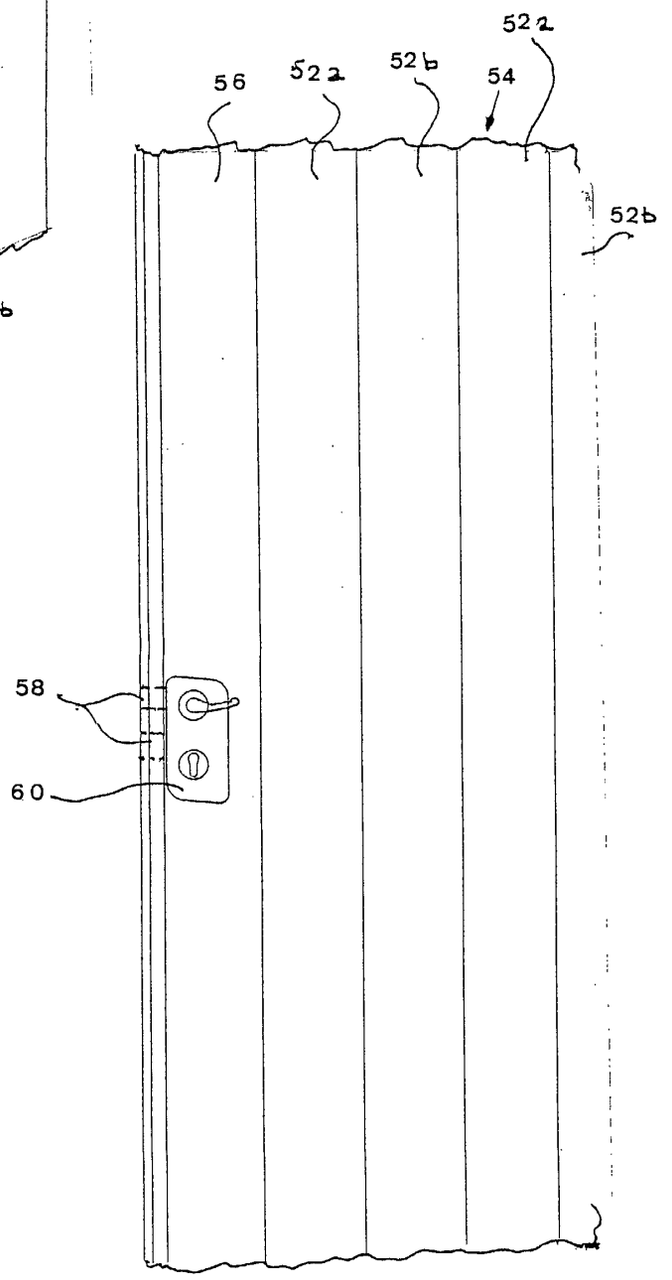


Fig. 5

Fig. 6

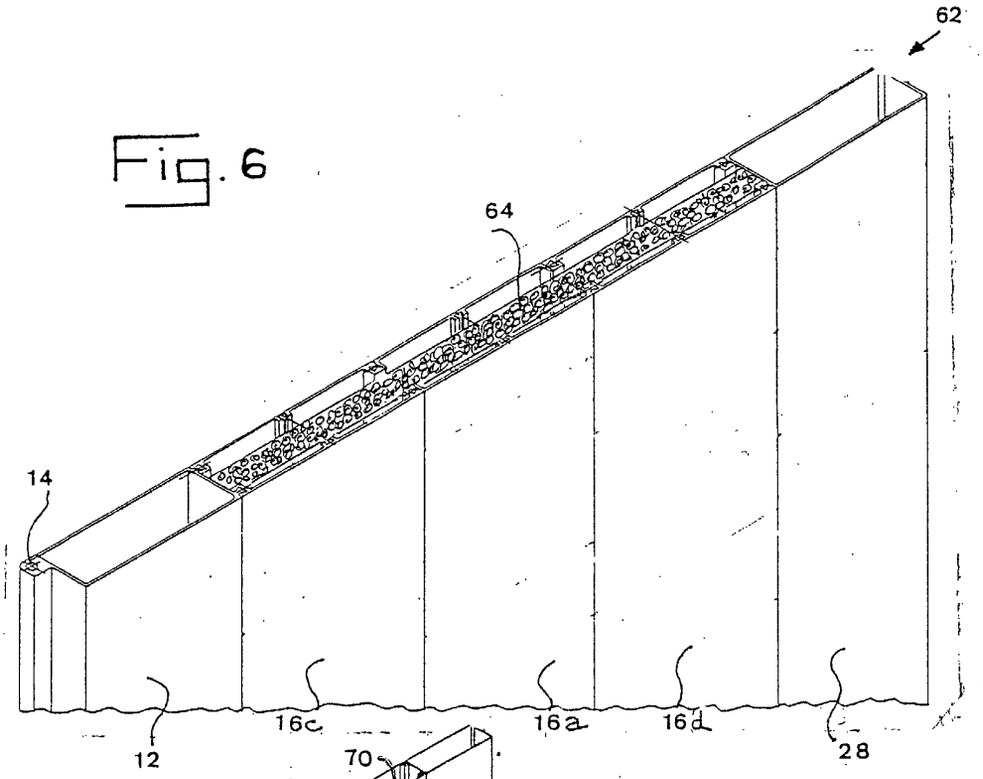


Fig. 7

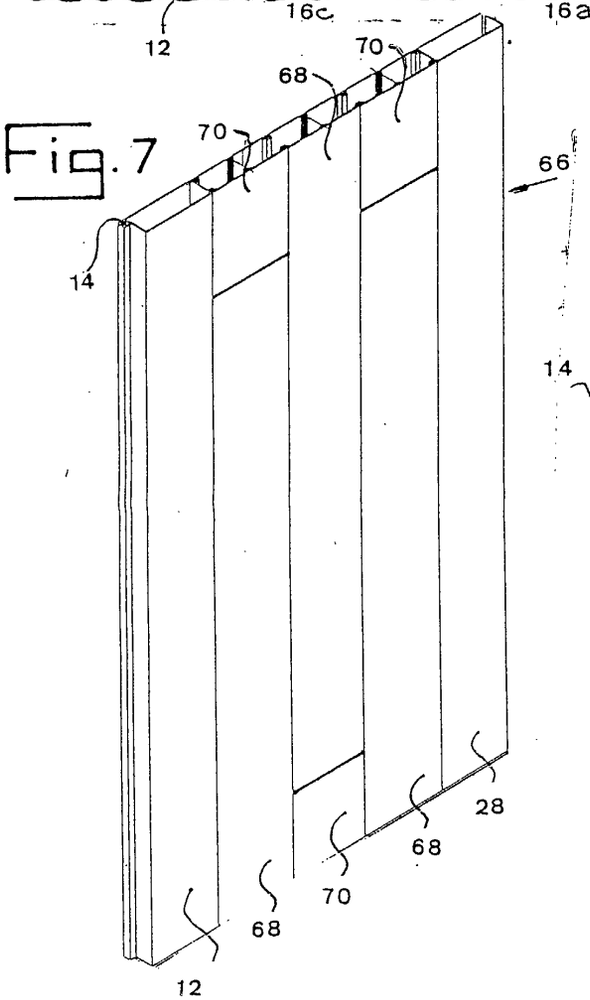
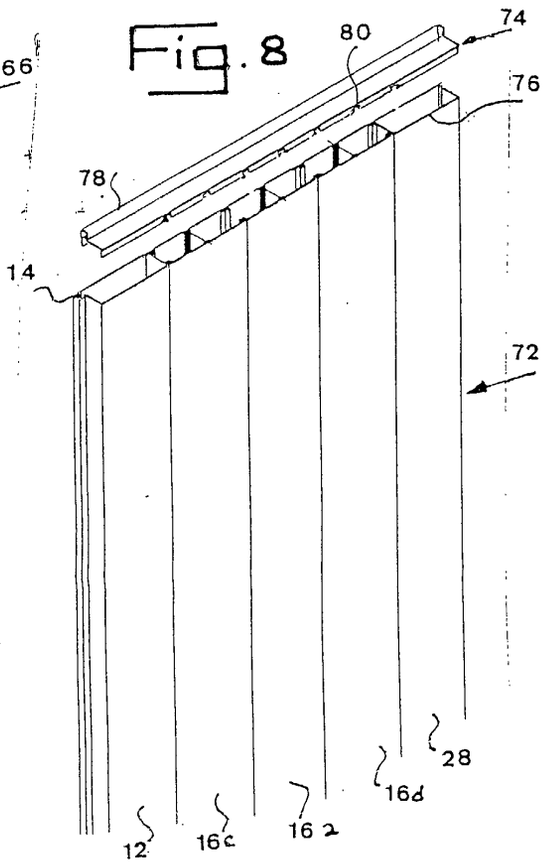
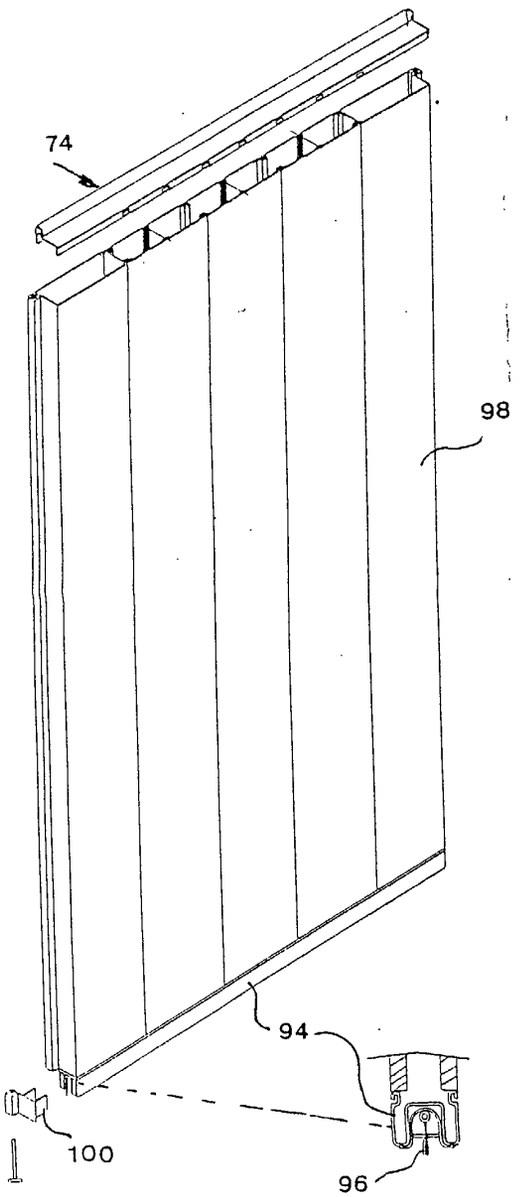


Fig. 8




74
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94
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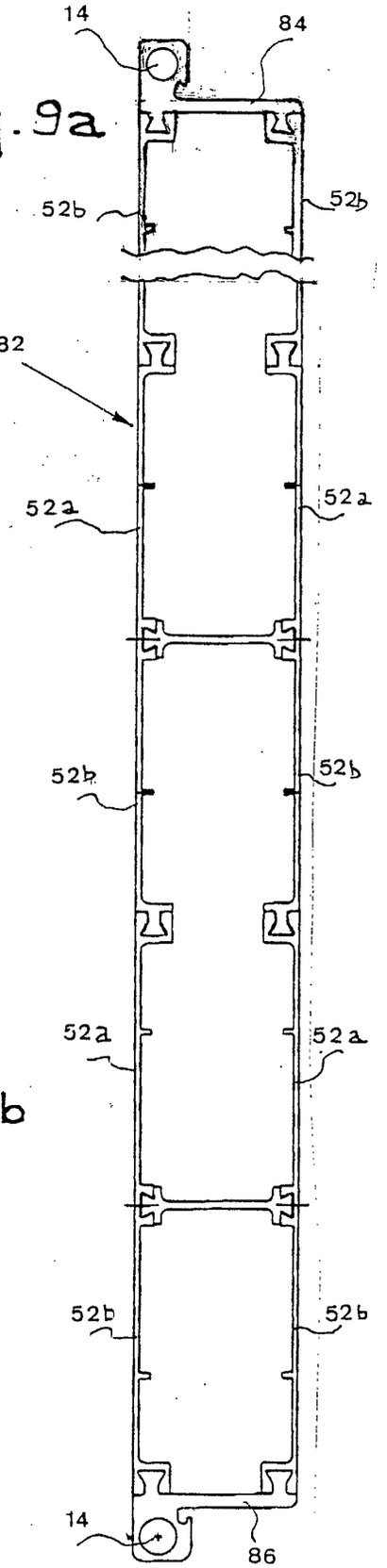
96

Fig. 9a


14
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82
52a
52a
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52b
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52a
52b
52b
14
86

Fig. 9b

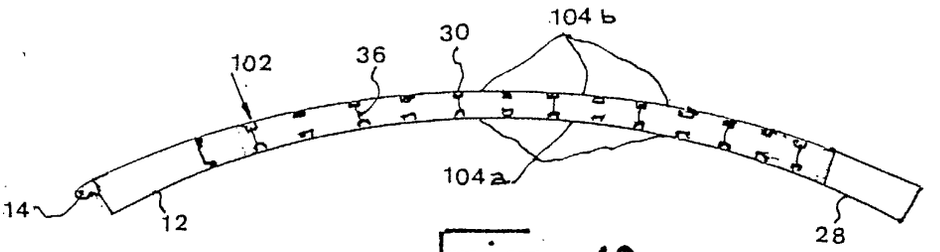

Fig. 10

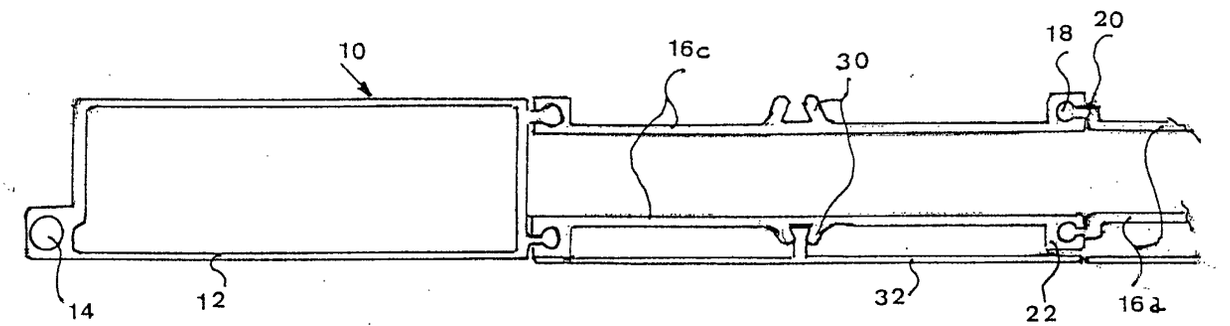

Fig. 11