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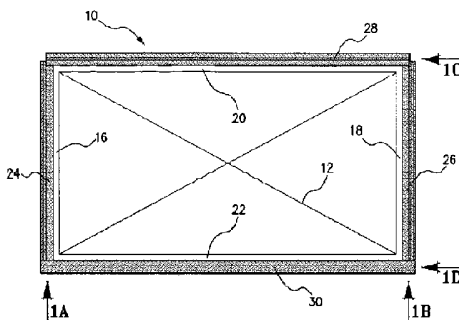
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(54) Title: FACADE SYSTEM

FIG. 1



(57) Abstract: A facade module in the form of a panel (10) is mountable to a floor of a building. The panel (10) comprises a support frame (12) for supporting cladding (14) that is located externally on the frame in use of the module. The frame comprises opposing sides (16, 18) that extend between a frame top (20) and an opposing frame bottom (22). The frame also comprises one or more joiners (24, 26, 28) and (30) arranged to be mounted to extend along at least one of the sides, top or bottom of the frame. Each joiner is configured for enabling the panel in use to engage, at a join, another joiner located adjacent to the respective frame side, top or bottom, in a manner such that movement of the joiner with respect to the other joiner can be accommodated at the join.

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FACADE SYSTEM

TECHNICAL FIELD

A facade system is disclosed that facilitates the mounting of unique facade
5 modules to a building. The modules are configured such that the components thereof
can mostly be formed from metal. The system also comprises a method for forming a
facade module, as well as a method of installing a facade at a building. The facade
system finds particular though not exclusive application with multi-story buildings in
which each floor typically comprises a concrete slab, whereby the facade modules may
10 be mounted to extend around a given floor slab.

BACKGROUND ART

Many multi-storey buildings are constructed whereby a facade (also referred to
as a "curtain wall") is affixed to respective and successive concrete floor slabs, to
15 define the exterior of the building. Such facades can be constructed almost entirely of
glass panels, or may comprise glass panels that are arranged between, and that
vertically alternate with, either non-metal or metal panels.

In curtain walls it is known to manufacture a metal supporting frame for each
facade (e.g. from steel). Such supporting frames are sometimes referred to as strong-
20 backs. Existing curtain wall systems construct the facade panels on site, including the
fastening of external cladding to the strong-backs.

In facade panels that comprise steel strong-backs, various attempts have been
made during the installation process to ensure that the panels can accommodate
movement arising from thermal expansion/contraction of the panels, and movements
25 arising under load. However, problems exist with maintaining a weatherproof
performance, especially where such facade panels also support glass window suites,
which typically have different thermal expansion/contraction characteristics to the
strong-backs.

The above references to the background art do not constitute an
30 admission that the art forms a part of the common general knowledge of a person of
ordinary skill in the art in Australia or elsewhere.

SUMMARY OF THE DISCLOSURE

In a first aspect there is disclosed a facade module for mounting to a floor of a building, the module comprising:

- a support frame for supporting cladding that is located externally on the frame in use of the module, the frame comprising opposing sides that extend between a frame top and an opposing frame bottom; and
- a joiner arranged to be mounted to extend along at least one of the sides, top or bottom of the frame, the joiner being configured for enabling the module in use to engage, at a join, another joiner located adjacent to the respective frame side, top or bottom, in a manner such that movement of the joiner with respect to the other joiner can be accommodated at the join.

By providing a facade module that has one or more joiners that are configured to engage whilst accommodating movement at the join, the facade module can be pre-fabricated as a complete unit (e.g. offsite). Also, the “floating” characteristic of the join can be utilised to assist with installation of the module, whereby positioning adjustments can be made in-situ. The one or more joiners can thus considerably simplify installation and can also expedite the formation of a facade (i.e. a curtain wall) at a building. In addition, the interaction of the joiners may be such that, during the facade installation, final sealing at the join may be eliminated altogether.

As referred to in the Background, the relative movement that can occur between adjacent modules can be thermally induced (e.g. by the expansion/contraction of the modules and/or the differential expansion/contraction of an adjacent building component, such as a window suite). Such movement can alternatively or additionally be caused by other movements (eg. deflection due to load of a building floor to which the module is mounted, wind-induced movements of a facade etc).

This capacity of the one or more joiners to accommodate such movements can also enable various components of the module to be fabricated from metal materials. The employment of joiners in the facade module can also allow for a “composite” construction of the facade module. In this regard, the support frame can be manufactured so as to possess the required structural performance characteristic of the module, enabling the joiner that is employed to be “non-structural”. This ability to use a non-structural joiner allows the joiner to be specifically (or purposely) fabricated to

provide for ease of module connectivity and also for ease of (or automatic) join weatherproofing.

For example, the support frame can be fabricated from a structural metal such as structural steel, to provide the module with its required degree of structural integrity and compliance with building performance regulations. In this regard, in one embodiment the support frame may take the form of a stud frame that is formed from steel sections. When the support frame is fabricated from a structural metal, cladding may be mounted thereto that is fabricated from a metal (e.g. from a galvanised and optionally painted steel sheet). This can allow the support frame and cladding to be prefabricated in a rapid and cost effective manner (e.g. offsite in a factory).

Conversely, where the joiners can be fabricated from a metal that does not require a structural function in the module, a metal can be employed for the joiner that is more easily deformed and shaped, such as aluminium (e.g. the one or more joiners may each be formed from aluminium extrusion). In this latter case, a joiner profile can be designed and formed (e.g. extruded) which is optimised towards accommodating the range of different movements that the module will be subjected to when located in a resultant facade, as well as being optimised to weatherproofing the join.

In this regard, in one embodiment, the at least one joiner can be defined by an elongate member (e.g. a predetermined length of extrusion) having a profile which in use is shaped to interact (e.g. to mate) at the join with a complementary profile of the adjacent other joiner. More specifically, in one embodiment each joiner for respective mounting to the sides, top and bottom of the frame may comprise a length of aluminium extrusion. Thus, in use, the movement of air, water and airborne particulates via the join can be substantially restricted by the interacting (mating) joiners.

For example, in one embodiment the elongate member can be defined by an extrusion that comprises:

- a web that extends for the length of the extrusion and that is adapted for mounting at and along a respective face at the side, top or bottom of the frame;
- a first flange that projects from one side of the web for the length of the extrusion; and
- a second flange that projects from the other side of the web for the length of the extrusion.

In this embodiment, when the joiner is to be mounted to one of the frame sides, the second flange can form part of a channel formation that projects from the web's other side and for the length of the extrusion. Thus, when an extrusion with the same profile is mounted on each respective side of a given module frame (but with the first and second flanges in a reversed orientation on either side of the given module) then, at each side of the given module:

- the first flange can in use be received in a channel formation of a complementary extrusion that is mounted on a side of an adjacent module frame, and
- the first flange of the complementary extrusion can in use be received in the channel formation of the extrusion mounted on the given module frame.

Thus, the same extrusion profile can be used for each side of each given module. Also, in this way, each module can be made "modular" in the sense that each module is adapted for engaging each like module on either side thereof.

In one embodiment each of the sides, top and bottom of the frame has a respective joiner mounted thereto. This defines a border frame that is mounted to extend right around a perimeter of the support frame. Further, each of the joiners at the top and bottom of the frame can be configured to engage with an adjacent window. For example, when the window forms part of a window suite, each joiner at the top and bottom of the frame can be shaped to interact at the join with a respective adjacent elongate component (e.g. frame member) of the window suite. The respective window frame member can, in this regard, be securingly received between the first and second flanges of the top and bottom joiners.

To provide for sealing at a four-way junction between adjacent modules and adjacent overlying window suites, the first and second flanges of the top joiner can each comprise a return that laterally projects therefrom towards the opposing return, with each return extending for the length of the extrusion. A seal, as set forth hereafter, can be freely (floatingly) positioned to extend between and locate under the returns of adjacent top joiners.

In one embodiment the top joiner may further comprise an additional flange that projects from an edge of the web in an opposite direction to the first flange and for the length of the joiner. Then, when the top joiner is mounted to the frame, an in-use upper

edge of cladding can be located under the additional flange, to better secure the cladding to the module.

In one embodiment the module may further comprise a weatherproof lining mounted to an in-use external face of the frame and, optionally, a smoke screen mounted to an in-use internal face of the frame. For example, the weatherproof lining and smoke screen may each comprise a flat steel sheet, with the weatherproof lining comprising galvanised steel sheet.

In a second aspect there is disclosed a method of forming a module for a facade comprising the steps of:

- forming a frame that comprises opposing sides that extend between a frame top and an opposing frame bottom; and
- mounting a joiner to extend along at least one of the sides, top or bottom of the frame, the joiner being configured for enabling the module in use to engage, at a join, another joiner located adjacent to the respective frame side, top or bottom in a manner such that movement of the joiner with respect to the other joiner can be accommodated at the join.

In the method of the second aspect a joiner may be mounted to each of the sides, top and bottom of the frame to define a joiner border frame that extends right around a perimeter of the frame, for example, using a joiner as defined in the first aspect.

The method of the second aspect may comprise a further step of mounting an edge sealing and packing strip along the edge faces of each of the sides, top and bottom of the frame, prior to mounting each joiner thereto. The edge strip may comprise a packing material that is adapted (including being sized) so as to be suitable to the height and width of the opposing edge faces. This enables appropriate waterproofing of the join. The packing material may comprise a silicone, a polymeric foam tape or other expandable strip.

In addition, the method of the second aspect may comprise a further step of mounting a weatherproof lining to an in-use external face of the frame and, optionally, a smoke screen mounted to an in-use internal face of the frame. The weatherproof lining and smoke screen may comprise a flat steel sheet that is mounted right across a

respective face of the frame using a series of discretely spaced fasteners, with the weatherproof lining being galvanised.

The method of the second aspect may comprise a further step of mounting a cladding to an in-use external face of the frame. The cladding may comprise a galvanised and optionally painted preformed steel sheet that is mounted right across the external face of the frame using a series of discretely spaced fasteners.

In the method of the second aspect the frame may be formed from steel sections that are connected together to form a stud frame. For example, the steel sections can be roll-formed steel channel.

The method of the second aspect can form a facade module as defined in the first aspect.

In a third aspect there is disclosed a method for installing at a building a facade module that is as defined in the first aspect. The method comprises the steps of:

- mounting one or more supporting brackets at a floor of a building, with each bracket being adapted for connecting to the facade module;
- arranging the facade module into suitable proximity of the one or more brackets; and
- attaching the module to the brackets.

In the method of the third aspect each of the brackets may be defined by right angle section. In the method of the third aspect one or more fasteners (e.g. bolts or screws) may be introduced through preformed respective apertures located in a flange of each of the brackets to fasten to an in-use interior face of the facade module. When the facade module comprises a stud frame formed from sections, the one or more fasteners can be introduced to fasten into a respective section of the frame.

In the method of the third aspect each facade module may be preformed and may be pivoted into position from an overlying floor of the building. Once suitably located it can then be rapidly attached (fastened) to its respective floor.

The method of the third aspect may comprise a further step of attaching at the building floor a like facade module, adjacent to the existing installed facade module, so as to interactively engage the respective joiners at the adjacent module sides. Then, a series of adjacent like modules may be attached along each side of each floor of the building, such that respective joiners at adjacent module sides interactively engage, to

define a row of modules extending around each building floor. This enables a curtain wall to be simply and rapidly constructed at the building.

In the method of the third aspect a respective window suite may be installed along each of a lower module of a lower module row, so that the suite is located
5 between the lower module and a subsequently aligned upper module in an upper module row. Thus, respective joiners at the top of the lower module and at the bottom of the upper module can interactively engage with a respective component of the window suite, to enable secure location of the window suite between the lower and upper modules. This can allow the curtain wall to be rapidly completed.

10 The method of the third aspect may also comprise a step of arranging a seal at a junction of two adjacent modules in a given row with two adjacent and overlying window suites (e.g. a four-way wet joint for weatherproofing purposes). For example, the seal may comprise a plate that is floatingly positioned to extend within and between the top joiners of the two adjacent modules in the given row and such that a respective
15 portion of the plate underlies each of two adjacent and overlying window suites.

In a fourth aspect there is disclosed a seal for positioning at a junction of two adjacent modules in a given row with two adjacent and overlying window suites.

Thus, when each module is as defined in the first aspect, whereby in each
20 module the first and second flanges of the top joiner comprise laterally projecting returns, a portion of the seal may be arranged to be located on the web of each joiner and under the returns.

For example, the seal may take the form of a plate (e.g. of aluminium for optimum weatherproofing) that is dimensioned to extend between each adjacent joiner
25 and under the returns. The plate may additionally comprise a deformable polymeric foam material attached to its opposing faces, to provide additional sealing.

BRIEF DESCRIPTION OF THE DRAWINGS

Notwithstanding any other forms which may fall within the scope of the facade
30 module, its formation and installation methods, and the seal as defined in the Summary, specific facade module embodiments will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a schematic front view of a facade module embodiment, and Figures 1A to 1D respectively show end profile views of joiner embodiments for locating at the left side, right side, top and bottom of the facade module;

Figures 2A to 2C respectively show a perspective view and two corner details of the facade module of Figure 1, with cladding attached to the in-use exterior face thereof;

Figure 3 schematically depicts a plan (profile) view of a right side joiner embodiment of one module mating with a left side joiner embodiment of an adjacent module, with Figure 3A showing a detail of the right side joiner with a gasket located therein;

Figures 4A and 4B respectively show perspective (3D) views of a stud frame (strong-back) for the facade module, and the frame with a continuous seal/packing around its perimeter;

Figures 5A and 5B respectively show perspective (3D) views of the frame of Figure 4 with joiners mounted to extend around the frame perimeter, and with a first smoke screen panel fastened to a rear (in-use interior) face thereof;

Figures 6A and 6B respectively show perspective (3D) views of the frame of Figure 5 with a first panel of weatherproof lining fastened to a front (in-use exterior) face thereof, and with third and fourth panels of weatherproof lining and smoke screen fastened to front and rear faces thereof;

Figures 7A and 7B respectively show perspective (3D) views of the frame of Figure 6 with a cladding mounting strip fastened to extend part way and fully along a lower part of the frame (at the exterior weatherproof lining);

Figures 8A and 8B respectively show perspective (3D) views of the frame of Figure 7 with cladding panels mounted to extend part way and fully along a lower region of the frame (over the exterior weatherproof lining);

Figures 9A and 9B respectively show perspective (3D) views of the frame of Figure 8 with cladding panels mounted to extend part way and fully along an upper region of the frame (over the exterior weatherproof lining) so as to complete the construction of the facade module (Figure 9B);

Figure 10 shows an end sectional detail taken through an upper part of the facade module (i.e. as if looking in from the right upper side of the module of Figure 1);

Figure 11 shows an end sectional detail taken through a lower part of the facade module (i.e. as if looking in from the right lower side of the module of Figure 1);

Figure 12 shows a front sectional detail taken through a left lower part of the facade module (i.e. as if looking from the front lower left side of the module of Figure 1);

Figure 13 shows a plan sectional detail taken through a top left part of the facade module (i.e. as if looking down on the top left side of the module of Figure 1);

Figure 14 shows an end profile view of a joiner embodiment for locating at the top of the facade module, together with a schematic illustration of a seal plate for location in and with respect to the joiner; and

Figure 15 shows a front sectional detail taken through a facade that comprises two adjacent facade modules and two overlying respective window suites, to illustrate a four-way wet seal (joint).

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Referring firstly to Figures 1 and 2A-2C, a facade module for mounting to a floor of a building is shown in the form of a panel 10. The panel 10 can be prefabricated to enable a modular system to be applied to the formation of a facade (curtain wall) for a building. The panel 10 comprises a stud frame 12 for supporting cladding 14 that is located externally on the frame in use of the panel on a building (i.e. when the panel forms part of the building's curtain wall).

The panel 10 is designed to accommodate movement that can occur between adjacent panels. Such movement can be thermally induced and can include expansion/contraction of each panel as well as a differential expansion/contraction of an adjacent building component, such as a window suite. Such movement can also be caused by other movements (eg. deflection due to load of a building floor to which the panel is mounted, causing a panel "rotation" relative to an adjacent panel, as well as wind-induced movements of the facade etc).

The stud frame 12 can be fabricated from a structural metal such as from structural steel sections, to provide the module with its required degree of structural integrity, and also to comply with building performance regulations. When the stud frame is fabricated from a structural metal, the cladding 14 that is mounted to the frame

can be formed from a metal (e.g. galvanised and painted preformed steel sheet). The panel 10, including the stud frame 12 and cladding 14, can be prefabricated offsite (e.g. in a factory) in a rapid and cost effective manner, so that in use a completed, modular panel is delivered to a construction site, ready to be installed.

5 The frame 12 comprises opposing sides 16, 18 that extend between a frame top 20 and an opposing frame bottom 22. In the embodiments depicted herein joiners in the form of elongate extrusions 24, 26, 28 and 30 are mounted to extend along each of the respective sides 16, 18, top 20 and bottom 22. This defines an extrusion border frame (shown schematically in solid line in Figure 1) that extends right around the perimeter
10 of the frame 12. However, in its simplest form (e.g. when the panel is located at the end of a row in a curtain wall) an extrusion may be mounted to extend solely along one of the sides of the frame.

 The side extrusions 24, 26 are each configured to enable the panel to engage the side of an adjacent panel. On the other hand, the extrusions 28 and 30 are each adapted
15 for engaging a component of a widow suite, as explained hereafter.

 As shown in Figure 3, each side extrusion 24, 26 is configured for enabling the panel to engage (i.e. mate with) at a join J another extrusion mounted to the side of an adjacent panel. The side extrusions are configured such that such that the in-use movement of one extrusion (e.g. the right side extrusion 26) with respect to the other
20 extrusion (e.g. a left side extrusion 24') can be accommodated at the join. The left side extrusion 24' is typically mounted to an adjacent like panel (i.e. a panel that has the same configuration as panel 10).

 This ability of each panel to accommodate movement at the join, enables each panel to be pre-fabricated as a complete and modular unit (e.g. offsite) because there is
25 not the usual requirement to construct the panel on site and to then, during installation, build in suitable spacings (and then separately seal these) to take account of the in-use movement to which the panels will be subjected to. Also, the "floating" characteristic of the join can be utilised to assist with installation of the panel, whereby the panel can be manoeuvred during installation, and whereby subtle positioning adjustments can be
30 made in-situ. The extrusions can thus considerably simplify installation and can also expedite the formation of the entire facade (i.e. a curtain wall) at a building.

As also depicted in Figure 3, each side extrusion 24, 26 is configured such that, after the facade installation, no further sealing between adjacent panels is required. In this regard, as shown in Figure 3A, the left side extrusion 24' can have an appropriately shaped elongate gasket G located in the channel Ch defined in the flange F1' (as may
5 the right side extrusion 26). The join is also such that the movement of air, water and airborne particulates via the join is substantially restricted because of the way in which the extrusions mate, whereby in some applications no such gasket G may be required.

As best shown in Figures 1A to 1D, each extrusion generally comprises a web W that extends for the length of the extrusion and that is adapted for close-facing
10 mounting at and along a respective face at the sides 16, 18, top 20 and bottom 22 of the frame 12. Each extrusion further comprises a first flange F1 that projects from one side of the web W for the length of the extrusion. Further, a second opposing flange F2 projects from the other side of the web W for the length of the extrusion.

In each side extrusion 24, 26 the second flange F2 forms part of a channel C that
15 projects from the web W for the length of the extrusion. Furthermore, the same extrusion profile is used for each side extrusion 24, 26 but is arranged so that the first and second flanges are in a reversed orientation at each panel side.

In Figure 3 it will also be seen that each side extrusion 24, 26 comprises a central recess formation CR in the web W. In the assembled configuration of Figure 3,
20 these formations oppose each other and face inwardly. Each formation is adapted for receiving therein a respective mating part of a known window suite. The elongate ribs Ri and Ri' that project into and along the recess from opposing sides thereof strengthen the central recess formation and assist with the mating to the known window suite.

As again shown in Figure 3, the right side extrusion 26 is arranged such that the
25 first flange F1 is snugly received in use in the channel C' of the complementary left side extrusion 24' of the adjacent panel, and the first flange F1' of the extrusion 24' is snugly received in use in the channel C of the extrusion 26. In this way, the panels automatically weatherproof the facade. Also, each panel is also "modular" in the sense that each prefabricated panel is adapted for engaging a like prefabricated panel on either
30 side thereof, without requiring any further packing, sealing etc.

As best shown in Figures 1C, 1D, 2B and 2C, the top and bottom extrusions 28 and 30 are each adapted for engaging and securely locating thereat a component (i.e. an

elongate window frame member) of a window suite. In the top extrusion 28 each of the first F1 and second F2 flanges comprises a respective return R1 and R2 that laterally projects therefrom and towards the opposing return, with each return also extending for the length of the extrusion. A lower elongate window frame member of an overlying window suite can sit on an upper surface of each return in use (Figure 15). This then defines a space S (see Figure 14) between the underside of the window frame member and the web W. Into this space a sealing plate P (as specifically described with reference to Figures 14 and 15) can be freely (floatingly) positioned, with the plate P extending between the flanges F1 and F2 and locating under the returns R1 and R2.

Such a sealing plate can provide a four-way seal at the junction between adjacent panels and adjacent overlying window suites, as described hereafter.

The first F1 and second F2 flanges of the bottom extrusion 30 are also each adapted for engaging and securely locating therebetween an upper elongate window frame member of an underlying window suite. In use, the flanges F1 and F2 of extrusion 30 have a sufficient length, and also the panel is specifically connected to the floor, such that the web W of the bottom extrusion 30 is spaced above the upper window frame member to allow for window suite expansion, contraction and other movements thereof (e.g. rotational movements under load).

As best shown in Figures 2B and 2C, the top extrusion 28 further comprises an additional flange F3 that extends along and projects downwardly in use from an edge of the web W, in a generally opposite direction to the first flange F1 and for the length of the extrusion. This allows an in-use upper edge lip 32 of the cladding 14 to be slipped up and under the additional flange F3 during construction of the panel. The flange F3 “flashes” out rainfall and airborne water (i.e. to prevent water from passing through to the back of the cladding 14).

As explained in the Facade Panel Production section (below) each panel 10 further comprises a weatherproof lining and a smoke screen that may each comprise a flat steel sheet (steel sheet blanket) mounted to both external and internal faces of the frame 12.

The panel 10 thus has a “composite” construction. In this regard, the support frame is manufactured to possess the required structural performance characteristic of the panel, thereby enabling a “non-structural” border frame to be employed that is

specifically configured for mating with adjacent panels on either side, and with overlying and underlying window suites. In this regard, a series of extrusions can be employed for the border frame that comprise an easily deformed and shaped metal, such as aluminium. The ability to use non-structural “joining-type” extrusions allows for a specific and purpose-built panel peripheral (border) frame that is designed to provide for ease of panel connectivity, for automatic join weatherproofing, and that also accommodates a range of movements in use.

Facade Sealing

Figures 14 and 15 depict a four-way seal (wet joint) for positioning at the junction of two adjacent panels 10, 10' in a given row with two adjacent and overlying window suites WS1 and WS2. In this regard, a seal in the form of a plate P is dimensioned and configured such that it can freely (floatingly) be positioned to extend between and locate under the returns R and R' of the adjacent top extrusions 28 and 28' respectively.

The plate P can be of aluminium (for corrosion resistance) and can comprise a deformable polymeric foam (e.g. of urethane foam) mounted to its upper and lower faces to enable a wet seal to be defined. In this regard, the foam can compress against the webs W and W' of the extrusions 28 and 28', and against the undersides of the returns R and R', but without restricting movement of the plate in use. The foam can also expand to fill the junction space JS defined above and under the plate when positioned as shown in Figure 15 to effectively weatherproof the four-way joint.

It should also be noted that like side extrusions (i.e. that are the same as extrusions 26, 24') can be positioned along adjacent sides of the adjacent window suites WS1 and WS2 to facilitate mating therebetween. This can again enhance facade installation (in the same ways as the extrusions 24, 26).

Facade Panel Production

One example of a method of forming a panel 10 for a building facade is depicted in sequence in Figures 4 to 9, as well as in Figures 10 to 13. In overview, the method comprises the steps of:

- forming the structural frame 12;

- mounting the extrusions 24-30 to the sides, top and bottom of the frame to define a border frame that extends right around a perimeter of the frame.

More specifically, and as illustrated in sequence in Figures 4-9, the method comprises the following steps:

- 5 ⇒ Figure 4A - forming a structural stud frame 12 from sections of rolled steel channel (with respective sections defining the vertical studs, the top and bottom horizontal plates and the horizontal noggins of the frame);
- ⇒ Figure 4B - mounting an edge sealing and packing strip 40 along the edge faces of each of the sides 16, 18, top 20 and bottom 22 of the frame 12. The edge sealing
10 strip comprises a packing material that is appropriately sized to the height and width of the opposing edge faces. This provides waterproofing of the join. The packing material comprises a silicone strip, a polymeric foam tape or another expandable strip material;
- ⇒ Figure 5A - mounting the extrusions 24-30 to the sides 16, 18, top 20 and
15 bottom 22 of the frame 12 to define an extrusion border frame that extends right around a perimeter of the frame;
- ⇒ Figure 5B - mounting a first panel that acts as a smoke screen 42 to an in-use internal (lower rear) face of the frame. The smoke screen comprises a flat steel sheet
20 blanket that is mounted across the frame face using a series of discretely spaced fasteners that engage with the stud frame members;
- ⇒ Figure 6A - mounting a first panel of weatherproof lining 44 to an in-use external face (lower front) face of the frame. The weatherproof lining comprises a
 galvanised flat steel sheet that is mounted across the frame face using a series of discretely spaced fasteners that engage with the stud frame members;
- 25 ⇒ Figure 6B - mounting third and fourth panels of weatherproof lining 46, and smoke screen 48 respectively to the external (upper front) and internal (upper rear)
 of the frame front and rear faces;
- ⇒ Figures 7A and 7B - mounting cladding fastening strips 50A and 50B to a lower edge of the external face of the frame;
- 30 ⇒ Figures 8A and 8B - mounting first and second cladding panels 14A and 14B to the lower part of the frame external face using a series of discretely spaced fasteners
 that engage with the stud frame members. The cladding panel lower edges

respectively engage and are secured by the cladding fastening strips 50A and 50B. The cladding panels each comprise a galvanised and painted preformed steel sheet; ⇒ Figures 9A and 9B - mounting third and fourth cladding panels 14C and 14D to the upper part of the frame external face. The cladding panel upper edges 32
5 respectively engage under and are secured by the additional flange F3 (Figures 2B and 2C). This produces the completed panel 10 (Figure 9B).

Façade Module Installation

A method for installing the completed (prefabricated) panel 10 at a building to
10 construct a facade (curtain wall) comprises the following steps:

- arranging (e.g. flat stacking) a suitable number of prefabricated panels at a given floor of a building;
- mounting (bolting) a number of spaced supporting brackets to a next floor below the given floor, with each bracket also being adapted for connecting to an inside face of a
15 respective panel at one of the sections of the stud frame 12;
- positioning using a crane a given panel along its upper inside edge and along the given floor edge;
- pivoting (using the crane) the given panel about its upper inside edge whilst resting it along the given floor edge;
- 20 - manoeuvring the bottom extrusion 30 of the panel into alignment with an upper frame component of an underlying window suite (the suite already having been mounted to an underlying row of panels at a next lower floor);
- at the same time, manoeuvring the left side extrusion 24 of the panel into alignment with the right side extrusion 26 of an existing panel (the existing panel already having
25 been mounted to the underlying row of window suites);
- at the same time, manoeuvring the panel into suitable proximity of the brackets;
- bolting the panel rear side to the brackets;
- mounting in a similar manner a series of further panels along the floor of the building, to define a row of panels extending along this side of the floor, and then around all of
30 the sides of the building floor.

This method enables a curtain wall to be simply and rapidly constructed at the building.

In the installation method each of the brackets comprises a short length of galvanised right-angle plate, with the fasteners (bolts) being introduced through preformed respective apertures located in the flanges of each of the brackets to respectively fasten the brackets to the floor and to the inside face of the panel.

5 The installation method also comprises arranging, at the appropriate time, the weatherproofing seal plate P at the junction of two adjacent panels with two adjacent and overlying window suites (i.e. the four-way wet joint of Figures 14 and 15).

10 Whilst a number of specific facade module (panel), seal and construction/installation method embodiments have been described, it should be appreciated that the facade module, seal and construction/installation methods may be embodied in many other forms.

15 In the claims which follow, and in the preceding description, except where the context requires otherwise due to express language or necessary implication, the word “comprise” and variations such as “comprises” or “comprising” are used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the facade module, seal and construction/installation methods.

20

Claims

1. A facade module for mounting to a floor of a building, the module comprising:
 - a support frame for supporting cladding that is located externally on the frame in use of the module, the frame comprising opposing sides that extend between a frame top and an opposing frame bottom; and
 - a joiner arranged to be mounted to extend along at least one of the sides, top or bottom of the frame, the joiner being configured for enabling the module in use to engage, at a join, another joiner located adjacent to the respective frame side, top or bottom, in a manner such that movement of the joiner with respect to the other joiner can be accommodated at the join.
2. A facade module as claimed in claim 1 wherein the at least one joiner is defined by an elongate member that has a profile which in use is shaped to interact at the join with a complementary profile of the adjacent other joiner.
3. A facade module as claimed in claim 2 wherein the elongate member is an extrusion that comprises:
 - a web that extends for the length of the extrusion and that is adapted for mounting at and along a respective face at the side, top or bottom of the frame;
 - a first flange that projects from one side of the web for the length of the extrusion; and
 - a second flange that projects from the other side of the web for the length of the extrusion.
4. A facade module as claimed in claim 3 wherein, when the joiner is to be mounted to one of the frame sides, the second flange forms part of a channel formation that projects from the web other side for the length of the extrusion.
5. A facade module as claimed in claim 4 wherein an extrusion with the same profile is mounted on each respective side of a given module frame, but with the first and second flanges in a reversed orientation on either side of the given module, the first flange can in use be received in a channel formation of a complementary extrusion that is mounted on a side of an adjacent module frame, and the first flange of the complementary

extrusion can in use be received in the channel formation of the extrusion mounted on the given module frame.

5 6. A facade module as claimed in any one of the preceding claims wherein each of the sides, top and bottom of the frame has a respective joiner mounted thereto, thereby defining a border frame that is mounted to extend right around a perimeter of the support frame.

10 7. A facade module as claimed in claim 6 wherein each of the joiners at the top and bottom of the frame can engage with an adjacent window.

15 8. A facade module as claimed in claim 7 wherein the window forms part of a window suite, whereby each joiner at the top and bottom of the frame is shaped to interact at the join with a respective adjacent elongate component of the window suite.

9. A facade module as claimed in claim 7 or 8 wherein the first and second flanges of the top joiner each comprise a return that laterally projects therefrom towards the opposing return, with each return extending for the length of the extrusion.

20 10. A facade module as claimed in claim 9 wherein the top joiner further comprises an additional flange that projects from an edge of the web in an opposite direction to the first flange and for the length of the joiner whereby, when the top joiner is mounted to the frame, an in-use upper edge of cladding can be located under the additional flange.

25 11. A facade module as claimed in any one of the preceding claims wherein each joiner for respective mounting to the sides, top and bottom of the frame comprises aluminium extrusion.

30 12. A facade module as claimed in any one of the preceding claims wherein the support frame is a stud frame formed from steel sections.

13. A facade module as claimed in any one of the preceding claims further comprising a weatherproof lining mounted to an in-use external face of the frame and, optionally, a smoke screen mounted to an in-use internal face of the frame.
- 5 14. A facade module as claimed in claim 13 wherein the weatherproof lining and smoke screen each comprise a flat steel sheet, with the weatherproof lining comprising galvanised steel sheet.
- 15 15. A facade module as claimed in any one of the preceding claims further comprising cladding mounted to an in-use external face of the frame.
16. A facade module as claimed in claim 15 wherein the cladding is a galvanised and optionally painted preformed steel sheet.
- 15 17. A facade module substantially as herein described with reference to the accompanying drawings.
18. A method of forming a module for a facade comprising the steps of:
- forming a frame that comprises opposing sides that extend between a frame top and an opposing frame bottom; and
 - mounting a joiner to extend along at least one of the sides, top or bottom of the frame, the joiner being configured for enabling the module in use to engage, at a join, another joiner located adjacent to the respective frame side, top or bottom in a manner such that movement of the joiner with respect to the other joiner can be accommodated at the join.
- 25 19. A method as claimed in claim 18 wherein a joiner is mounted to each of the sides, top and bottom of the frame to define a joiner border frame that extends right around a perimeter of the frame.
- 30 20. A method as claimed in claim 18 or 19 wherein the joiner is as defined in any one of claims 2 to 11.

21. A method as claimed in any one of claims 18 to 20 comprising the further step of mounting an edge sealing and packing strip along the edge faces of each of the sides, top and bottom of the frame.
- 5 22. A method as claimed in any one of claims 18 to 21 comprising the further step of mounting a weatherproof lining mounted to an in-use external face of the frame and, optionally, a smoke screen mounted to an in-use internal face of the frame.
- 10 23. A method as claimed in claim 22 wherein the weatherproof lining and smoke screen are each a flat steel sheet that is mounted right across a respective face of the frame using a series of discretely spaced fasteners.
24. A method as claimed in any one of claims 18 to 23 comprising the further step of mounting a cladding to an in-use external face of the frame.
- 15 25. A method as claimed in claim 24 wherein the cladding is a galvanised and optionally painted preformed steel sheet that is mounted right across the external face of the frame using a series of discretely spaced fasteners.
- 20 26. A method as claimed in any one of claims 18 to 25 wherein the frame is formed from steel sections that are connected together to form a stud frame.
27. A method as claimed in claim 26 wherein the steel sections are roll-formed steel channel.
- 25 28. A method as claimed in any one of claims 18 to 27 that forms a facade module as defined in any one of claims 1 to 17.
- 30 29. A method of forming a module for a facade substantially as herein described with reference to the accompanying drawings.

30. A method for installing at a building a facade module that is as defined in any one of claims 1 to 17, the method comprising the steps of:

- mounting one or more supporting brackets at a floor of a building, with each bracket being adapted for connecting to the facade module;
- 5 - arranging the facade module into suitable proximity of the one or more brackets; and
- attaching the module to the brackets.

31. A method as claimed in claim 30 wherein one or more fasteners are introduced through respective apertures in a flange of each of the one or more supporting brackets
10 to fasten to an in-use interior face of the facade module.

32. A method as claimed in claim 31 wherein, when the facade module comprises a stud frame formed from sections, the one or more fasteners are introduced so as to fasten into a respective section of the frame.

15 33. A method as claimed in claim in any one of claims 30 to 32 wherein each facade module is preformed, and wherein the lifting step comprises pivoting the module into position from an overlying floor of the building.

20 34. A method as claimed in claim in any one of claims 30 to 33 comprising a further step of attaching at the building floor a like facade module, adjacent to the existing installed facade module, so as to interactively engage the respective joiners at the adjacent module sides.

25 35. A method as claimed in claim 34 wherein a series of adjacent like modules are attached along each side of each floor of the building, such that respective joiners at the adjacent module sides interactively engage, to define a row of modules extending around each building floor, to enable a curtain wall to be constructed at the building.

30 36. A method as claimed in claim 35 wherein a respective window suite is installed along each of a lower module of a lower module row, so that the suite is located between the lower module and a subsequently aligned upper module in an upper

module row, whereby respective joiners at the top of the lower module and at the bottom of the upper module interactively engage with a respective component of the window suite.

5 37. A method as claimed in claim 36 comprising a further step of arranging a seal at a junction of two adjacent modules in a given row with two adjacent and overlying window suites.

38. A method as claimed in claim 37 wherein the seal comprises a plate that is
10 floatingly positioned to extend within and between the top joiners of the two adjacent modules in the given row and such that a respective portion of the plate underlies each of two adjacent and overlying window suites.

39. A method for installing at a building a facade module, the method being
15 substantially as herein described with reference to the accompanying drawings.

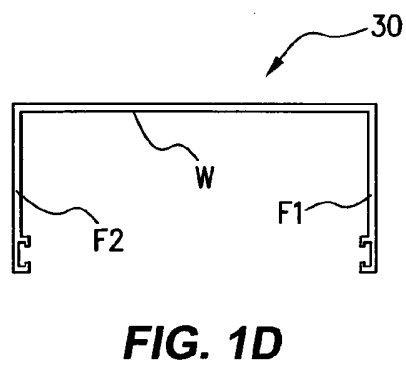
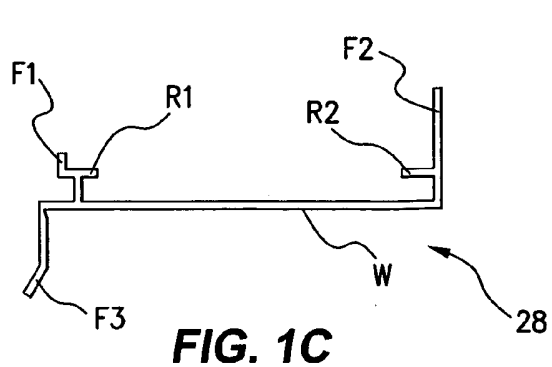
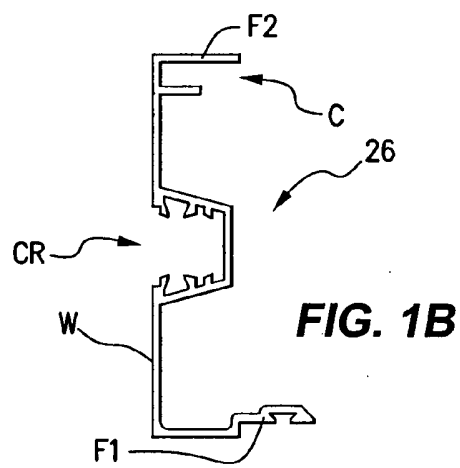
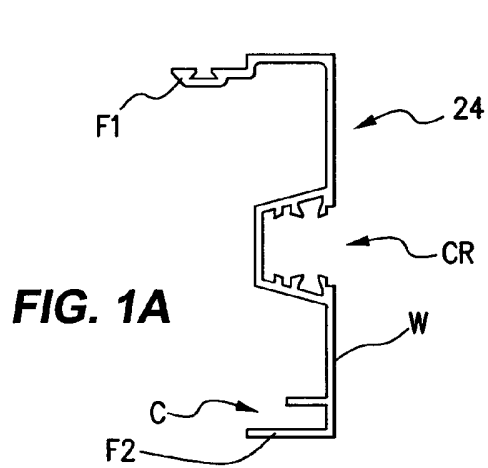
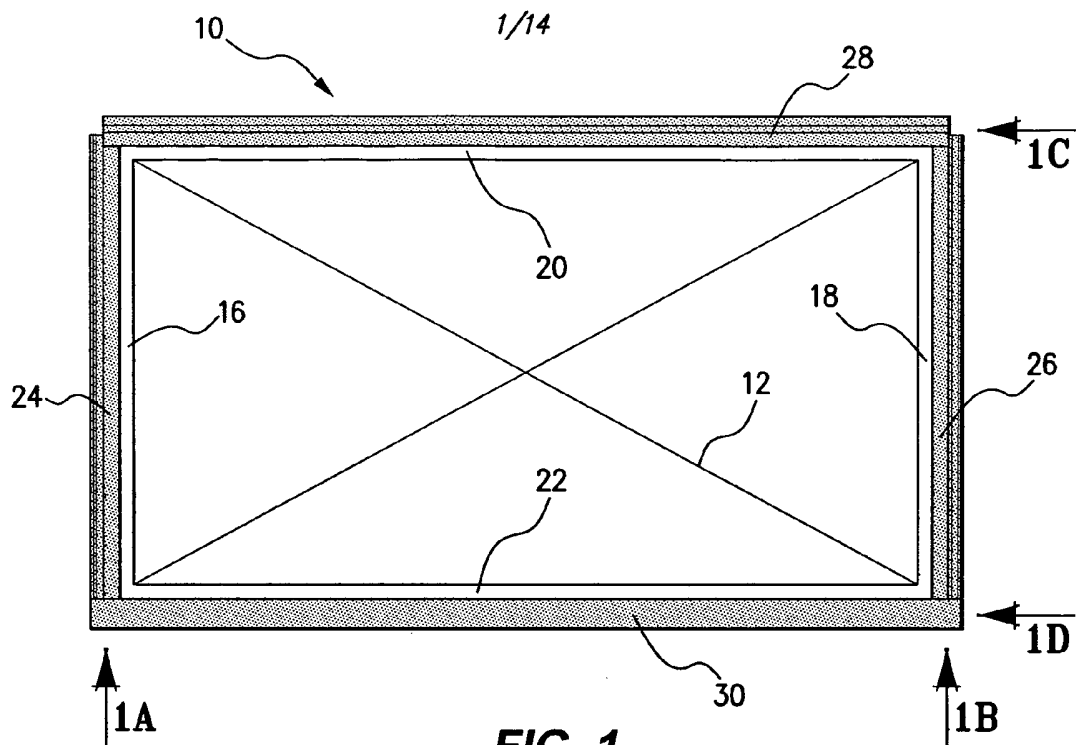
40. A seal for positioning at a junction of two adjacent modules in a given row with two adjacent and overlying window suites, as defined in claim 37 or 38.

20 41. A seal as claimed in claim 40 wherein each module is as defined in claim 9, whereby in each module the first and second flanges of the top joiner comprise laterally projecting returns, and whereby a portion of the seal is arranged to be located on the web of each joiner and under the returns.

25 42. A seal as claimed in claim 40 or 41 that is a plate that is dimensioned to extend between each adjacent joiner and under the returns.

43. A seal as claimed in claim 42 wherein the plate additionally comprises a deformable polymeric foam material attached to its opposing faces.

30 44. A seal for positioning at a junction of two adjacent modules substantially as herein described with reference to the accompanying drawings.



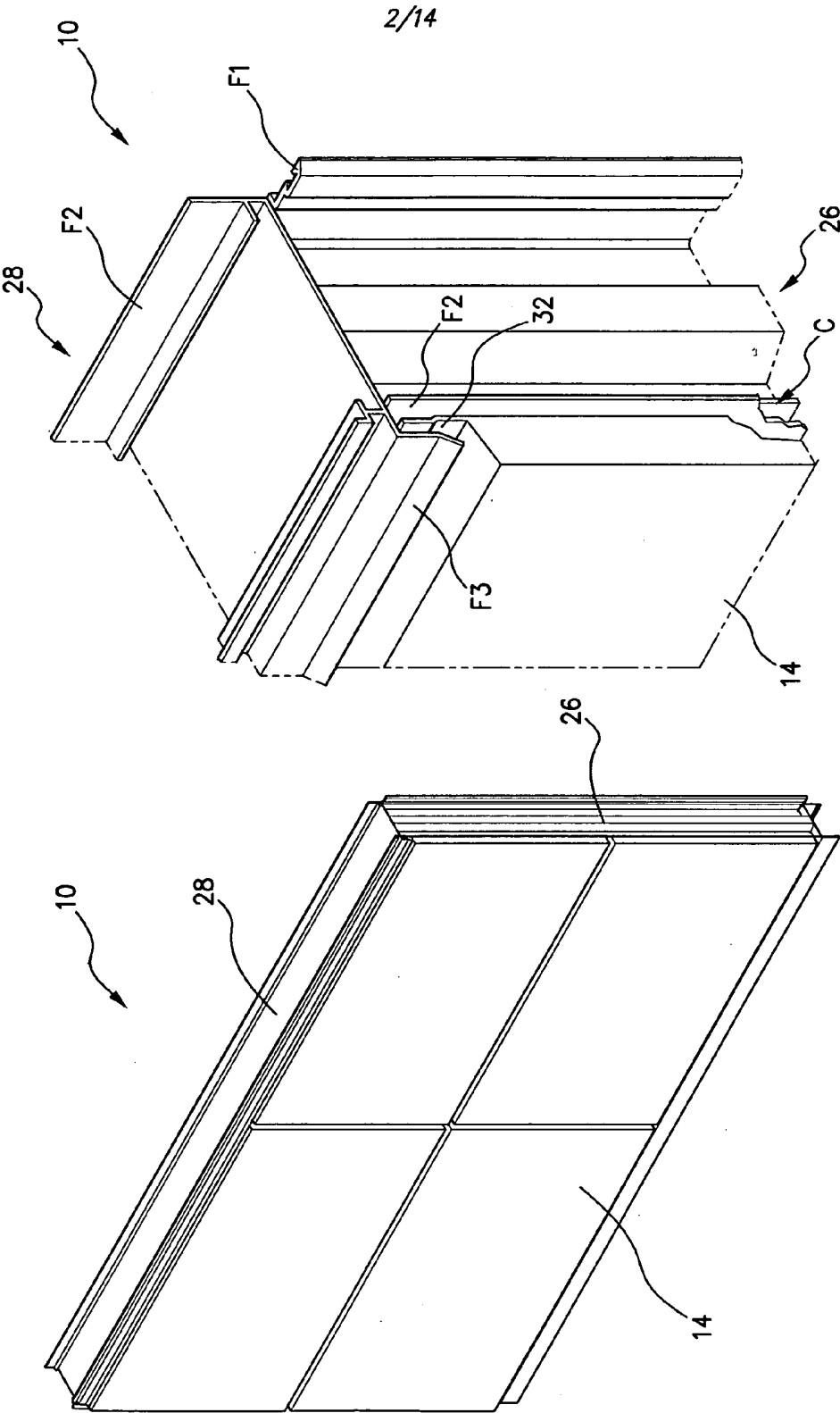
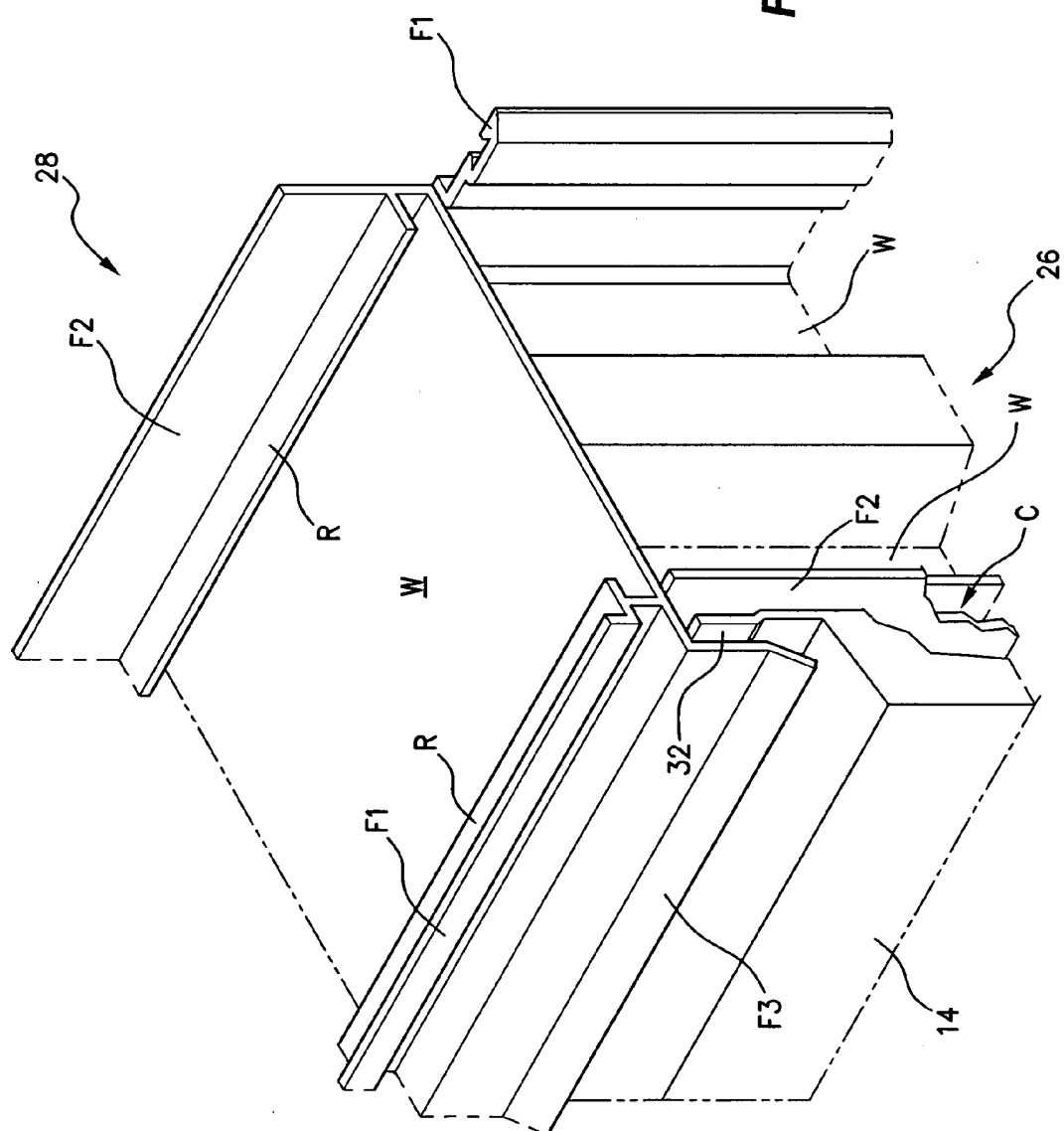


FIG. 2B

FIG. 2A

FIG. 2C



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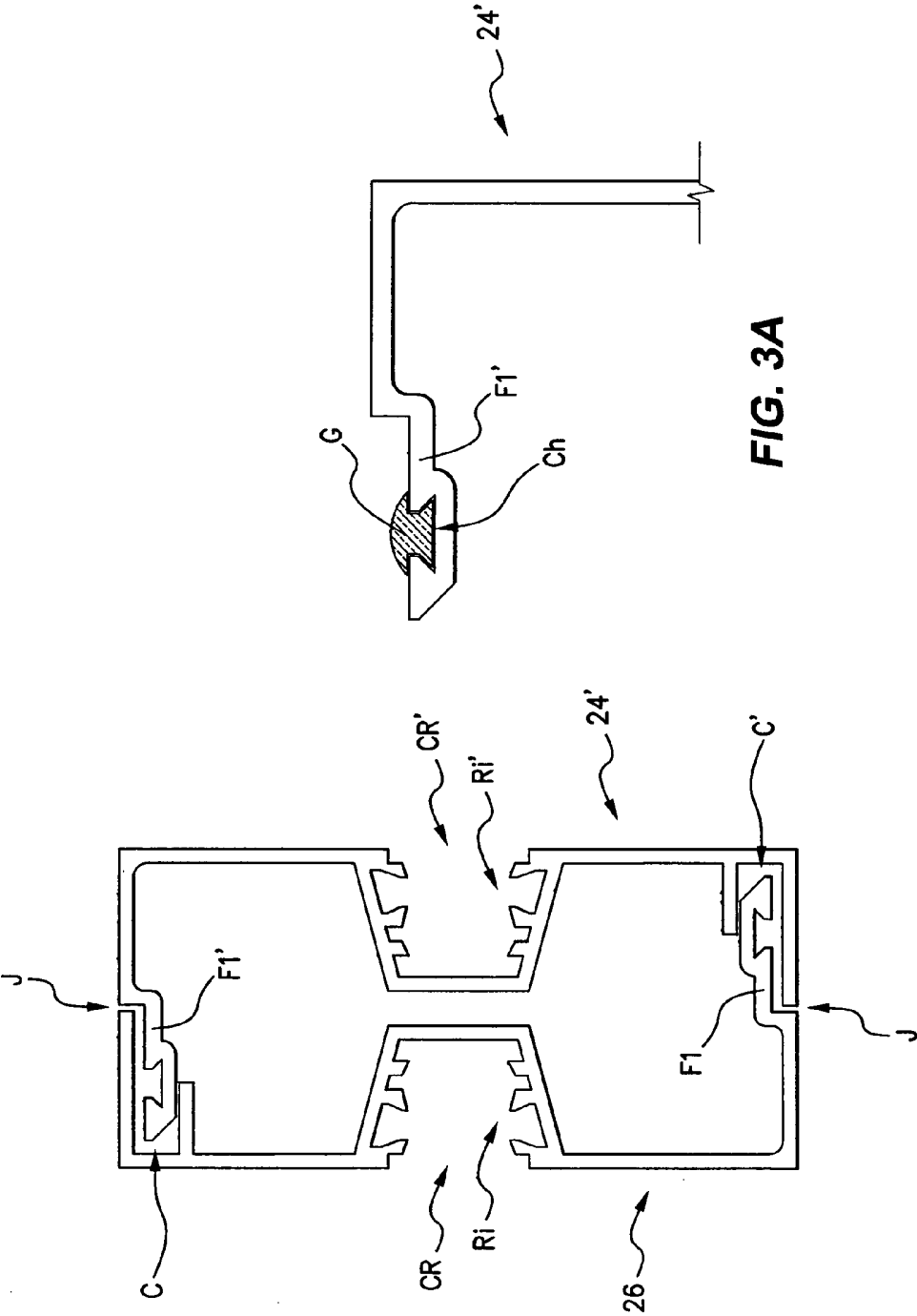


FIG. 3A

FIG. 3

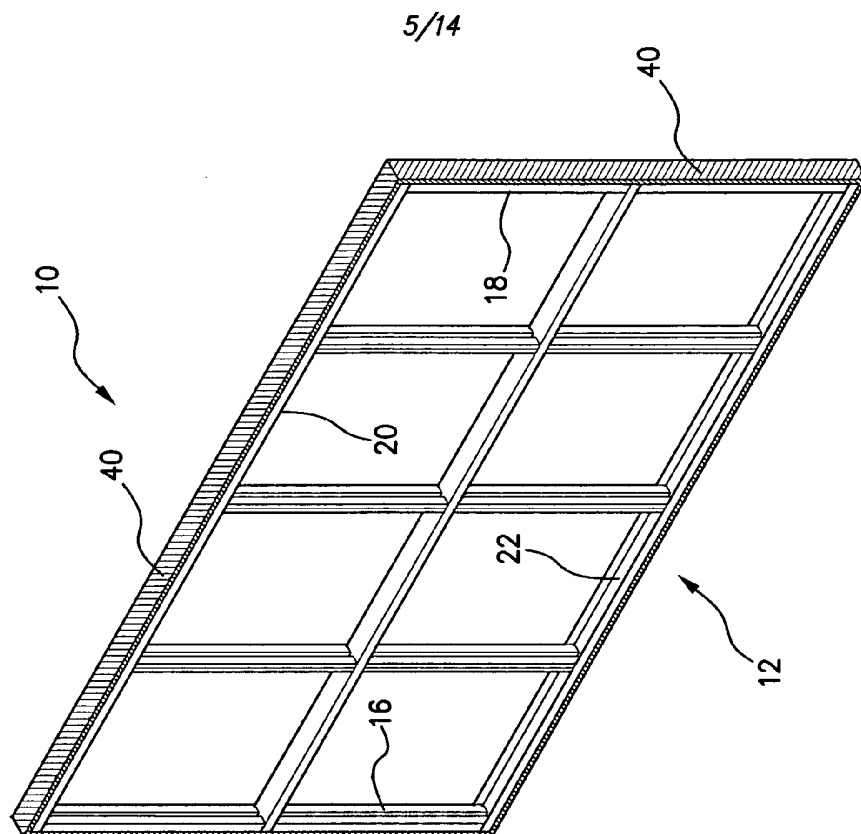


FIG. 4B

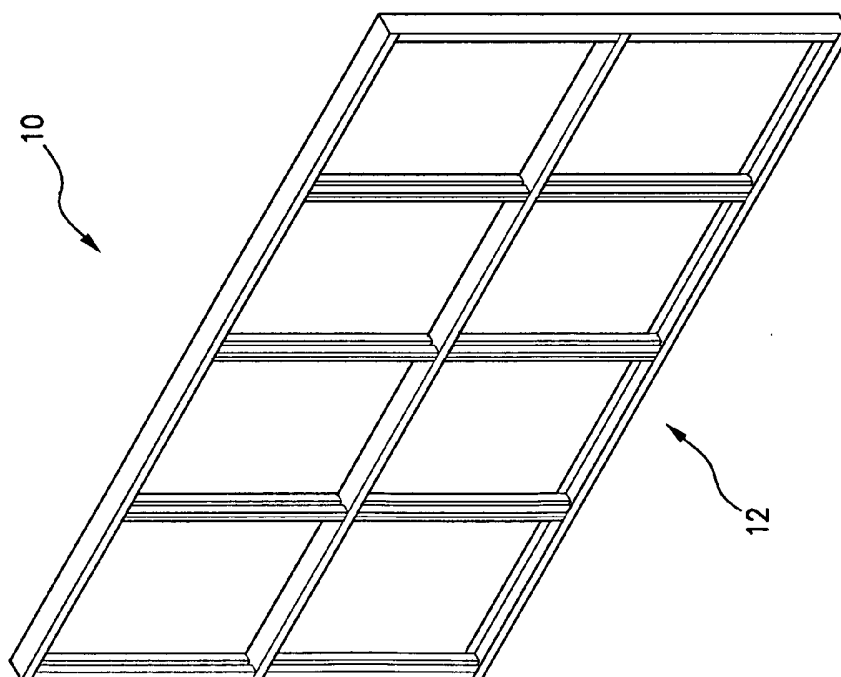


FIG. 4A

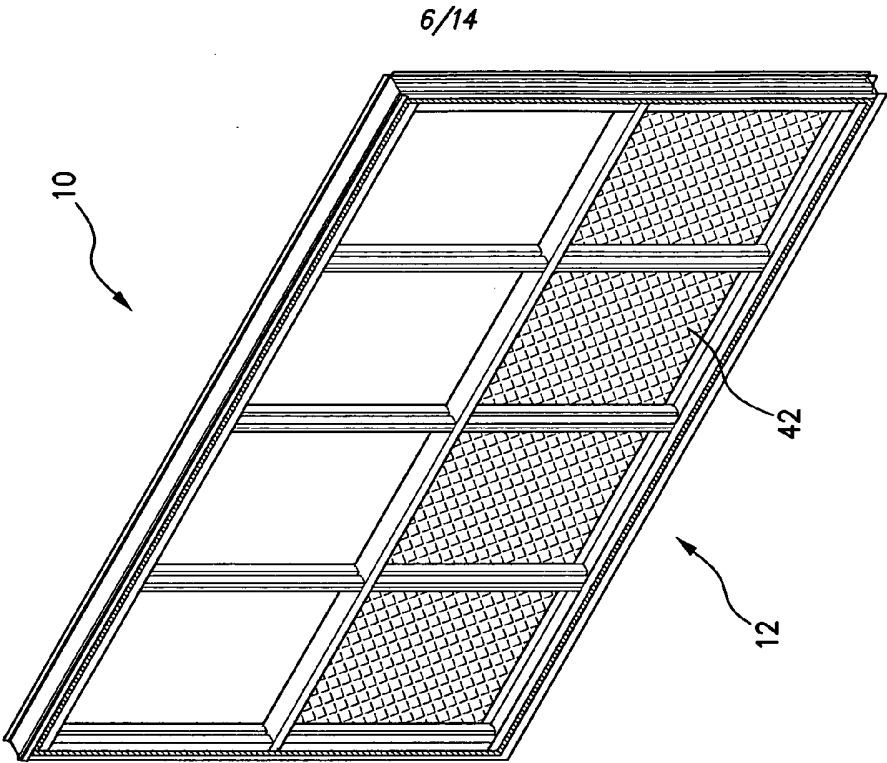


FIG. 5B

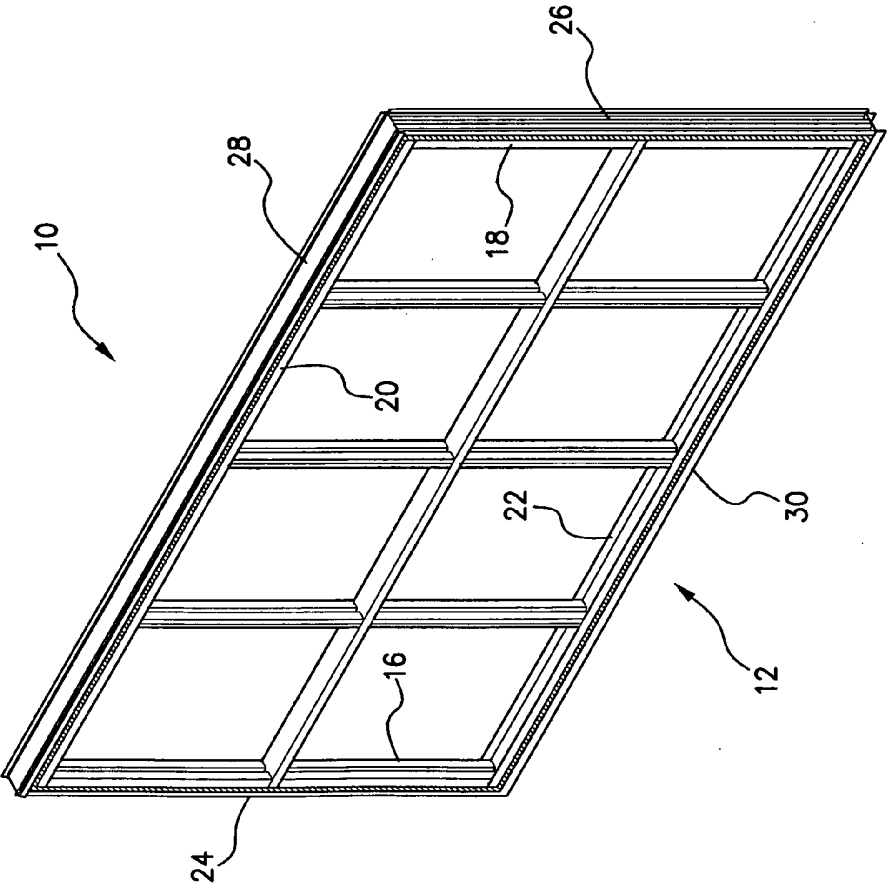


FIG. 5A

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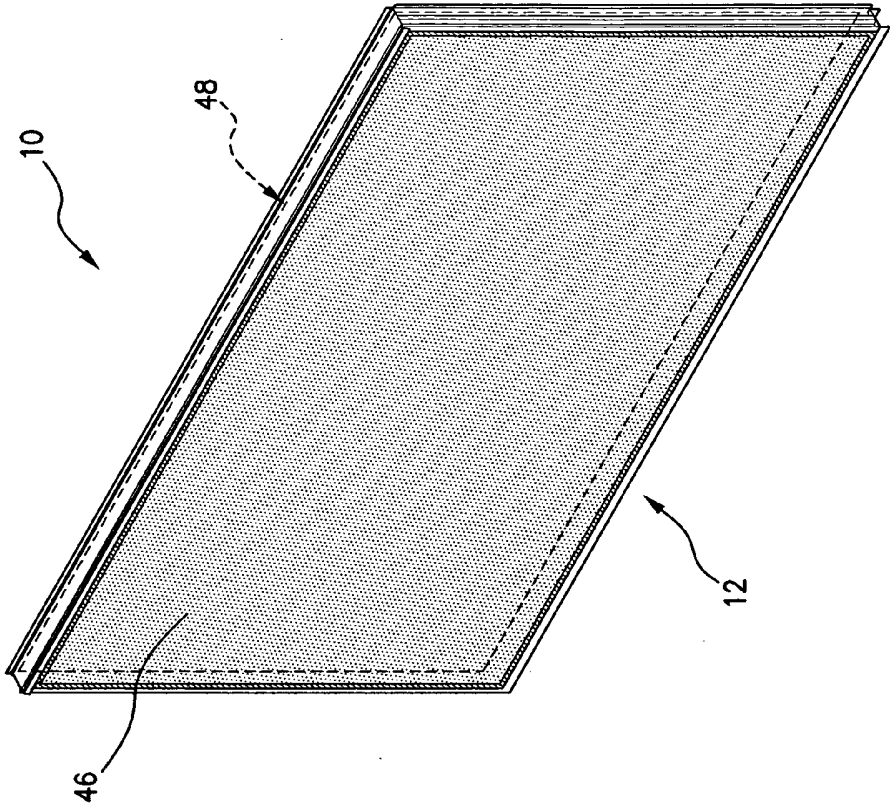


FIG. 6B

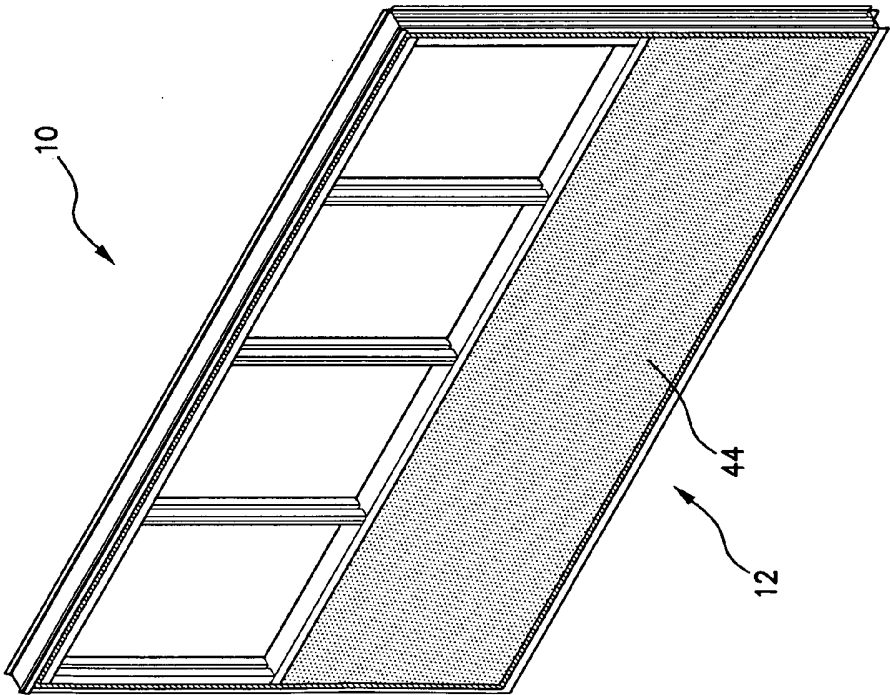


FIG. 6A

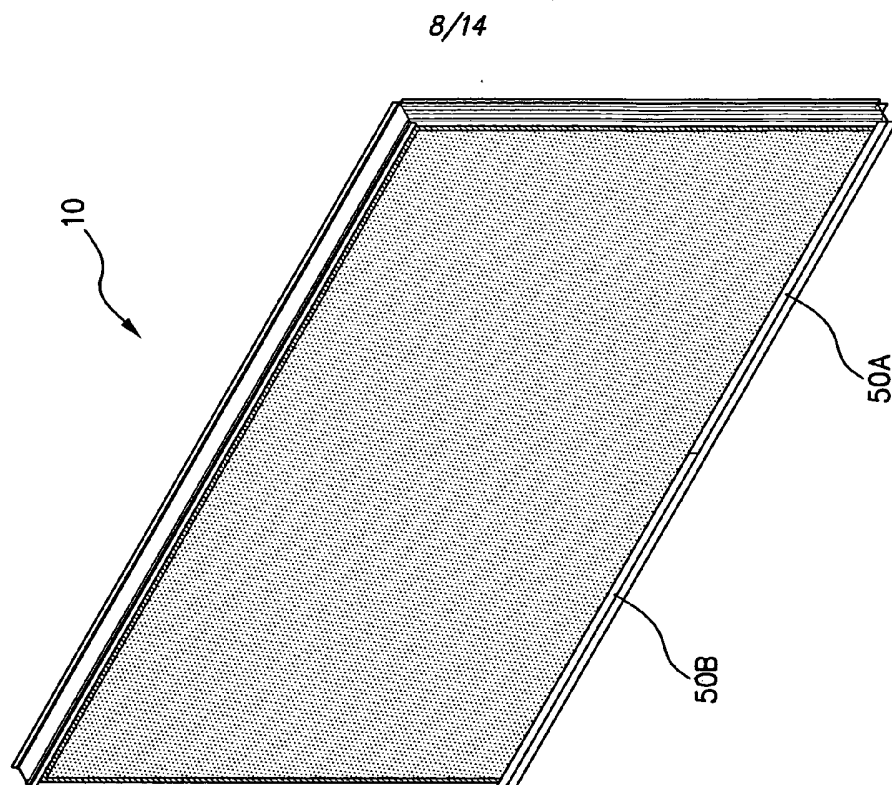


FIG. 7B

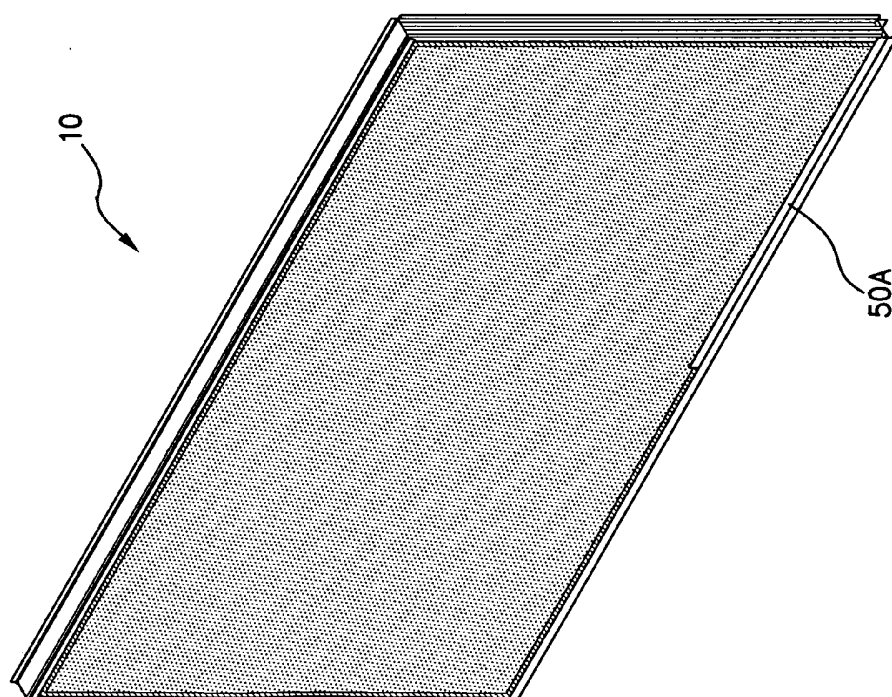


FIG. 7A

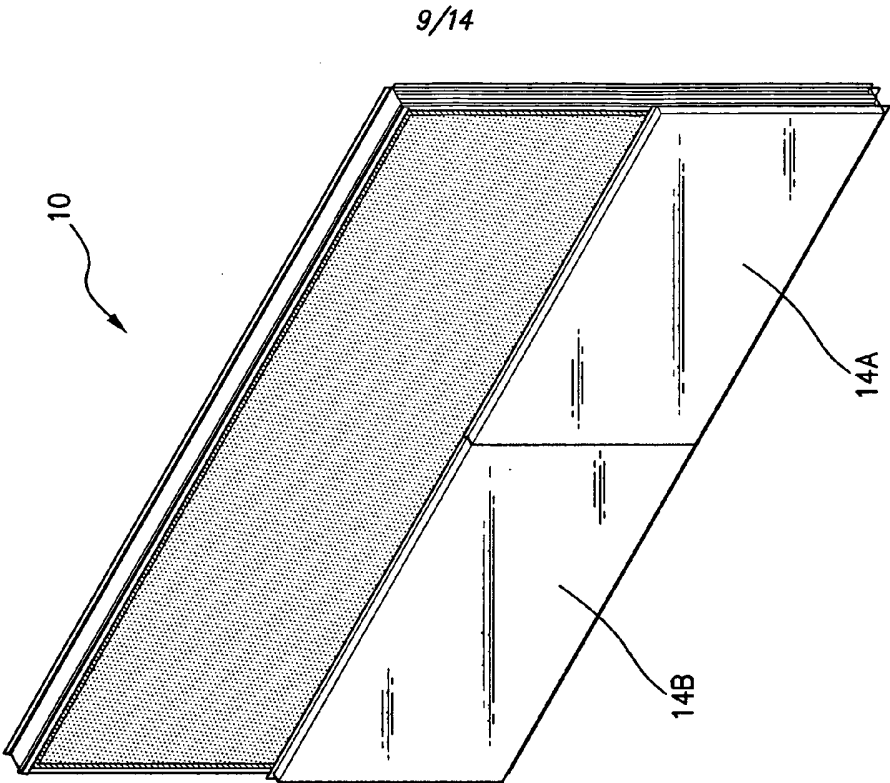


FIG. 8B

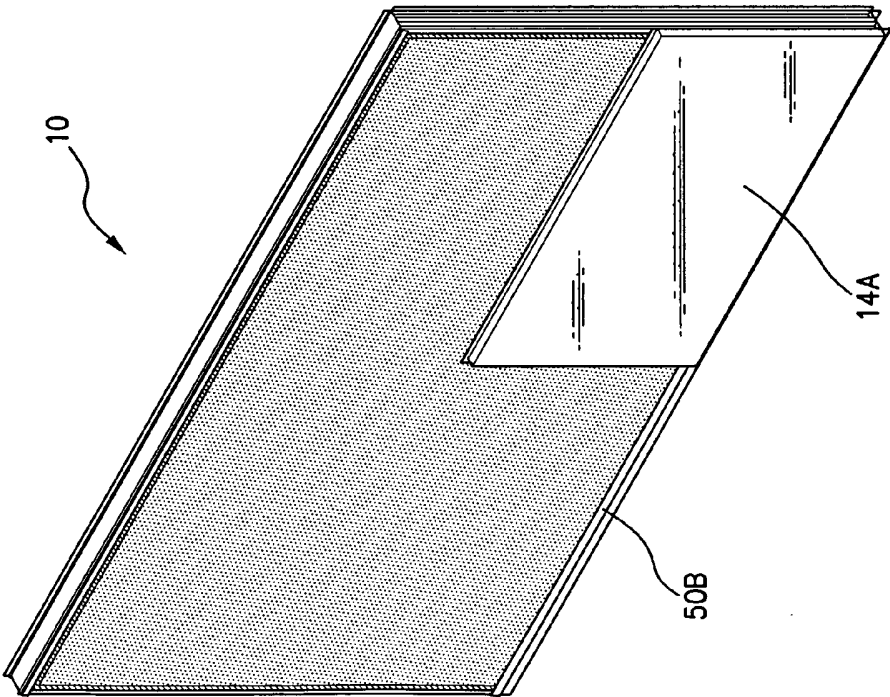


FIG. 8A

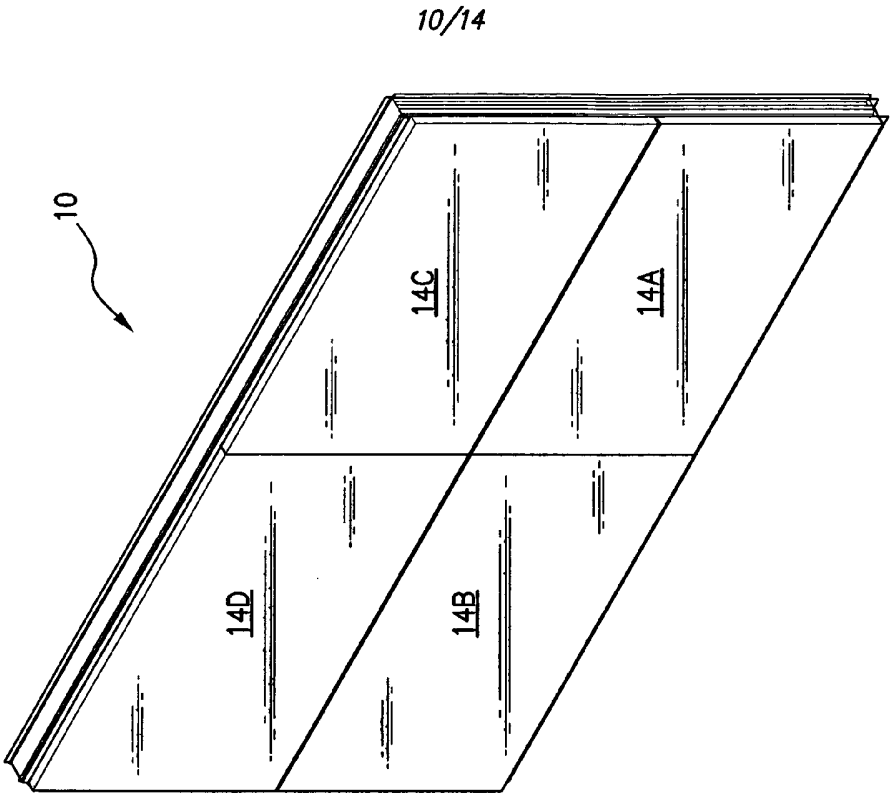


FIG. 9B

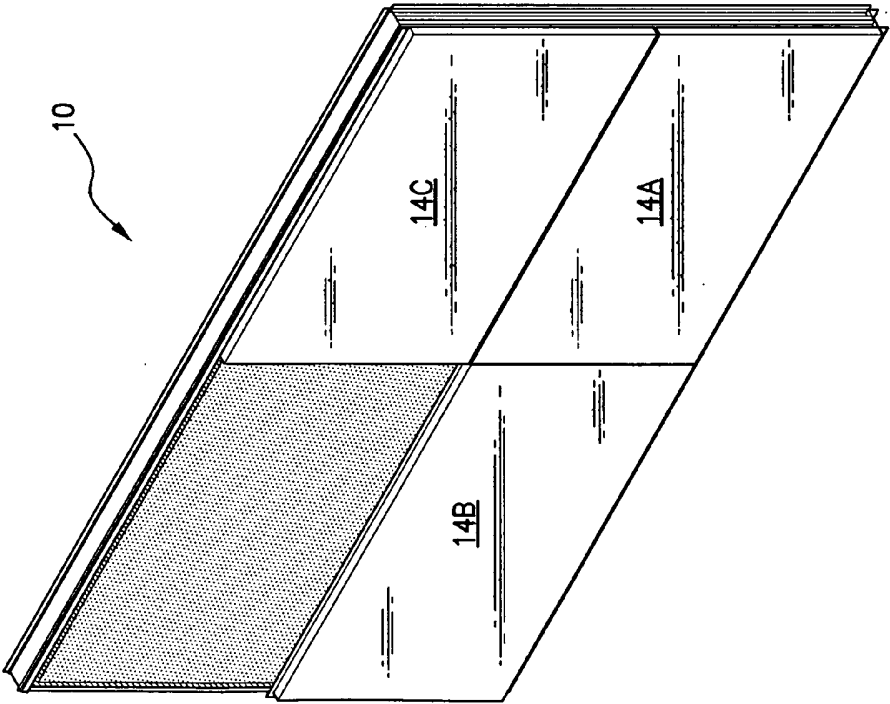
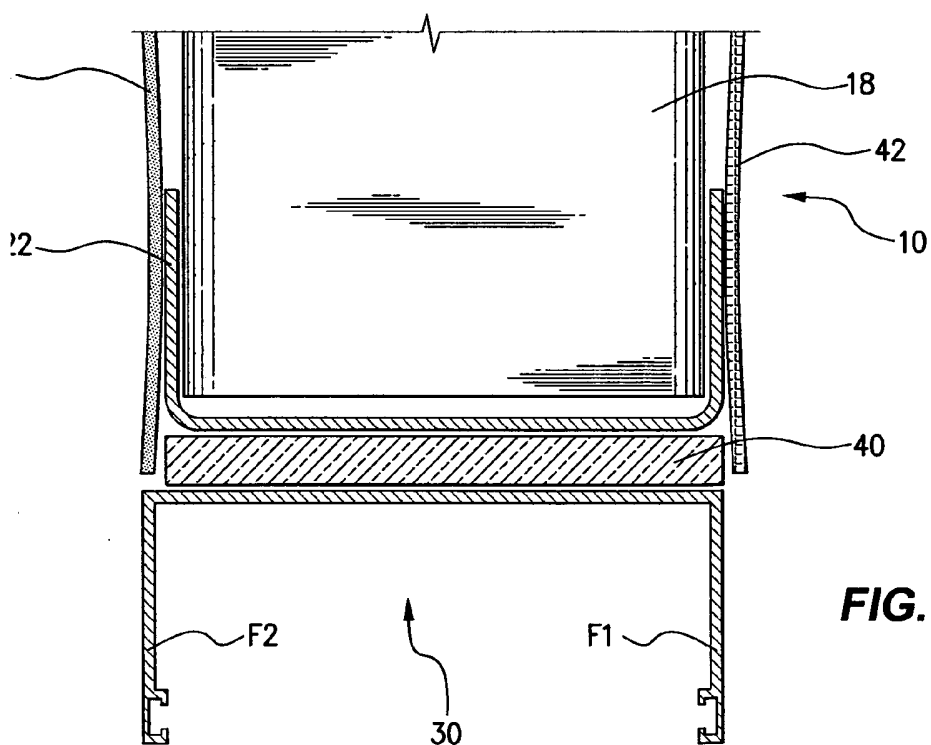
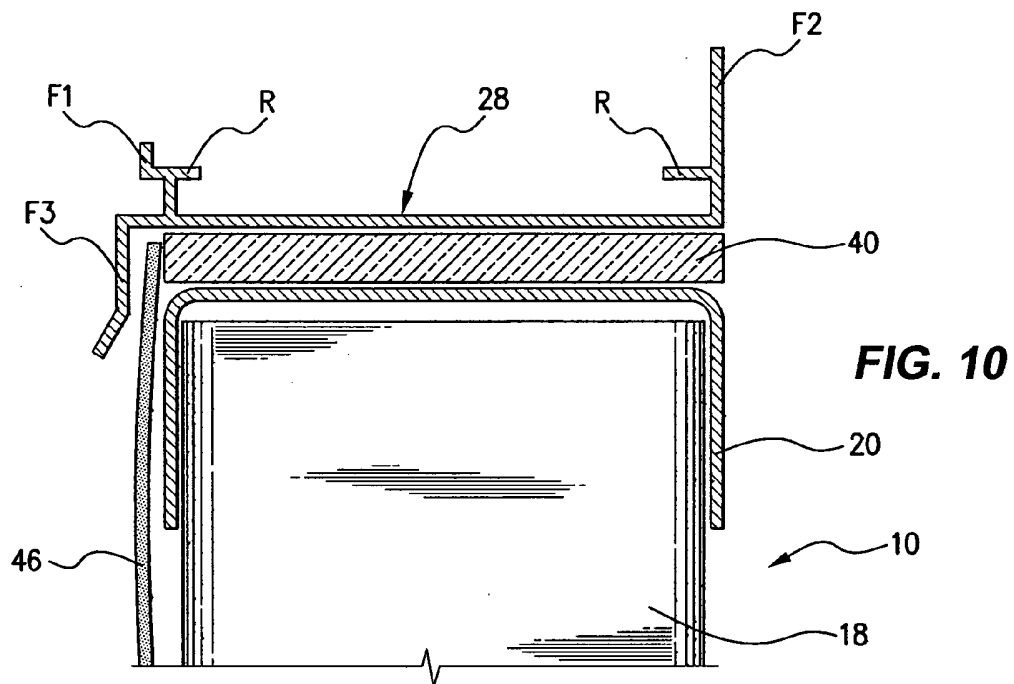


FIG. 9A

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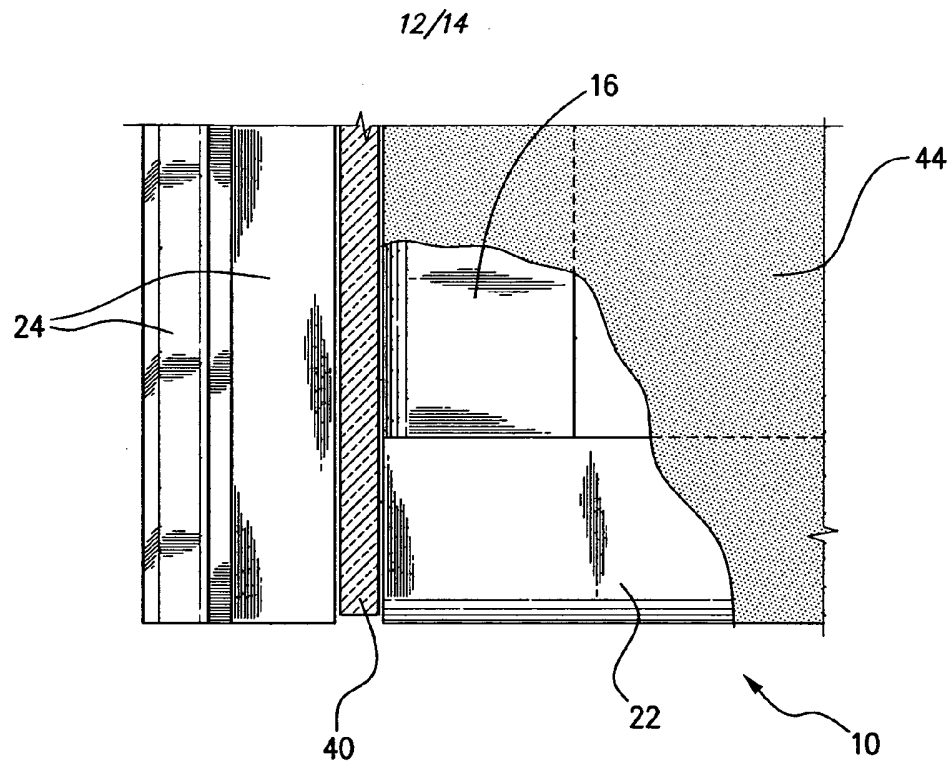


FIG. 12

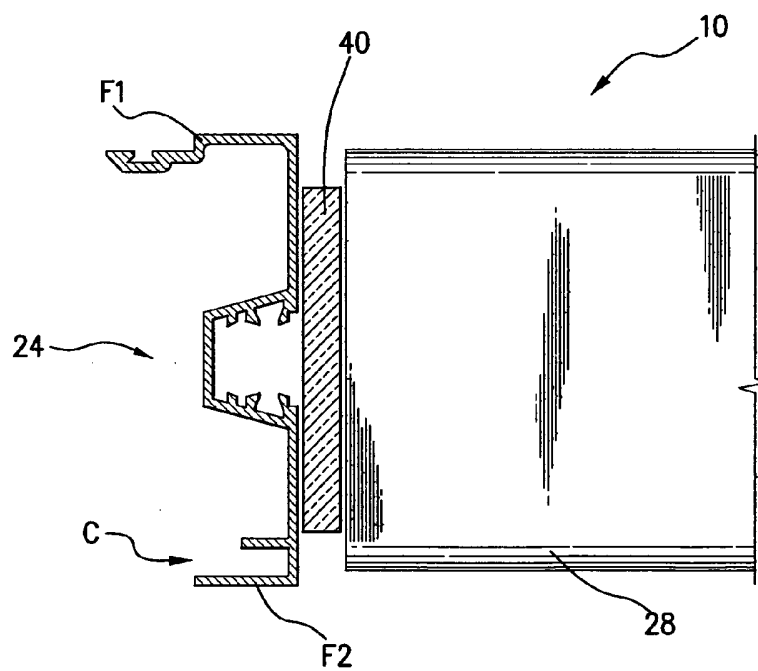


FIG. 13

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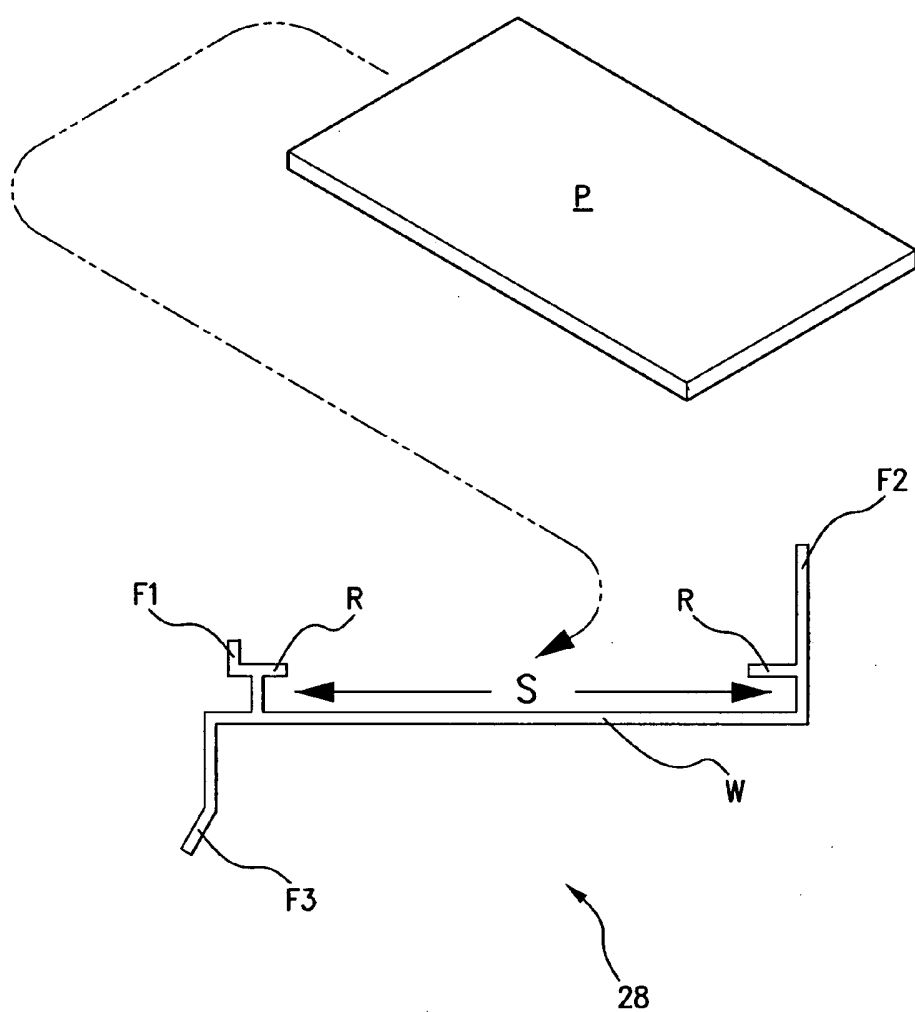


FIG. 14

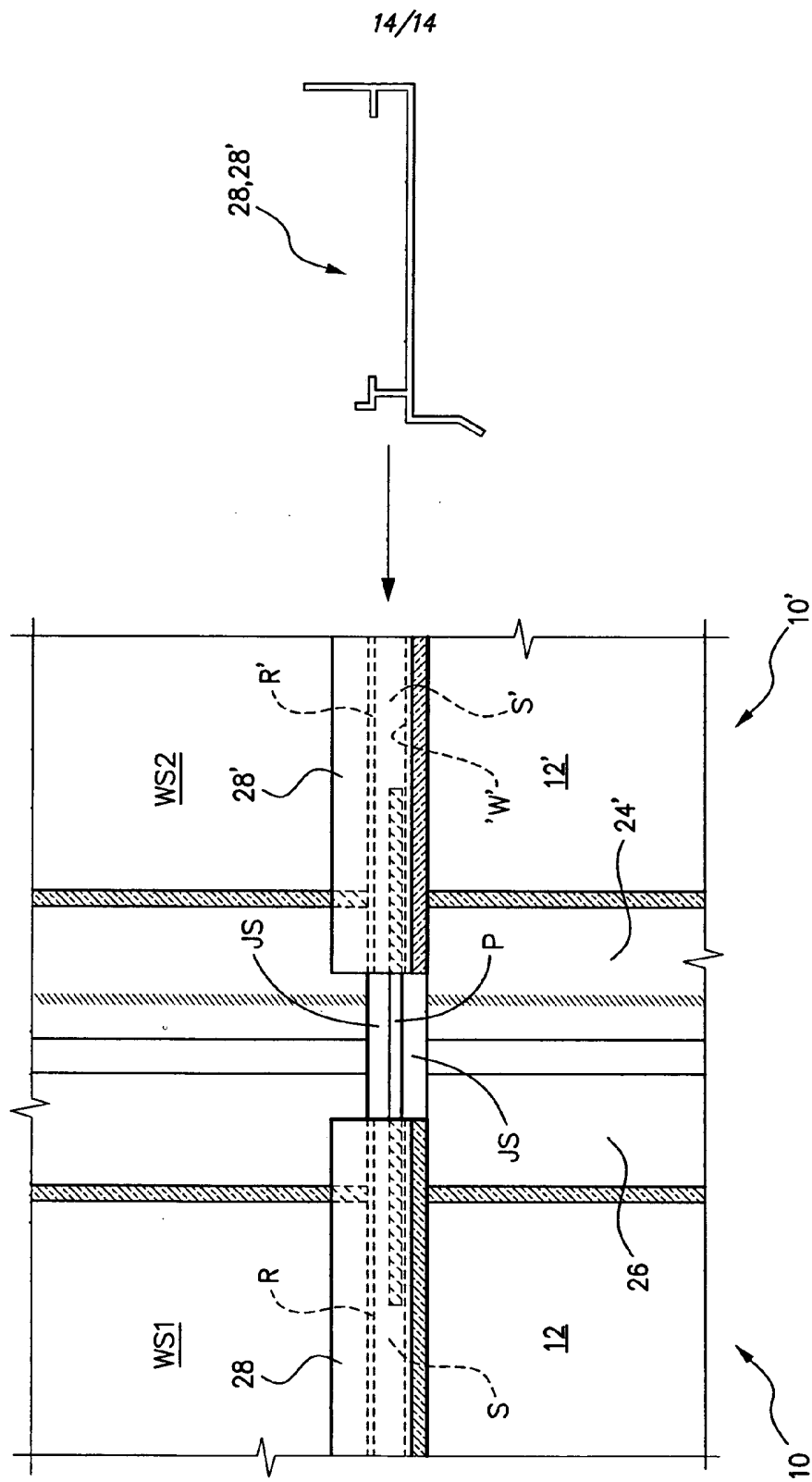


FIG. 15