

[54] EXPANDABLE JOINT DEVICE

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UNITED STATES PATENTS			
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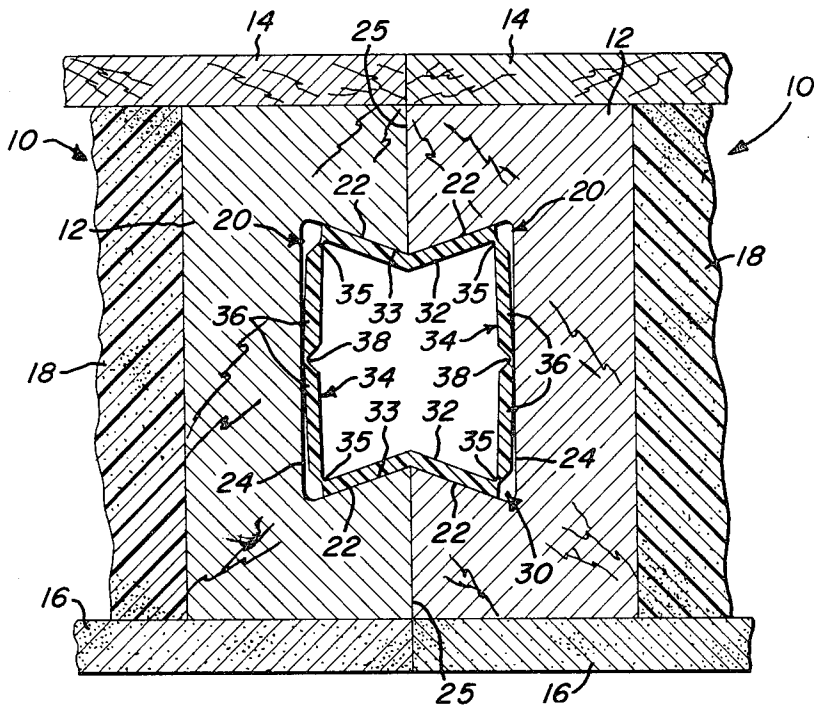
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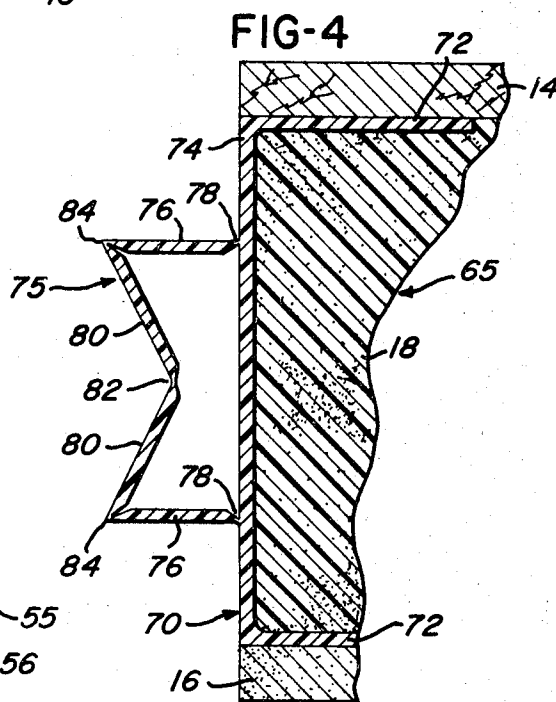
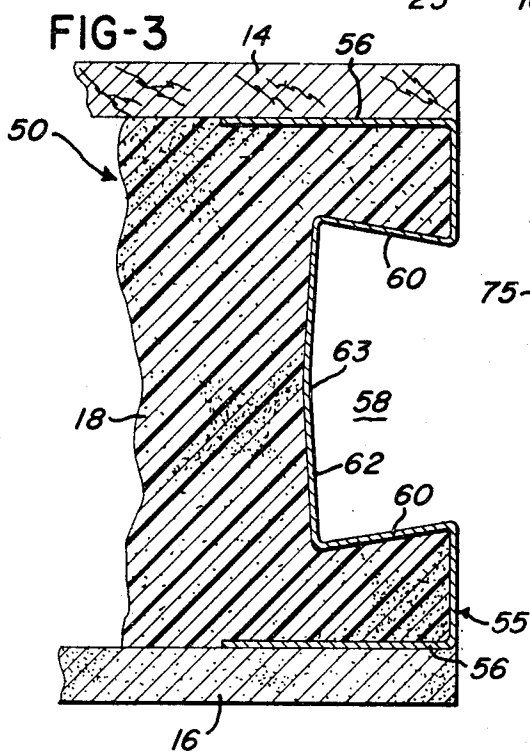
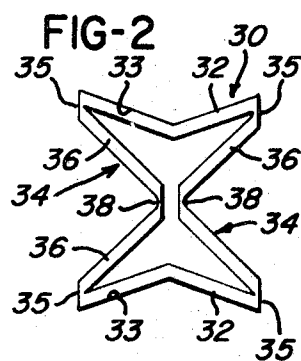
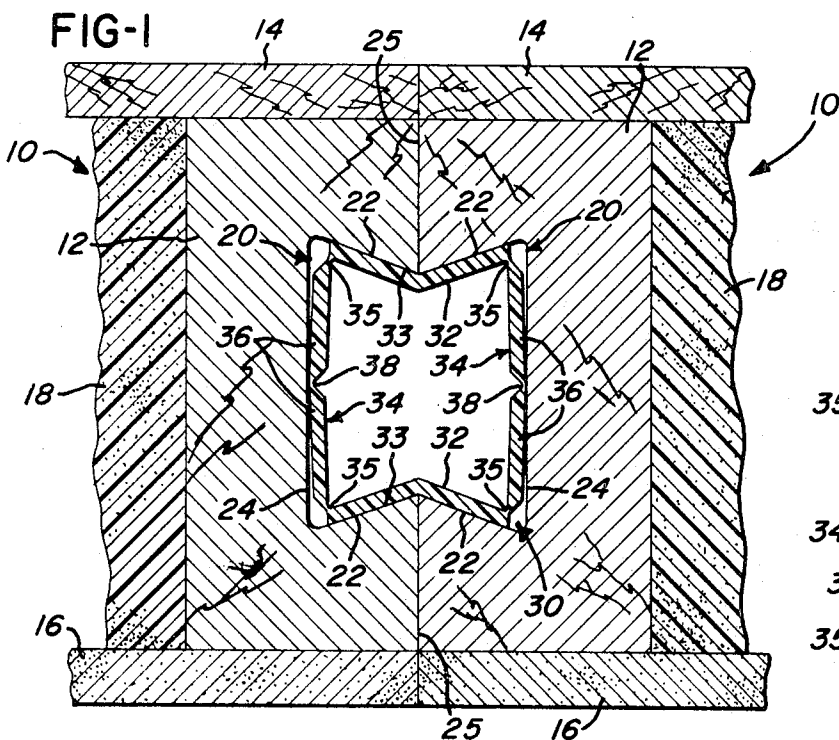
Primary Examiner—Alfred C. Perham

[57] ABSTRACT

The adjacent edge surfaces of prefabricated building panels have opposing undercut recesses of dovetail configuration and are rigidly connected and sealed by an elongated tubular joint device including a pair of opposing rigid V-shaped sidewalls connected by a pair of opposing flexible base walls each having a set of rigid sections. The joint device is formed as a polypropylene extrusion with the sidewalls and base wall sections integrally connected by thin web hinges, and is expandable from a collapsed position facilitating insertion into the recesses to an extended position where the sidewalls clamp the panels together in response to flexing of the base wall sections to overcenter locking positions. In another embodiment, only one of the panels has an undercut recess, and integral hinges connect the sidewalls of the joint device to the adjacent panel.

12 Claims, 4 Drawing Figures





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EXPANDABLE JOINT DEVICE

BACKGROUND OF THE INVENTION

As a result of the trend toward prefabricating more and more building components within a factory to obtain the advantages of volume production and to reduce on-site labor requirements, there exists an increasing problem of how to couple or connect the building components rigidly, quickly and conveniently at the building site when there is no access to the inner structure of the component. For example, in the joining of modular dwelling units, housing sections or building panels, it is desirable to form a rigid and dependable connection between the adjacent modules, sections or panels and also to form a continuous fluidtight seal. One form of joint connection is disclosed in U.S. Pat. No. 2,363,405 wherein an elongated key member is extended longitudinally into opposing dovetail grooves or recesses formed within adjacent edges of the building panels. A similar form of key joint is disclosed in British Pat. No. 577,543.

Another form of connection is shown in U.S. Pat. No. 3,310,917 wherein adjacent edge surfaces of panels are connected by snap fitting key members. Prefabricated building panels are also connected by a plurality of cam actuated mechanical locking devices located at spaced intervals, as shown in U.S. Pat. No. 3,392,497. Still another form of joint device is disclosed in U.S. Pat. No. 2,863,185 wherein a series of deformable soft metal fasteners are proposed for joining adjacent edge surfaces of building members or panels.

In any form of joint connection, it is highly desirable for the joining or connecting device to be effective in forming a rigid and dependable connection which effectively draws the surfaces together uniformly along their entire length. It is also desirable for the connecting device to be simple and convenient to install, inexpensive in construction and to form a continuous fluidtight seal between the surfaces. As is apparent after a complete analysis, each of the connecting devices disclosed in the above patents is lacking in providing one or more of these desirable features.

SUMMARY OF THE INVENTION

The present invention is directed to an improved joint device which is inexpensive and simple in construction and provides a continuous internal force which effectively clamps or draws the adjacent surfaces of two members together. The joint device is also adapted to be quickly and conveniently installed and forms a continuous fluidtight seal between the adjacent surfaces.

In accordance with one embodiment of the invention, the joint device comprises a tubular polypropylene extrusion having a pair of opposing rigid sidewalls each with a V-shaped cross-sectional configuration. The sidewalls are integrally connected by a pair of opposing base walls each consisting of a pair of rigid base wall sections. Each pair of base wall sections are integrally connected to each other and to the sidewalls by thin web hinges.

The joint device is adapted to be inserted into opposing undercut recesses formed within the edge surfaces of adjacent members such as building panels, and the sidewalls are expandable from collapsed positions to extended positions clamping the members together in response to flexing of the base wall sections from inwardly converging relation to generally parallel relation. The hinge connecting each pair of base wall sections passes through a plane defined by the hinges connecting the base wall sections to the sidewalls to effect overcenter locking of the sidewalls in their extended clamping positions. In another embodiment, only one of the edge surfaces is provided with an undercut recess, and substantially rigid sidewalls of the joint device are integrally connected to the adjacent building member by thin web hinges.

Other features and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a horizontal fragmentary section through the adjacent vertical edge portions of abutting building members or panels and through a joint device which is constructed in accordance with the present invention and shown in its expanded condition;

FIG. 2 is an end view of the elongated joint device of FIG. 1 and shown in its collapsed condition; and

FIGS. 3 and 4 show another embodiment of a joint device constructed in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a joint device of the invention is described in connection with two prefabricated building panels 10 each being rectangular, as for example, 4x8 feet in size. It is to be understood, however, that the joint device of the invention may also be used for rigidly connecting adjacent surfaces of any two members regardless of their specific material composition. Thus for purposes of illustration only, each of the preassembled panels 10 includes a vertical frame member 12 which joins similar frame members (not shown) forming each edge surface of the panel. The panels 10 are intended to be used in forming the exterior wall of a building structure, and each panel includes an outer skin formed by a sheet 14 of rough-sawn exterior plywood which may be scored at spaced intervals or adapted to receive horizontally spaced battens. The inner skin of each panel 10 includes a sheet 16 of "dry wall," and a polyurethane foam core 18 fills the space between the sheets 14 and 16 and bonds to the sheets 14 and 16 and the frame member 12. The sheets 14 and 16 of each panel 10 are also secured to the frame member 12 and the other bordering frame members and internal frame members (not shown) by either suitable mechanical fasteners or cement.

An undercut recess 20 of dovetail cross-sectional configuration is formed within each frame member 12 by longitudinally extending and inwardly diverging side faces 22 connected by a base surface 24 extending parallel to the corresponding edge surface 25 of the frame member 12. Preferably, the recess 20 extends around the entire periphery of each panel 10, that is, within both of the opposite side frame members 12 and also within both of the opposite end frame members (not shown). Thus the peripherally extending undercut recess 20 within each panel 10 is generally similar to the undercut recess extending around the periphery of the building panel disclosed in above-mentioned U.S. Pat. No. 3,310,917. Accordingly, the panels 10 are especially suited for high volume production of an assembly line within a factory and may be prefabricated in different widths, as for example, 2 feet, 4 feet, 6 feet, etc., and in different lengths depending upon whether the panels are intended for use as floor panels, wall panels, ceiling panels or roof panels.

In accordance with the present invention, an elongated tubular joint device 30 extends within each pair of opposing recesses 20 and includes a pair of opposite sidewalls 32 each having a V-shaped outer surface 33. The joint device 30 is extruded from polypropylene, and the opposing sidewalls 32 are integrally connected by a pair of opposing base walls 34 and thin web corner hinges 35. Each of the base walls 34 consists of a pair of rigid base wall sections 36 which are integrally connected by a thin web hinge 38.

The sidewalls 32 of the joint device 30 are expandable or movable from collapsed relation or positions (FIG. 2) to extended positions (FIG. 1) in response to flexing of the base walls 34 from inwardly converging relation or positions (FIG. 2) to generally parallel relation or positions (FIG. 1). In the collapsed condition shown in FIG. 2, the joint device 30 can be conveniently inserted laterally into each of the recesses 20.

When the sidewalls 32 are expanded to their extended positions, the outer surfaces 33 of the sidewalls 32 engage the corresponding inwardly diverging faces 22 of the recesses 20 and

exert forces tending to clamp or draw the frame members 12 together. The corresponding movement of the base walls 34 from their inwardly converging positions to their generally parallel positions causes each of the web hinges 38 to pass through a plane defined by the corresponding corner hinges 35 thereby effecting overcenter locking of the base wall section 36 against the adjacent base surface 38 of the corresponding recess 20.

In use, the locking device 30 is first inserted in its collapsed condition into one of the undercut recesses 20, and another panel 10 is positioned in adjacent relation so that the joint device 30 extends into both of the opposing recesses 20 in its collapsed position shown in FIG. 2. The base walls 34 are then pivoted or flexed from their inwardly retracted positions (FIG. 2) to their extended or generally parallel positions (FIG. 1) by applying air pressure within the joint device 30 or by passing a mechanical tool such as a ball-like mandrel through the joint device.

Another embodiment of the invention is shown in FIGS. 3 and 4. In this embodiment, a rectangular building panel 50 includes an outer skin or sheet 14 of plywood, a polyurethane foam core 18 and an inner skin or sheet 16 of dry wall material. The sheets 14 and 16 and the foam core 18 are bonded to a sheet metal frame member 55 which is preferably roll-formed from a steel strip. The frame member 55 includes outer parallel flanges 56 which are secured to the sheets 14 and 16 with suitable fasteners or cement. An undercut recess 58 having generally a dovetail cross-sectional configuration is defined within the frame member 55 by opposing inwardly diverging sidewalls 60 integrally connected by a base wall 62 having a slight angular configuration defined by a break 63.

The panel 50 is adapted to be joined to a prefabricated panel 65 including an outer sheet 14, an inner sheet 16, and a foam core 18. A channellike frame member 70 is extruded of plastic such as polypropylene and includes outer parallel flanges 72 which are secured to the sheets 14 and 16 and the foam core 18 in the same manner as described above for the panel 50 in FIG. 3. The frame member 70 includes an end wall 74 which integrally connects the flanges 72.

A joint device 75 is extruded as an integral part of the frame member 70 and includes a pair of opposing rigid sidewalls 76 which are integrally connected to the end wall 74 by thin web hinges 78. A pair of rigid base wall sections 80 are integrally connected by a thin web hinge 82 and are also integrally connected to the sidewalls 76 by a set of thin web hinges 84.

The panels 50 and 65 are rigidly connected by abutting the frame members 55 and 70 so that the joint device 75 extend into the recess 58. When the base wall sections 80 are moved from their inwardly converging relation (FIG. 4) to a generally aligned relation adjacent the base wall 62 of the frame member 55, the sidewalls 76 expand outwardly to engage the inner faces of the sidewalls 60 of the frame member 55. As a result, the frame members 55 and 70 are urged or clamped together with substantial force. When the hinge 82 approaches the center of the base wall 62 of the frame member 55, the hinge 82 passes through a plane defined by the continuous hinges 84 to effect an overcenter toggle action which locks the base wall sections 80 in generally aligned relation adjacent the base wall 62 of the frame member 55. Thus the sidewalls 76 of the joint device 75 are positively locked in form engagement with the sidewalls 60 of the frame member 55.

From the drawing and the above description, it is apparent that a joint device constructed in accordance with the invention provides desirable features and advantages. For example, when the joint device 30 is collapsed as shown in FIG. 2, it may be conveniently inserted into the recesses 20 as the panels 10 are being erected or installed. Then by simply extending the base walls 34 from their inwardly converging relation (FIG. 2) to their generally parallel relation (FIG. 1), the sidewalls 32 firmly engage the faces 22 of the frame members 12 and clamp the frame members together with substantial force. The rigid V-shaped configuration of the sidewalls 32

and the overcenter locking of the base wall sections 36 assure that the joint between the frame members 12 remains rigid.

As another feature, the joint device 30 may be conveniently formed as a plastic extrusion so that its cost per linear foot is minimized. This enables the joint device 30 to be extended the entire length of the frame members 12 without substantial expense so that the clamping force is uniformly distributed. Moreover, the extruded plastic joint device 30 or 75 also forms a continuous fluidtight seal between the frame members. However, it is to be understood that a series of relatively short joint devices 30 may be used at spaced intervals between the two members 12 when a continuous seal and a continuous clamping force is not required.

While each of the frame members 12 is formed from a standard two-by-four, FIG. 3 shows that a frame member may also be roll-formed from a sheet metal strip in the same manner as a channellike steel two-by-four is produced. A frame member may also be extruded of aluminum or plastic so that it has generally the same configuration as the frame member 55, i.e., a substantially uniform thickness.

It is apparent that while the joint device 75 shown in FIG. 4 provides for a positive and continuous connection between the panels 50 and 65, this embodiment does not provide a connecting strength as great as that of the embodiment shown in FIGS. 1 and 2 since only the continuous web hinges 78 form the connection between the panels 50 and 65 after the joint device 75 is expanded within the recess 58. However, the embodiment of FIGS. 3 and 4 is quite satisfactory for quickly joining two members when substantial strength in the joint is not required. Furthermore, the extrusion of the joint device 75 as a part of the extrusion of the frame member 70 eliminates the additional handling of a separate joint device.

It is to be understood that the joint device 30, shown in FIG. 2, may be expanded simultaneously in both of the opposing recesses 20 or may be first expanded in one of the recesses 20 with a suitable tool and then expanded within the other recess 20 at a later time by means of either air pressure or a suitable tool as mentioned above. Furthermore, while the forms of joint devices herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of devices, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A joint device for rigidly connecting adjacent surfaces of first and second members wherein at least said first member has an undercut recess defined within the corresponding surface by opposing undercut side faces joined by a base surface, said device comprising a set of substantially rigid and noncompressible opposing sidewalls, means for connecting said sidewalls to said second member, a set of substantially rigid and noncompressible base wall sections extending between said sidewalls, linear hinge means connecting said base wall sections, linear hinge means connecting each said base wall section to one of said sidewalls, and said base wall sections being pivotable between collapsed positions converging inwardly between said sidewalls and generally aligned positions to effect movement of said sidewalls between retracted collapsed positions and extended positions firmly engaging said side faces.

2. A joint device as defined in claim 1 wherein said second member includes a second said undercut recess opposing the first said recess and defined by corresponding said side faces joined by a base surface, a set of substantially rigid and noncompressible opposite sidewalls within said second recess and connected to the corresponding said sidewalls within the first said recess, a set of substantially rigid and noncompressible base wall sections connecting said sidewalls within the second said recess, linear hinge means connecting the latter base wall sections to each other and to the corresponding said sidewalls, and the latter said base wall sections being pivotable between collapsed positions converging inwardly between the cor-

responding said sidewalls and generally aligned positions adjacent said base wall surface of said second recess to effect movement of the corresponding said sidewalls between retracted collapsed positions and extended positions engaging said side faces of said second recess.

3. A joint device as defined in claim 2 wherein said joint device comprises a tubular plastic extrusion, and the corresponding said sidewalls are rigidly connected and have a generally V-shaped outer surface.

4. A joint device as defined in claim 2 and further comprising a tubular plastic extrusion, the connected said sidewalls are rigid and have a generally V-shaped configuration for engaging the adjacent said side faces defining said first and second recesses in response to movement of said base wall sections within said first and second recesses.

5. A joint device as defined in claim 1 in combination with a frame member having a substantially uniform wall thickness and defining said undercut recess.

6. A joint device as defined in claim 1 wherein each said member comprises a building panel, said recess is located within an edge surface of one said panels, and said device extends continuously substantially the length of said edge surface said base wall means comprise a set of substantially rigid base wall sections, and hinge means connecting said base wall sections to each other and to said sidewalls.

7. A joint device as defined in claim 1 wherein said hinge means connecting said base wall sections move slightly through a plane defined by said hinge means connecting said base wall sections to said sidewalls to cause overcenter movement of said base wall sections into contact with said base surface to effect locking of said sidewalls in said extended positions engaging said side faces.

8. A joint device as defined in claim 1 and comprising an ex-

trusion of plastics material, and each said hinge means comprises an extruded integral hinge.

9. A joint device for rigidly connecting adjacent surfaces of first and second members having opposing recesses each defined by opposing undercut side faces joined by a base surface, said device comprising a tubular body extending into said recesses and including a set of substantially rigid and non-compressible opposite sidewalls each having a generally V-shaped outer surface, a pair of opposite base walls each including a set of substantially rigid and noncompressible base wall sections, linear hinge means connecting corresponding said base wall sections to each other and to said sidewalls, each set of said base wall sections being pivotable between collapsed positions converging inwardly between said sidewalls and generally parallel extended positions to effect movement of said sidewalls between retracted positions facilitating insertion of said device into said recesses and extended positions causing said sidewalls to engage said side faces.

10. A joint device as defined in claim 9 including means for locking said base wall sections in said extended positions.

11. A joint device as defined in claim 10 wherein said hinge means connecting each set of said base wall sections, is effective to pass through a plane defined by said hinge means connecting said base wall sections to said sidewalls and into engagement with the corresponding base surface of said recess to effect said locking means.

12. A joint device as defined in claim 9 and being formed of a substantially rigid plastics material, and said hinge means comprises thin web integral hinges connecting said base wall sections to each other and to said sidewalls.

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