

[54] BUILDING STRUCTURE

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[51] Int. Cl.E04c 1/10

[58] Field of Search.....52/281, 403, 747, 586, 580, 52/464, 468, 285, 286, 282; 287/20.92 E, 20.92 K

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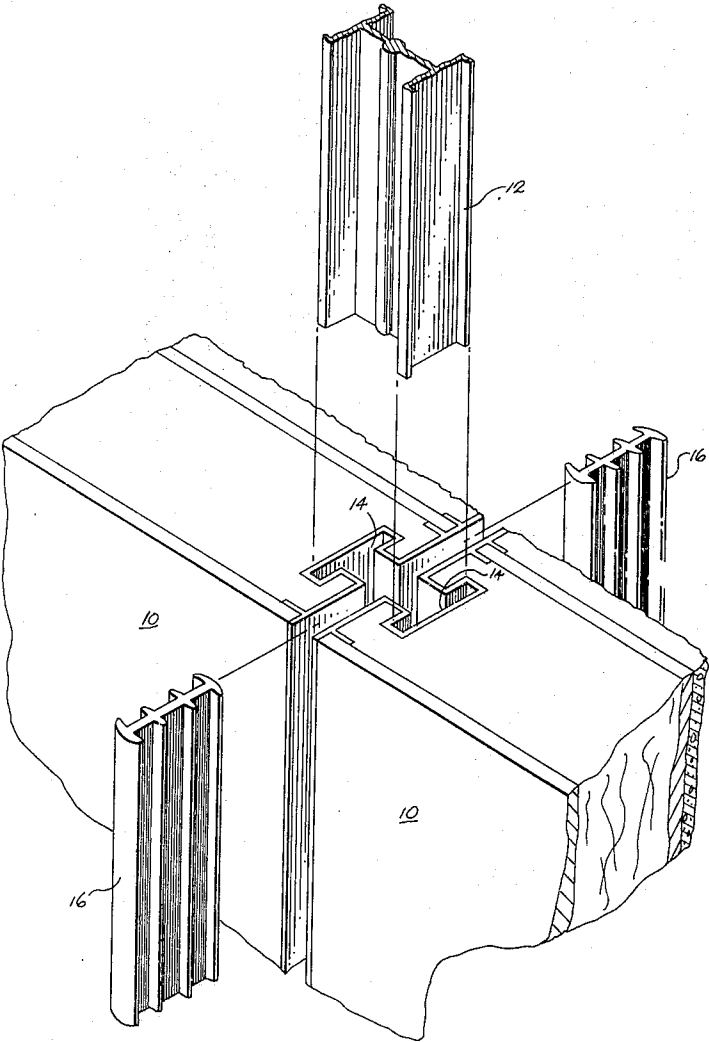
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[57] ABSTRACT

An assembly structure for building panels having undercut channels in the end portions thereof wherein a key is inserted into a plurality of such channels to loosely join the panels, and resilient inserts are thereafter driven into spaces between the panels to render the junction rigid, and a method of joining the assembly by progressively positioning the inserts.

10 Claims, 9 Drawing Figures



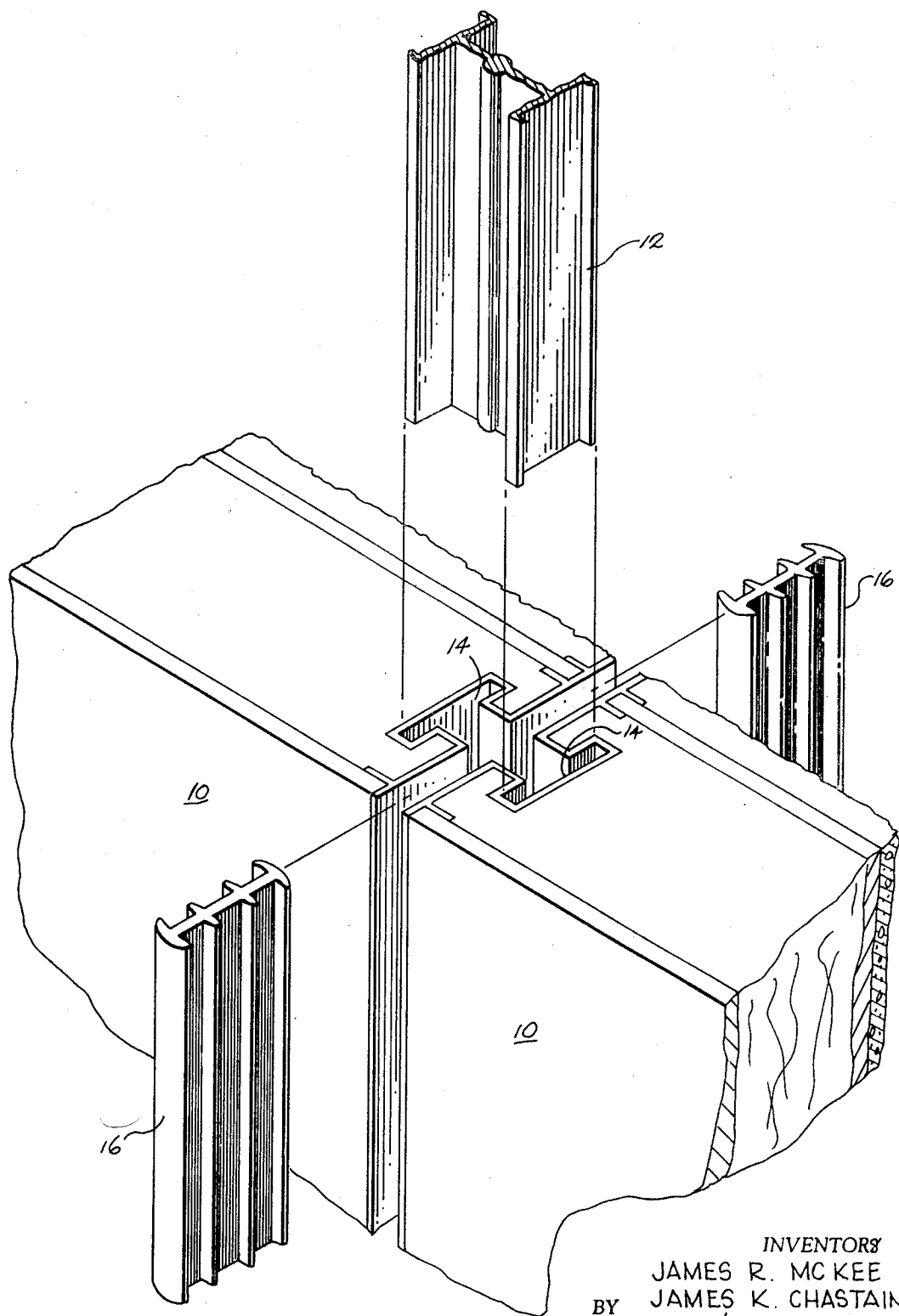


Fig. 1

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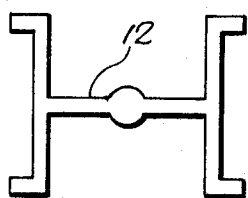


Fig. 3

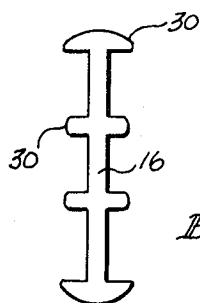


Fig. 4

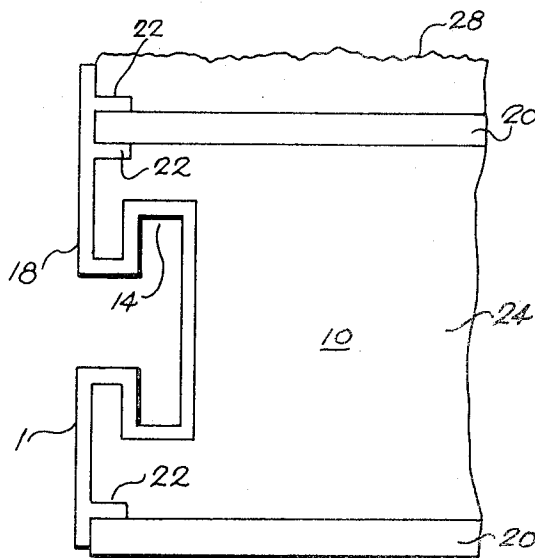


Fig. 2

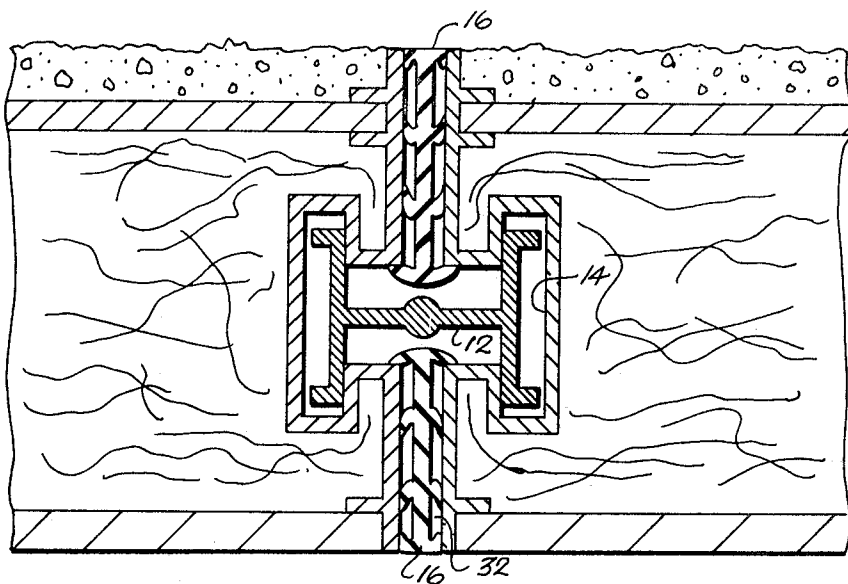


Fig. 5

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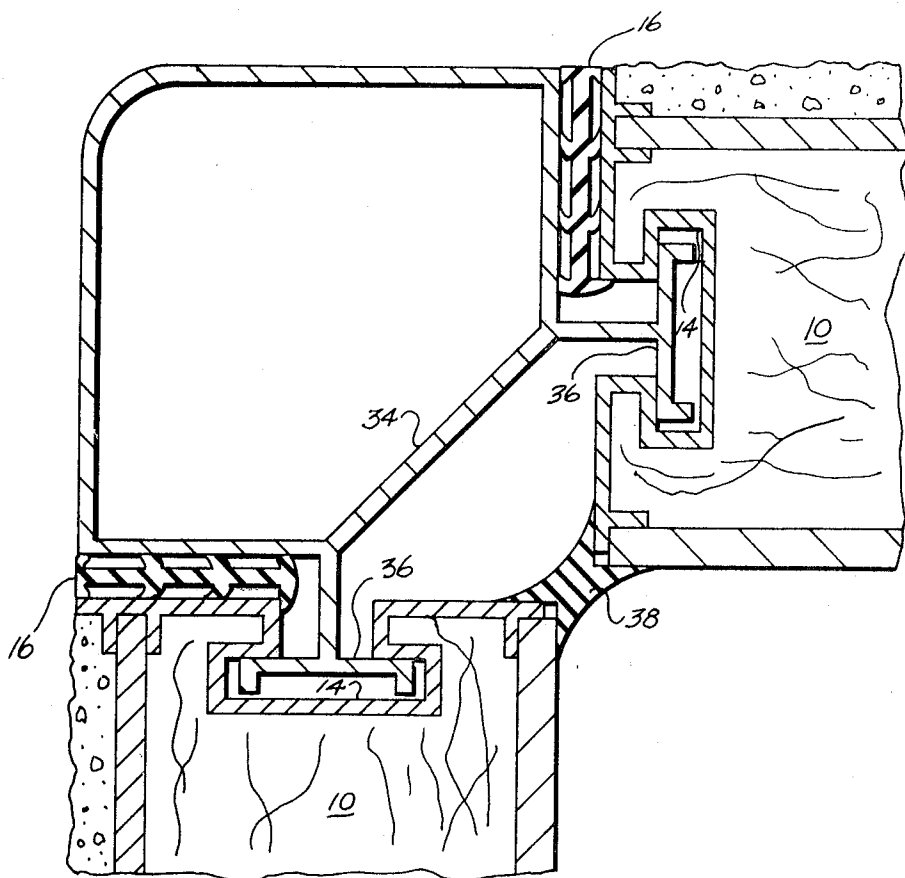
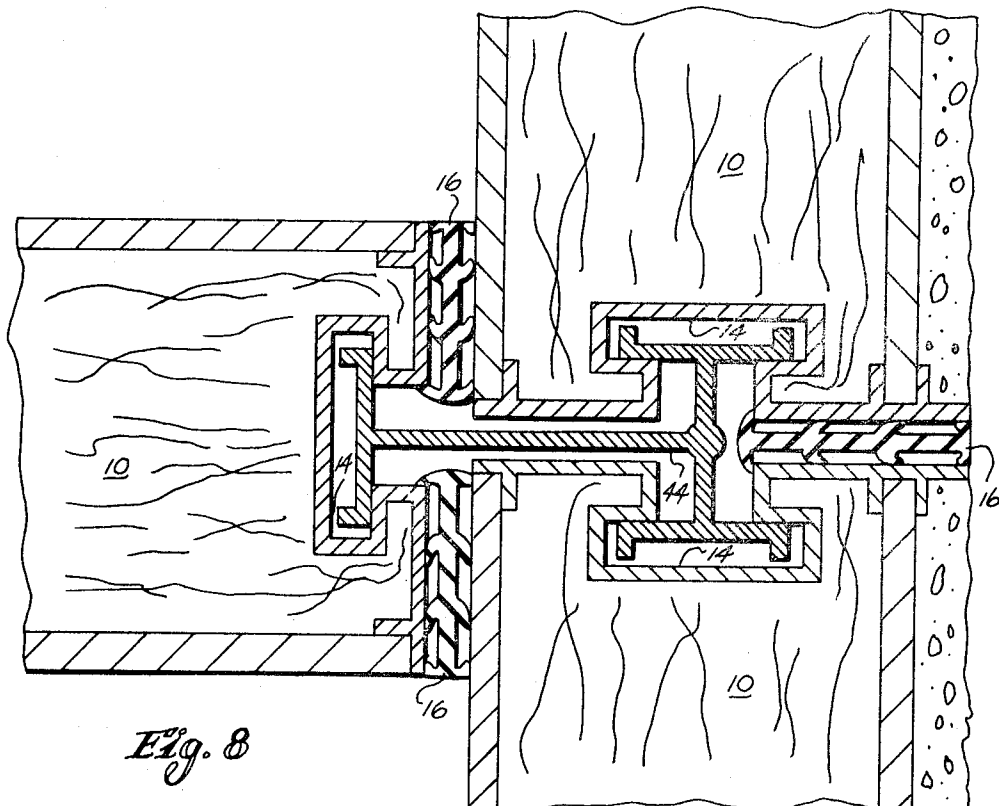
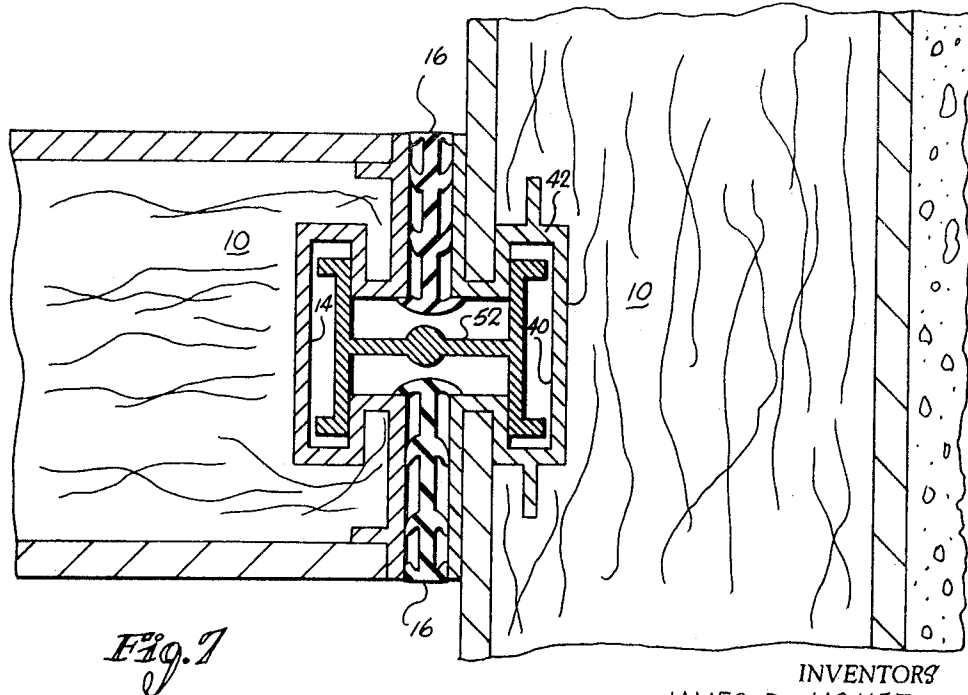


Fig. 6

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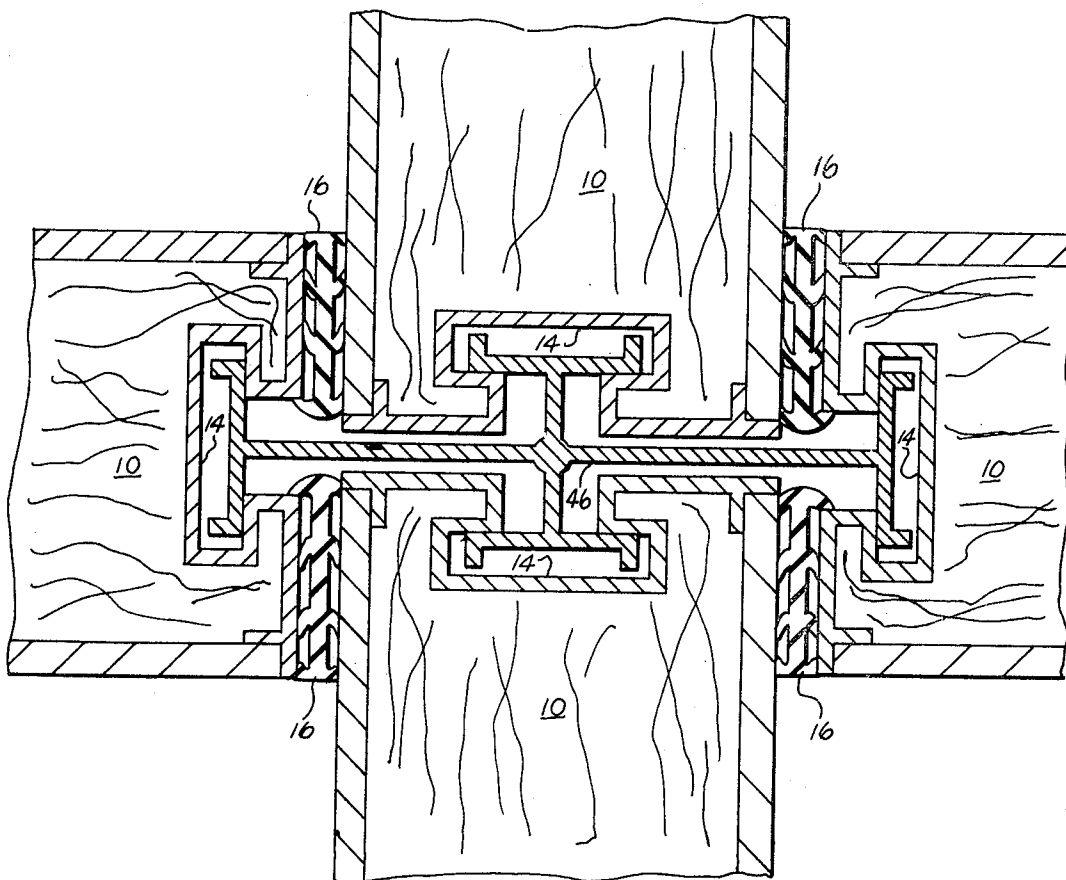


Fig. 9

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BUILDING STRUCTURE

This invention relates to structural assemblies for building construction. More particularly, this invention relates to a means of assembling preconstructed, load-bearing panels in a secure and efficient manner.

Modern construction techniques have largely utilized a load-bearing skeleton to which inter and outer walls and other building members are attached. Basically, the visible portions of buildings employing such construction are supported by an internal skeleton.

For instance, residential construction generally utilizes a wooden stud skeleton in the vertical wall to which the inner plaster or wallboard is attached and to which the outer sheathing or other covering such as masonry is secured. Similarly, high-rise buildings employ strong metal skeletons as the framework to which the enclosing portions of the building are attached.

One basic drawback to such construction is that it must usually be assembled piecemeal at the building site. Therefore, the construction process and personnel are exposed to the elements. Also, since equipment must be distributed between all of the active building sites, only simple, relatively inefficient equipment is employed.

The attractiveness of a centralized, protected, and specialized location for the preassembly of units to be assembled on site into a building has long been recognized. In addition to the convenience and comfort afforded the workmen, this procedure also permits the use of more specialized equipment, such as jigs, to produce more accurately sized equipment than can be produced on a job site.

With the discovery of lightweight foam panels only inches thick which display all of the insulating properties of walls many times such thickness, the advantages of a preassembled building unit become even more apparent. Module sections of buildings can be produced by such materials by foaming polymers, for instance urethanes, with the door openings, window openings, and other needed features integral with the unit. Such compact and complete units may then be conveniently shipped to a construction site and rapidly assembled.

However, one drawback has been the inability to produce a joint structure which is structurally sound, weathertight, durable, and which may be quickly and efficiently assembled. Since the units must be readily assembled and since the joining structure must be internal of the unit surface, it is very difficult to gain compressive forces at the joint. One approach has been to key or slide the units together. However, when sufficient forces are provided to produce a strong and weathertight joint, the force required to join such units together is prohibitive. For this reason, a simple, tight, tongue-in-groove type joint is not satisfactory for such large building units.

It is therefore an object of the instant invention to provide a method of strongly and securely joining building units.

Another object of this invention is to provide a means for quickly and efficiently joining building units.

Still another object of this invention is to provide a building unit joint which provides a weathertight seal.

Yet still another object of this invention is to provide a building unit joint which is durable.

Still yet another object of this invention is to provide a building joint which may be assembled and made secure on a building site without benefit of complex tools.

Other objects of this invention will be apparent from the drawings and following discussion.

According to this invention, building units are securely joined together by first securing two units together relatively loosely by inserting a key into integral channels at the end portions of each of the units. While the key provides a very strong joint with regard to longitudinal forces attempting to pull the joint apart, it does not in anyway jam the ends together and, in fact, permits a rather substantial clearance between the units. A resilient insert is then progressively inserted into the clearance between the units on each side. This insert securely seals the joint in a weatherproof manner and also lends a stiffening effect to the unit which results in a strong, rigid joint between the units.

The significance of the separate resilient insert will be appreciated upon consideration of what appears to be an equivalent arrangement, but which arrangement is, in fact, unworkable. That is an arrangement in which the resilient seals are made integral with the unit ends and the compressive forces on the seals supposedly generated by the key as it is driven into the channels. However, the force required to drive the key into the channels is so high as to render this approach unworkable. On the other hand, if the key is first inserted into the channels with a loose fit, the rubber inserts may be driven locally by first inserting a small portion of the strip at, for instance, the top of the joint groove and then pounding the strip into the groove locally in a progressive manner until the entire resilient strip is within the groove. While the high pressures necessary for sealing are produced, high forces are not involved because the pressures are only localized.

The invention will be more readily understood with reference to the drawings in which:

FIG. 1 is a perspective, exploded view of a typical series of joint assemblies according to this invention;

FIG. 2 is a top view of a building unit as used in the instant invention;

FIG. 3 is a top view of a key as used in the instant invention;

FIG. 4 is an end view of an insert as used in the instant invention;

FIG. 5 is a cross-sectional representation of a simple butt joint according to the instant invention;

FIG. 6 is a cross-sectional representation of a corner joint according to the instant invention;

FIG. 7 is a cross-sectional representation of a T-joint according to the instant invention;

FIG. 8 is a cross-sectional representation of a combination butt joint and T-joint;

FIG. 9 is a cross-sectional representation of a combination butt joint and two T-joints.

As can be seen from FIG. 1, building units 10 are joined by means of keys 12 inserted in channels 14 defined in units 10. Resilient inserts 16 are then inserted between the units 10 to lend strength and rigidity to the joint and to render the joint weatherproof.

The nature of building unit 10 will be more readily appreciated with reference to FIG. 2 wherein it may be seen that channel 14 is more specifically defined in an end section 18 which may be of metal, polymer, or other material, and is preferably extruded. End sections 18 may preferably be employed in the production of building units 10 by securing one wall 20 within projections 22 of end section 18. An insulating material, such as formed-in-place urethane is then placed between walls 20 to form core 24. Core 24 adheres to walls 20 and end section 18 to form an integral unit. If desired, a decorative outer surface 28 may be adhered to wall 20. Decorative surface 28 may be of stone, wood, or facsimile brick, or other desired finish as may be appropriate for exterior or interior use.

Key 12, as shown in FIG. 3, is of a relatively simple configuration which is readily extruded from, for instance, polymers or metals, though aluminum extrusions are preferred for strength and ease of handling.

Resilient insert 16 shown in FIG. 4 includes several projections 30 on each side thereof to enhance sealing. Also, projections 30 enable the resilient insert 16 to be readily positioned in the finished unit and to generate the desired lateral forces to provide rigidity in the joint.

As shown in FIG. 5, two building units 10 are joined by positioning key 12 in channel 14 of each building unit 10. Key 12 provides a loose, flexible joint between building units 10. The joint is rendered strong and rigid by inserting resilient inserts 16 into gaps 32 between building units 10. In this manner, key 12 provides great longitudinal strength in the joint while resilient inserts 16 stiffen the joint and preclude bending of the joint in the direction normal to the wall surfaces.

When in place, inserts 16 are preferably flush and present the appearance of a carefully caulked joint. Alternatively, other outer surfaces may be presented by insert 16 including a curved rib or even a surface similar to decorative surface 28.

As shown in FIG. 6, corner sections may be assembled in a similar manner. Building units 10 are loosely assembled by inserting corner member 34, and specifically keylike projections 36—which may be disposed at various angles—of corner member 34 into the channels 14 of building units 10. A resilient spacer 38 is positioned at the inside juncture of building units 10. Resilient inserts 16 are then positioned between corner member 34 and building units 10 to complete the joint. The integrity and strength of such a corner joint will be readily apparent.

FIG. 7 illustrates the simple T-joint between building units 10 in the form of an external wall and an internal wall. This joint utilizes key 12, channel 14 and insert 16 in a manner analogous to the above-discussed butt joint. However, a channel 40 analogous to channel 14 is provided in outside building unit 10 at the location at which the junction is desired by means of an insert 42 which is molded into building unit 10 as discussed above.

FIG. 8 illustrates a T-joint between three building units 10 where two are butt joined together and the third joint in a T fashion and the butt joint. This type of joint utilizes a special key 44 which is adapted to engage the channels 14 of all three building units 10. The special key 44, of course, provides a loose joint between the three building units and resilient inserts 16 are utilized to lend rigidity to the joint.

Still another complicated joint illustrating the flexibility of this invention is shown in FIG. 9. In this joint, four building units 10 are joined in a manner discussed above utilizing variant keyway 46. As in the other examples, variant keyway 46 is inserted into channel 14 of each building unit 10. Because of the discussed clearances, this step is readily accomplished. Then, resilient inserts 16 are driven into the appropriate gaps to complete the joint.

EXAMPLE

A steel frame was fabricated to form a simulated foundation of a 12x12x8 foot building. The building was constructed of 4x8x0y foot structural panels as described herein. Facing on the panels was 1/8-inch hardwood on the inside and 1/8-inch cement asbestos board covered with 1/8-inch epoxy matrix and No. 2 marble chips on the outside. The core of the panel was a 2-pound per cubic foot poured-in-place polyurethane foam. Channels as shown in the drawings surrounded the perimeter of the panels, and the panels were assembled as shown in the drawings and discussed herein.

Loading was applied to the simulated windward face of the building by three identical hydraulic jacks which were interconnected through a manifold to equalize the pressure to each jack. A timber grillage was set at the face of each of the loaded panels between the wall panel and the jack to distribute the load so as to provide the proper relationship between maximum shear and maximum bending moment. Strain gauges were located at three points, 4 inches below the tops of each windward panel, to measure the deflection of the panels from true vertical. Pressures applied to the building wall were correlated to wind loadings. The wall was tested with pressures corresponding to winds of 75 m.p.h. loading, 150 m.p.h. loading, and 250 m.p.h. loading. The test was repeated with the building rotated 90°. In none of the tests was there a failure or permanent distortion of the panel and securing structure. Maximum deflections were less than 1 inch at the 7 foot 8 inch height of the center panel and not over one-half inch at either end panel during the 250 m.p.h. test.

From the above discussion and example, it will be apparent that the instant invention provides a structure and method whereby prefabricated panels may be easily and conveniently assembled on site utilizing ordinary tools. Further, the junction assembly provides excellent structural strength and weather seal.

It will be apparent from the above description and drawings that various modifications of the structure and method may be made within the scope of the invention. Therefore, the invention is not intended to be limited to the particular examples or

illustrations employed except as may be required by the following claims.

What is claimed is:

1. In a rigid, load-bearing, weatherproof joint structure comprising at least two building units having undercut channels defined therein, each of said channels having a shoulder and at least one of said channels being located at an end of one of said units, a key member having a web portion and spaced-apart flanges behind and engageable with said shoulders, said key member being disposed in the channels to fasten the building units together in a spaced-apart relationship whereby spaces are provided on opposite sides of said key member, and resilient inserts snugly positioned in the spaces between the building units and on opposite sides of said key member for holding the flanges of said key member in engagement with said shoulders.
2. A joint structure as set forth in claim 1 wherein both of the undercut channels are located at the end portions of the two building units and the key member is of an "I" cross-sectional shape.
3. A joint structure as set forth in claim 2 wherein each of the resilient inserts is a rubber strip.
4. A joint structure as set forth in claim 2 wherein the building unit comprises a foam core and nonporous, solid outer wall portions.
5. A joint structure as set forth in claim 2 wherein each of the channels is of a "T" cross section.
6. A corner assembly of building units comprising two building units having undercut channels defined in the end portions thereof, each of said channels having a shoulder, a corner key member having side portions and protrusions including flange portions behind and engageable with said shoulders, said protrusions extending outwardly from said side portions and being shaped complementary to the channels, disposed at an angle to each other and positioned one each loosely within the channels wherein spaces are provided between the side portions of the corner key member and the units, said corner key member loosely fastening said building units together, and separate resilient inserts snugly positioned in the spaces between the units and the side portions of the corner key member for holding the flange portions of said protrusions in engagement with the shoulders of said channels so as to provide rigidity to the assembly.
7. An assembly of building units comprising a first building unit and a second building unit each having undercut channels defined therein, each of said channels including a shoulder, the first building unit having the channel in the end portion thereof and the second building unit having a channel in the sidewall thereof, a key member having a web portion and spaced-apart flanges shaped complementary to the channel and positioned behind and engageable with said shoulders, said flanges being disposed in and between the two channels to fasten the first building unit loosely in a position normal to the wall surface of the second building unit but spaced apart therefrom, and a pair of resilient inserts snugly positioned between the two building units and on opposite sides of said key member for holding the flanges of said key member in engagement with said shoulders.
8. An assembly of building units comprising at least three building units having undercut channels defined at the end portions thereof, each of said channels including a shoulder, two of said building units being positioned in an end-to-end, spaced-apart relationship with the channels confronting one another, and the other of said building units being positioned normal to the confronting building units with the channel positioned adjacent to but spaced apart from the space between the two confronting building units, a key member having web portions and spaced-apart flanges behind and engageable with said shoulders, said key member being positioned in all three channels to loosely fasten the building units in the described relationship, a first separate resilient insert snugly positioned within the space between the confronting building units, a second separate resilient insert snugly positioned within the

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space between said other building unit and one of said confronting building units and a third separate resilient insert positioned within the space between said other building unit and the other confronting building unit so as to hold the flanges of said key member in engagement with the shoulders of said channels whereby said inserts provide rigidity to said assembly.

9. An assembly of building units comprising four building units having undercut channels defined at the end portions thereof, each of said channels having a shoulder, two of said building units being positioned in an end-to-end, spaced-apart relationship with the channels confronting one another, and the other two of said building units being positioned normal to and on opposite sides of the confronting building units with the channels therein positioned adjacent to but spaced apart from the space between the two confronting building units, a key member having web portions and spaced-apart flanges behind and engageable with said shoulders, said key member being positioned in all four channels to loosely fasten the building units in the described relationship, and at least four separate resilient inserts snugly positioned within the spaces between the building units for holding the flanges of said key member in engagement with the shoulders of said channels so

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as to provide a rigid assembly, two of said inserts being positioned on one side of said confronting building units and on opposite sides of said key member and the other two of said inserts being positioned on the other side of said confronting building units and on opposite sides of said key member.

10. An assembly of building units comprising at least two building units having end portions each of which defines an undercut channel having a shoulder, a key member having a web portion and spaced-apart flanges behind and engageable with said shoulders, said key member being disposed in both of said channels for loosely fastening said units and for positioning said end portions in confronting but spaced-apart relationship, and at least two elongated resilient inserts each of which when in an undeformed state includes at least one portion having a transverse thickness greater than the distance between the confronting end portions, said inserts being positioned on opposite sides of said key member and snugly held in the spaces between the confronting end portions in a deformed state for holding the flanges of said key member in engagement with the shoulders of said channels, whereby said inserts add rigidity to the assembly.

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