Sept. 14, 1965 M. D. FELIX ETAL 3,205,630

WALL SYSTEM

Filed May 22, 1962 3 Sheets-Sheet 1

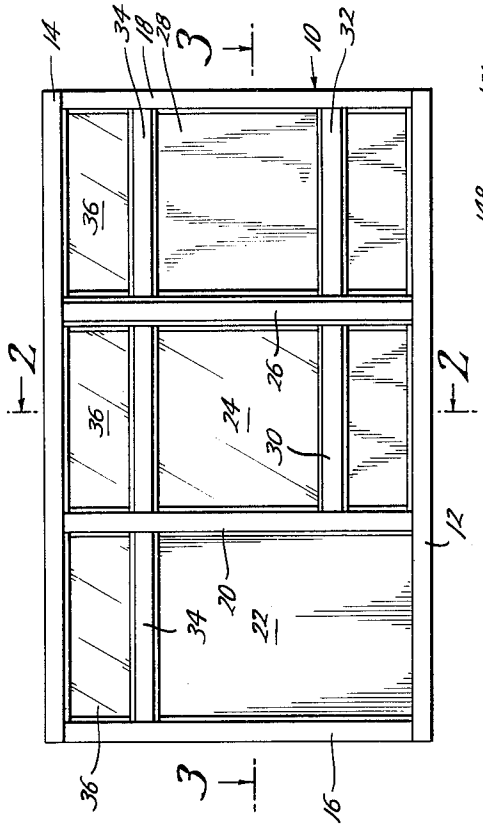

Fig. 1

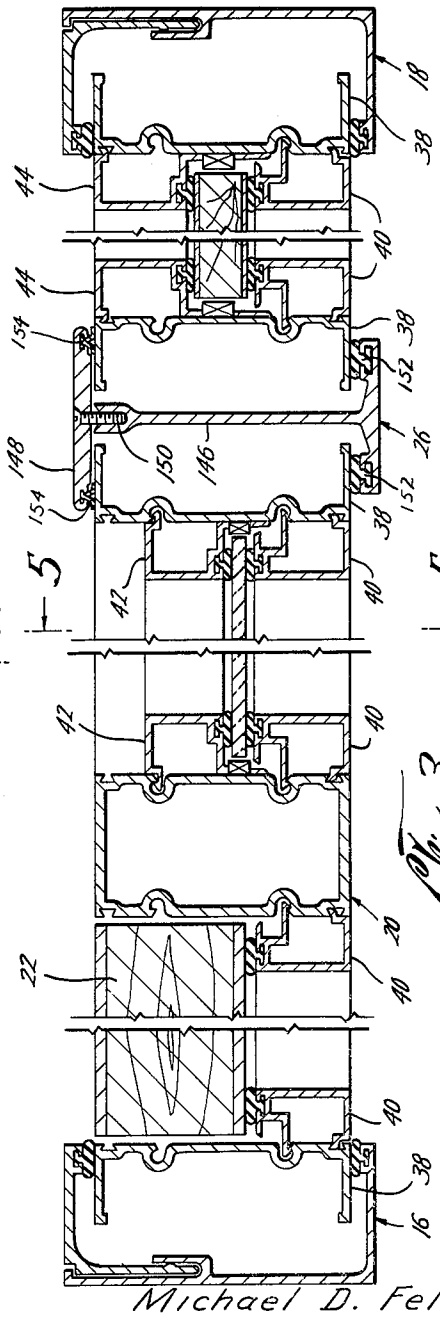

Fig. 3

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WALL SYSTEM

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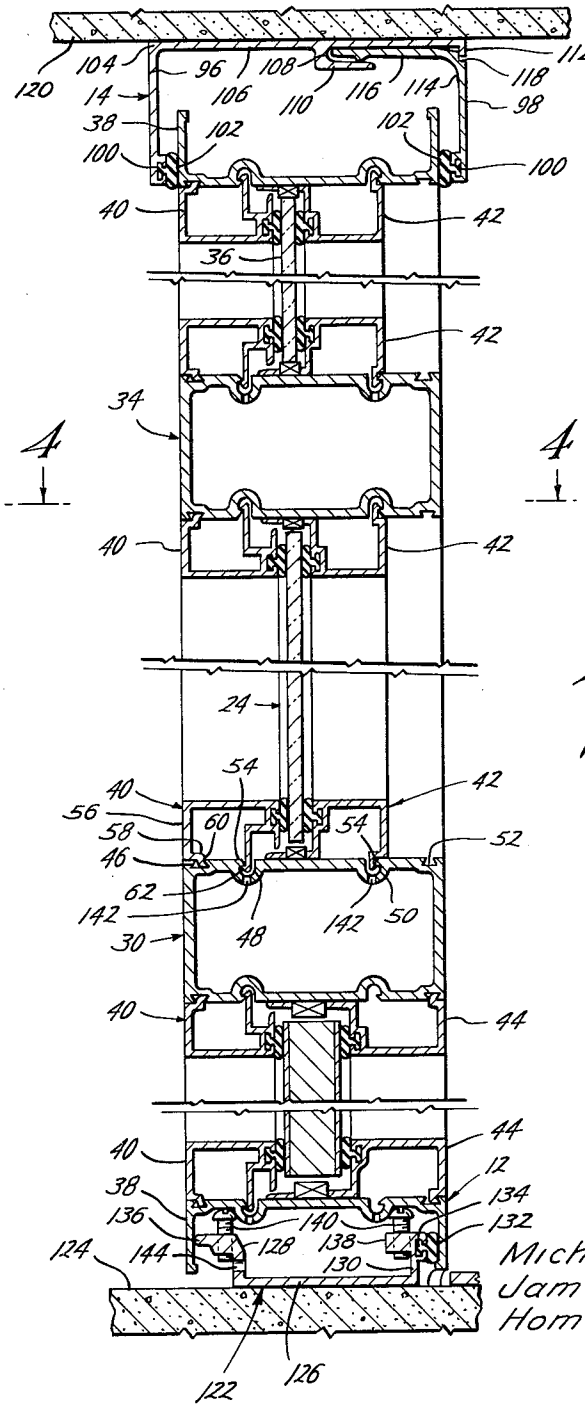

Fig. 2

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WALL SYSTEM

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Fig. 4

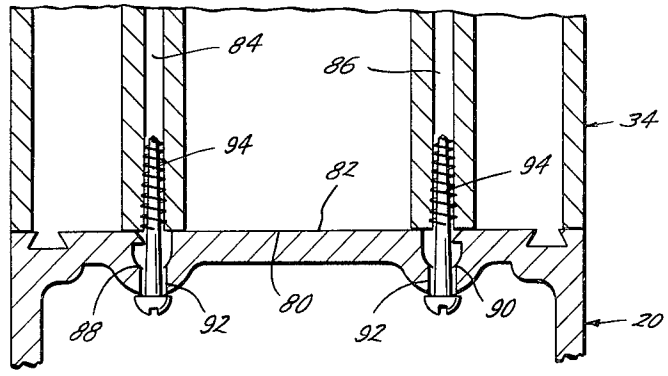
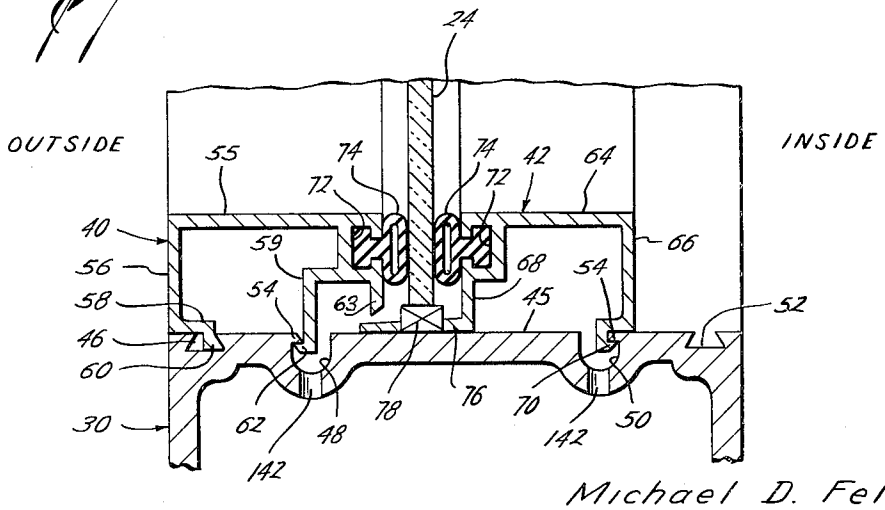


Fig. 5



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United States Patent Office 3,205,630 Patented Sept. 14, 1965

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WALL SYSTEM

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Filed May 22, 1962, Ser. No. 196,717
6 Claims. (Cl. 52—476)

This invention relates to wall systems for buildings, and more particularly it relates to the type of wall systems commonly known as curtain wall construction.

In curtain wall construction, a modular framework of steel or concrete is usually used, although wooden framework may be used. Frame members are usually spaced apart one floor in the vertical direction and from about five feet to about twelve feet in horizontal direction. This intervening space is covered by non-load bearing members such as glass, plastic, aluminum sheeting, panel boards, and insulating wall members or the like, often together with comparatively light frame elements to position such panel members and to connect them to each other. In single story or other low rise commercial buildings, motels, schools, and similar structures, it is necessary or desirable to use a very flexible wall system to cover this intervening space so that a large variety of different sizes, shapes and kinds of wall elements may be used. For example, where the space between two vertical framing members constitutes a unit of a motel, the wall would have to include a door, windows, and opaque wall elements.

It is an object of this invention to provide a wall system which is readily adaptable to a variety of wall elements in a single wall section.

Another object is to provide a wall system which is easy to erect with ordinary hand tools.

Still another object is to provide a wall system which will withstand adverse climatic conditions.

Yet another object is to provide a wall system which cannot be disassembled from the outside, so that the danger of breaking in therethrough is greatly reduced.

These and other objects of the invention are achieved by a wall system which comprises extruded frame members, e.g. aluminum, which are readily fastened together and to structural load-bearing members, to form openings of various sizes and shapes, and which are adapted to mount various wall panel members, including doors or windows. The structure of this invention has provision for decreasing difficulties with moisture caused by leakage or by condensation on and within the wall system, and will readily accommodate expansions and contractions caused by temperature changes.

For a better understanding of the invention, reference is now made to the accompanying drawings, wherein

FIGURE 1 is an elevational view of one embodiment of a wall section incorporating the wall system of this invention;

FIGURE 2 is an enlarged vertical sectional view of the embodiment of FIGURE 1, taken at line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged horizontal sectional view of the embodiment of FIGURE 1, taken at line 3—3 of FIGURE 1;

FIGURE 4 is a further enlarged showing of a typical intersection of two frame members, taken at line 4—4 of FIGURE 2, and

FIGURE 5 is an enlarged cross-sectional fragmentary view of a portion of the framework of one embodiment of this invention, taken at line 5—5 of FIGURE 3.

The wall section **10** shown in FIGURE 1 comprises a bottom plate **12** and a top plate **14**, each of which is, in the embodiment shown, an aluminum extrusion. Jambs **16** and **18** at either side of the wall section are also shown to be aluminum extrusions. A vertical post **20** separates a door opening **22** from a window **24**, and a vertical mullion **26** separates the window from a wall panel **28**. A horizontal muntin **30** defines the bottom of the window, and a similar horizontal muntin **32** defines the bottom of the opening for wall panel **28**. Additional horizontal muntins **34** define the tops of the door opening, the window, and the panel opening, and enclose transoms **36**.

It will be noted from an examination of FIGURES 2 and 3 that the foregoing structural elements have a common feature—the same basic system is used in each case to sealingly retain the glass or other wall panel, or to act as a stop for the door **22**. This system comprises a channel shaped element **38** with each of which an outer glazing bead **40** and one of inner glazing beads **42** or **44** is interlocked. In some instances two of the channel-shaped frame elements are formed back to back in a single tubular box cross-section member. Such box cross-section members are used, in the embodiment shown in the drawings, to form post **20** and horizontal muntins **30**, **32** and **34**.

For a better understanding of the interengagement of the basic channel members **38** and the glazing beads **40**, **42** and **44**, reference is now made to FIGURE 5, which depicts a portion of the window **24** and shows the means used to retain the glass pane in the wall section. Note that this figure is labeled "outside" and "inside" to show the difference in the assembly used on the outside and the inside of the wall. The outside assembly is such that it cannot be disassembled from the outside, whereas the inside assembly is readily disassembled as required for maintenance or for other reasons.

It will be noted that the top face **45** of muntin **30** has formed therein four longitudinally extending grooves **46**, **48**, **50** and **52**, although for retention of the window pane only grooves **46**, **48** and **50** are utilized. Grooves **46** and **52** are closely adjacent the opposite edges of the flat face **45** of the muntin **30**, and are substantially dovetail in form, so that a portion of the flat face **45** overhangs a portion of each side of the bottom of the grooves. Grooves **48** and **50**, however, are shown to be semicylindrical in shape, albeit still with a portion **54** of the face **45** outwardly of each groove overhanging a portion of the groove. The overhanging portions provide one half of a hook engagement, the other half of which is provided by the glazing beads.

The glazing bead **40** comprises a generally channel-shaped member having a web element **55** which is directed toward the opening which it frames. One flange **56** is, when installed, substantially coplanar with the outside flange of the channel member **38** with which it is engaged, or, in the case of the box cross-section members such as muntin **30**, the outside surface of the member. A longitudinally extending lip **58** on the edge of the flange **56** is turned inwardly of the glazing bead and terminates in a foot **60** diverging therefrom so as to engage groove **46**. The diverging foot and the inner dovetail surface of groove **46** cooperate to retain the edge of the flange **56** in contact with the face **45** of the muntin **30**.

The other flange **59** of the glazing bead has on its edge an inwardly turned hook **62** which extends down into groove **48** and is engaged under the overhanging portion **54** of the face of the muntin. Thus this flange of the glazing bead is retained in contact with the face **45** of the muntin, and the hook **62** and the foot **60** cooperate in the manner of a claw to grip a portion of the wall of the muntin therebetween so as to rigidly interlock the glazing bead and the muntin. It will be appreciated that the resilient character of the extruded aluminum glazing bead causes the foot **60** and hook **62** to be re-

siliently biased toward each other so as to hook under overhanging portions of the wall of the muntin. It is also apparent that with this type of engagement it will not be possible to disengage the glazing bead from the muntin by the application of force to the outside of the glazing bead in any direction. Furthermore a smooth, pleasing appearance is obtained because the flange **56** is rigidly held flush with the flat outer surface of the muntin. However, from the inside of the wall, the glazing bead **40** may be disengaged from the muntin by the application of a suitable tool behind the lip **63** formed on flange **59**.

On the inner side of the wall, glazing bead **42** has a body portion of a generally channel-shaped form, the web **64** of which faces the opening being framed. Flanges **66** and **68** extend toward the flat face **45** of the muntin, and this face closes the open side of the channel. A hook **70** on the edge of flange **66** extends into groove **50** and hooks under the over-hanging portion **54** of the flat face **45**.

Each of flanges **59** and **68** has formed therein a longitudinally extending outwardly facing groove **72** in which an elongate resilient weatherstrip **74** is sealingly received and retained. As shown, the portion of each weatherstrip which is outside the groove is tubular in form, and bears against the glass pane **24**. The proportions and relative positions of the glazing beads **40** and **42** and of the weatherstrips result in compression of the weatherstrips against the glass pane so as to provide sealing engagement therebetween.

Flange **68** of glazing bead **42** is provided with an outwardly extending flange **76** extending parallel to and along face **45** of the muntin. Flange **76** has retained in apertures therein resilient glass setting blocks **78** on which the glass pane **24** rests. Similar glass setting blocks are provided above and on the ends of the glass to allow for expansion.

The hook **70** on glazing bead **42** is resiliently retained in engagement with the groove by means of the force exerted by the resilient weatherstrip **74**. It will be seen, however, that this glazing bead is readily removed by merely applying pressure against flange **66** sufficient to compress the weather strip enough for the hook to move out from under the overhanging edge **54**. Thus the glass pane **24** is readily replaced.

FIGURE 4 depicts the method of assembly of the various vertical and horizontal channel-shaped elements **38**. In this figure the juncture of horizontal muntin **34** and vertical post **20** are used to illustrate the method of attaching these major elements to each other.

Note that the end **80** of muntin **34** is cut square so that it fits snugly against the flat face **82** of post **20**. Since the channel-shaped portions of these members are identical, the open ends of the semi-cylindrical grooves **84**, **86** in member **34** are in alignment with the grooves **88** and **90**, respectively, in member **20**, when the flanges of these members are flush with each other. Directly under the open ends of the grooves **84** and **86** a hole **92** is drilled in the metal forming each of grooves **88** and **90**, the axes of the holes **92** being aligned with the axial centerline of the grooves **84** and **86**. A self-tapping metal screw **94** is inserted through each of holes **92** and threaded into the grooves **84** and **86**. The metal screws are sized so that there is an interference fit in these grooves, with the result that they tap a thread in the walls of the grooves. The resilient nature of the aluminum material causes the walls of the grooves to resiliently bind the metal screws.

The joint between the end **80** of muntin **34** and the flat face **82** of post **20** is sealed after assembly by coating with an elastomeric sealant to insure that moisture flowing through the structure will follow the grooves provided and will not leak out at joints.

The jambs **16** and **18** and the top plate **14** are each of similar construction. Referring for example to FIGURE 2, it will be seen that the top plate comprises a two-piece channel member having an opening greater than the width of the channel-shaped members **38**, so as to receive one of the members **38** therebetween. The flanges **96** and **98** of the top plate are provided at their free edges with longitudinally extending inwardly directed grooves **100**, each of which sealingly retains a weatherstrip **102**, which has a tubular form portion extending from the groove into sealing engagement with the flanges of the member **38**.

As previously stated, the top plate is in two pieces. An outer receptor **104** is the larger of these pieces. This outer receptor includes flange **96**, a web portion **106**, an inwardly directed longitudinally extending slot **108** formed between an overlying web **110** and web portion **106**, and narrow flange **112** extending along the edge of the web opposite flange **96** and forming a retaining lip for the inner receptor **114**. The inner receptor is generally in the form of an angle having two legs, one forming flange **98**, and the other leg **116** being adapted to lay parallel to web **106** with its extremity engaged in slot **108**. The corner forming the juncture between these legs is notched at **118** to receive the lip **112**. It will be seen that when outer receptor **104** is in place and the channel **38** has been placed in position, the angle member forming the inner receptor may be pressed into place as shown by inserting leg **116** into slot **108** and pressing on flange **98** until the lip **112** snaps into notch **118**. The resiliency of the weatherstrip **102** resiliently urges the edge of flange **98** outwardly so as to cause a moment to be applied to the inner receptor which tends to hold it in place.

It is apparent that the inner receptor is readily removed by merely prying apart the lip **112** and the wall forming the notch **118**. However, the outer receptor cannot be removed from the outside, since it is securely anchored, as by anchor bolts, to the concrete framework **120**. Note that the structure of this invention provides for substantial inaccuracies and variations in the dimensions of the opening in which the curtain wall construction is installed. The weatherstrips **102** will seal anywhere across the width of the flanges of the channel **38**, so that the channel **38** may be positioned as shown within the top plate, or it may be positioned lower so that a substantial portion of its flanges are clear of the top plate.

The wall structure of this invention rests upon a sill receptor channel **122** which is fastened to the floor **124** or other member. The sill receptor channel comprises an upwardly open generally channel shaped member proportioned to fit between the flanges of channel **38**. The web **126** of the sill receptor channel lies on the floor, and flanges **128** and **130** extend upwardly therefrom. A weatherstrip **132** is received in an outwardly facing longitudinally extending groove **134** along the outside face of flange **130**, and bears against the inner flange of channel **38** to provide a resilient seal therebetween. Flanges **128** and **130** are provided with lateral support bolt lips **136** and **138**, respectively. Each of lips **136** and **138** is drilled and tapped to receive a vertically disposed machine screw **140** whose head projects upwardly therefrom to provide a support for channel **38**. A plurality of such screws **140** are provided along the length of each lip, and the height of each of the screws is adjustable as required for leveling of the curtain wall and for equalization of the loading of the screws.

A major benefit received from the curtain wall construction of this invention is the elimination of difficulties from moisture, either from windblown rain or from condensation, entering the building through the wall. This result is achieved principally by the grooves **48** and **50** in the various channel-shaped members **38**, which comprise channels through which water and air can be conducted. Each of the upwardly-opening grooves **48** and **50** is provided with a plurality of weep holes **142** through the bottom. Any moisture which leaks past the weather-

strips 74 gravitates down into the groove and then through the weep holes into the horizontal member. The moisture then flows along the inside of the horizontal member until it reaches a vertical member. It then flows into the grooves 48 and 50 of the vertical member and down these grooves to the trough formed by the upturned flanges of sill receptor channel 122. The outer flange 128 of this channel is provided with a plurality of horizontal weep holes 144 therethrough, through which the moisture may flow out to the outside.

Note that the outer flange of channel 38 is spaced up from the floor so as to leave a gap therealong. This gap, together with the weep holes 144 and 142, the grooves 48 and 50, and the hollow structural members, provides means for circulation of air throughout the structure for evaporation of any small amounts of water which may collect in the system. Thus even if, for some reason, the various weatherstrips may not provide a perfect seal under all conditions any moisture which may leak past the weatherstrip cannot enter the interior of the building, but drains to the outside, or is evaporated away.

Vertical mullion 26 (FIGURE 3) is illustrative of a modification of a post structure adapted for use in the structure of this invention. In this structure, a T cross-section member 146 has attached to its base a flat strip 148, screws 150 being provided to hold them together in an I-beam form. Resilient weatherstrips 152 on the inner faces of the flanges of the T and weatherstrips 154 on the inner face adjacent the edges of the flat strip 148 each bear on channel-shaped members 38 and are sealingly engaged therewith.

Another significantly superior feature of the structure of this invention is its versatility, in that it is readily adaptable to different thicknesses of wall panel materials. Note in FIGURE 2, for example, that glazing bead 42 is engaged in the inner of the grooves 50 and 52, whereas the glazing bead 44 is engaged in the outer of the two grooves. Furthermore, the glazing bead alone need be changed to provide for other panel thicknesses. All other parts remain the same.

It is now evident that the curtain wall construction which is the subject of this invention is far superior to those of the prior art in many respects, and that new and useful structure is provided which achieves new results.

The unique semi-cylindrical grooves in the channel members 38 perform four exclusive functions: (1) They provide means for engagement of screws to hold structural members together; (2) They act as a receptacle and lock to hold glazing beads; (3) They provide collecting gutters for condensate and precipitation; (4) They provide weeps and vents for voiding condensate and allowing for circulation of air throughout the wall system.

The glazing beads are designed for easy assembly and maintenance. They lock into the channel members and are secured without the use of any screws or other fastening elements. The exterior beads cannot be removed from the outside. In addition they provide means for sealingly retaining resilient rubber or plastic weatherstrips.

The outer and inner receptors forming the top plate and the jambs provide functions which are unique in curtain wall construction. Not only do these elements act as a locator for the panel units and provide positive anchorage to the frame structure, but they also include means for retaining weatherstripping to seal the perimeter of the wall section. Furthermore they allow for substantial variation in dimensions of the openings and for expansion and contraction caused by temperature changes. The two-piece construction greatly simplifies the removal and replacement of wall sections.

It is well known in the art that one of the most serious problems in curtain wall construction is water-tightness. The structure of this invention is designed with the assumption in mind that some leakage will inevitably occur, and thus means are provided to direct and guide any moisture so that it does not enter the interior of the building.

Equivalent structure capable of achieving some or all of these superior results will become apparent to those skilled in the art, upon consideration of the foregoing description of a preferred embodiment of this invention. Thus the invention is not limited to the specific forms shown and described, but only as set forth by the following claims.

We claim:

1. A structural assembly comprising a vertical, elongate hollow member having a substantially flat face free of protuberances, a longitudinally extending groove formed in said flat face, a horizontal elongate hollow member intersecting said flat face in abutting relationship, an upper flat face on said horizontal member, a longitudinally extending groove in said upper flat face intersecting the vertical groove, a plurality of weep holes in the bottom of the horizontal groove, a self-tapping machine screw extending through the wall forming the vertical groove axially of said horizontal groove and in engagement with the wall forming the horizontal groove, a pair of glazing beads attached to each of said flat faces, facing surfaces on said glazing beads, and a wall panel sealingly and resiliently retained between said facing surfaces, whereby any moisture that leaks between the glazing beads and the wall panel flows into said horizontal groove, through said weep holes, longitudinally of said horizontal member to said vertical member, and down the vertical groove.

2. A structural assembly comprising an elongate member, a first pair of longitudinally extending grooves formed in one face of said member comprising an outer groove near the edge of the face and an inner groove spaced inwardly therefrom, a portion of said face overhanging each of the outer and inner grooves of the first pair on the side thereof nearest the other groove, a third longitudinally extending groove in said face spaced from said inner groove and more remotely from said outer groove, a portion of said face overhanging the side of said third groove remote from said inner groove, said face being substantially flat and uninterrupted except for said grooves, a first elongate, resilient glazing bead having means thereon engaged with said outer and inner grooves by hooking under the overhanging portions related thereto, said means being resiliently biased against disengagement from said grooves, a second elongate glazing bead having means thereon engaged in said third groove and hooked under the overhanging portion related to said third groove, and a panel member sealingly received between said glazing beads.

3. A structural assembly as defined by claim 2 wherein a resilient gasket provides the sealing between said panel member and said second glazing bead and resiliently biases the hook means thereon against disengagement from said third groove.

4. A structural assembly as defined by claim 2 wherein said first glazing bead comprises a generally channel-shaped member having an outer flange free of surface protuberances and having a foot thereon engaging said outer groove, an inner flange having a hook thereon engaging said inner groove, and a lip on said inner flange adapted to be engaged by a glazing bead removal tool.

5. A structural assembly comprising

a vertical elongate hollow member having a substantially flat face free of protuberances,

a pair of spaced apart, longitudinally extending grooves formed in said flat face,

a portion of said flat face overhanging each of said grooves on the side thereof nearest the other,

a third longitudinally extending groove formed in said flat face and spaced away from said pair of grooves,

a horizontal elongate hollow member having a configuration substantially identical to the vertical member abutting the flat face of the vertical member,

the flat face of the horizontal member being in a horizontal plane,

at least some of the grooves in the horizontal member intersecting the grooves of the vertical member,

a first glazing bead on each member having means thereon engaged with both of the pair of grooves in said member by hooking under said overhanging portions, and resiliently biased against disengagement therefrom,

a second glazing bead on each member having means thereon engaging the third groove in each member, and

a wall panel sealingly and resiliently retained between said glazing beads.

6. A structural assembly comprising

a vertical elongate hollow member having a substantially flat face free of protuberances,

two pairs of spaced-apart, longitudinally extending grooves formed in said flat face,

a central portion of said flat face intermediate the inner grooves of the pairs,

a portion of said flat face overhanging each of said grooves on the side thereof nearest the other of its pair,

a horizontal elongate hollow member having a configuration substantially identical to the vertical member abutting the flat face of the vertical member,

the flat face of the horizontal member being in a horizontal plane,

at least some of the grooves in the horizontal member intersecting the grooves in the vertical member,

a first glazing bead on each member having means thereon engaged with both of one pair of grooves in said member by hooking under said overhanging portions, and resiliently biased against disengagement therefrom,

another portion of the flat face of each member overhanging the outer edge of the outer of the other pair of grooves,

a second glazing bead on each member having means thereon hooked under the other overhanging portion, and

a wall panel sealingly and resiliently retained between said glazing beads.

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