

Aug. 22, 1961

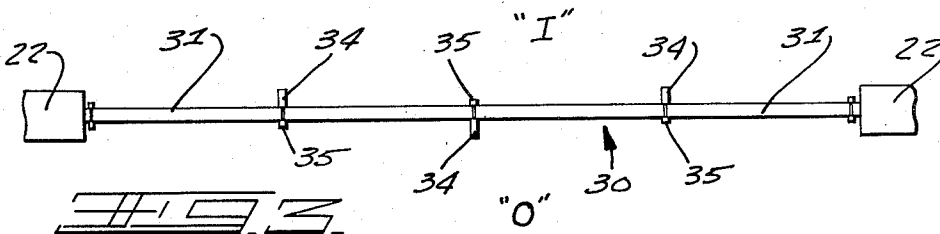
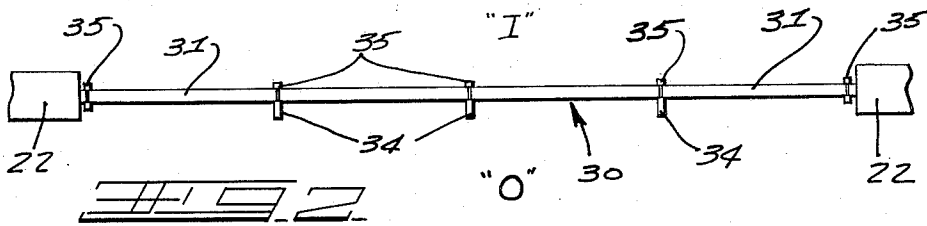
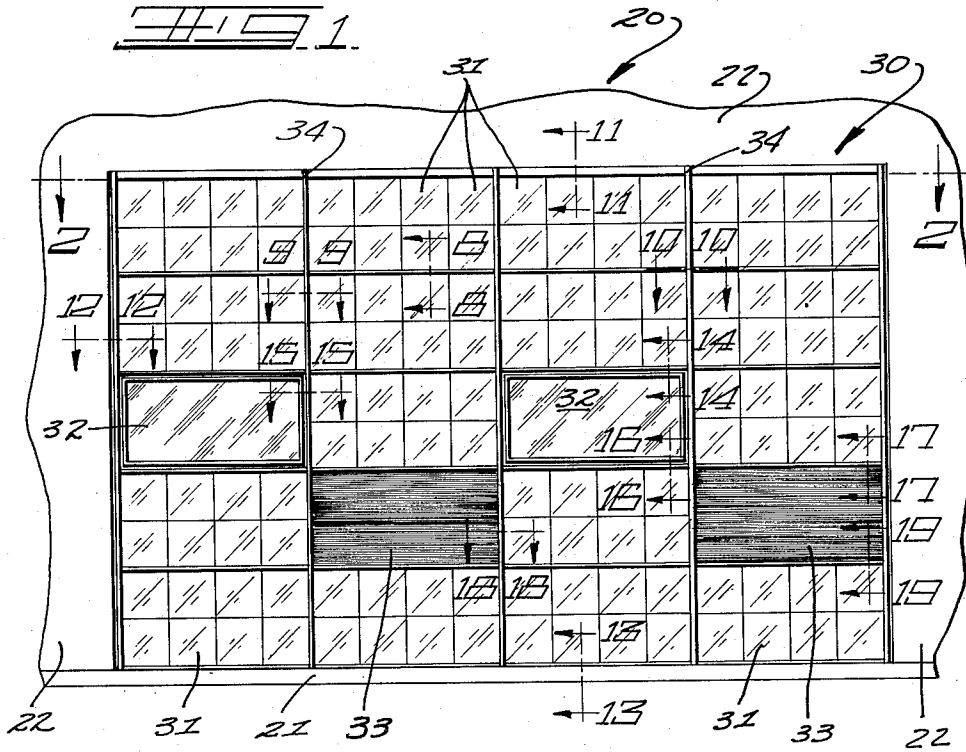
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2,996,845

STRUCTURAL PANEL AND BUILDING WALL CONSTRUCTION UTILIZING SAME

Filed Sept. 11, 1958

7 Sheets-Sheet 1



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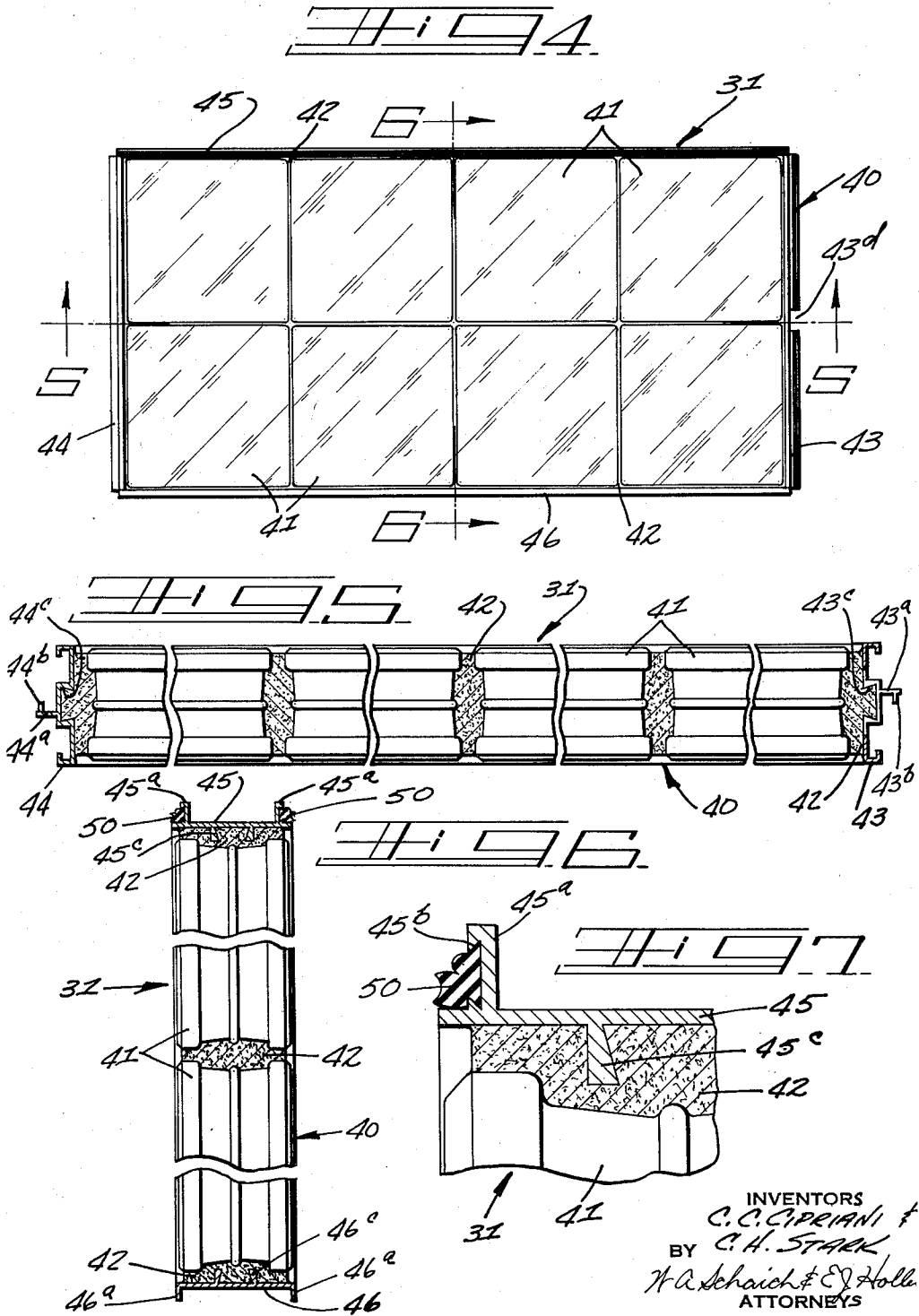
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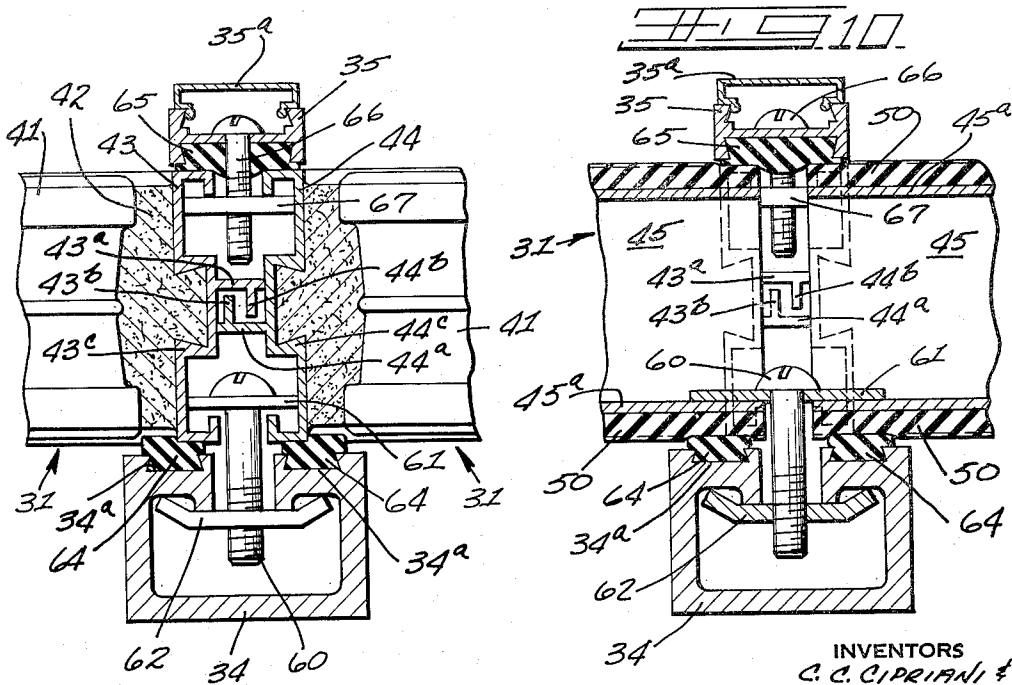
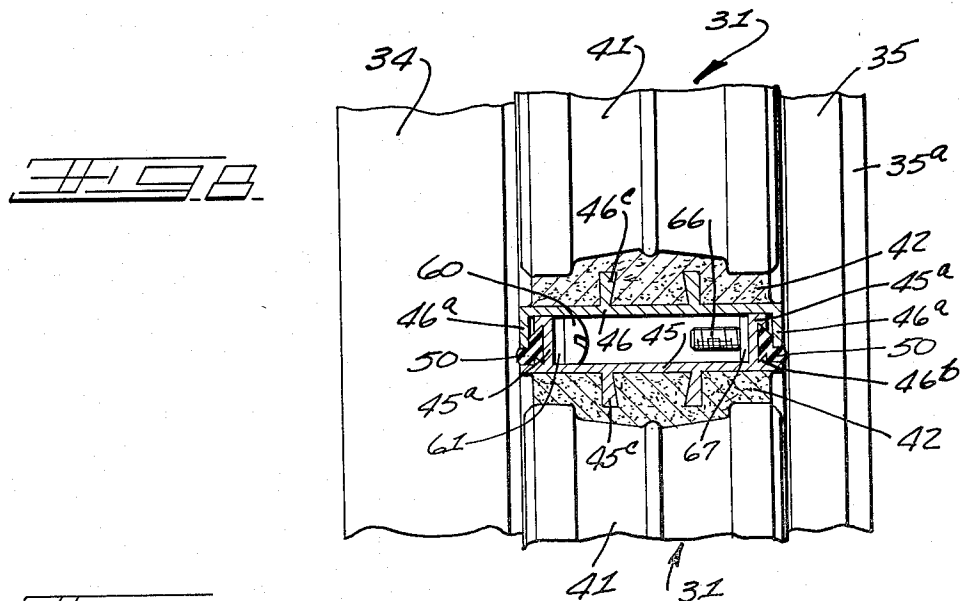
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7 Sheets-Sheet 3



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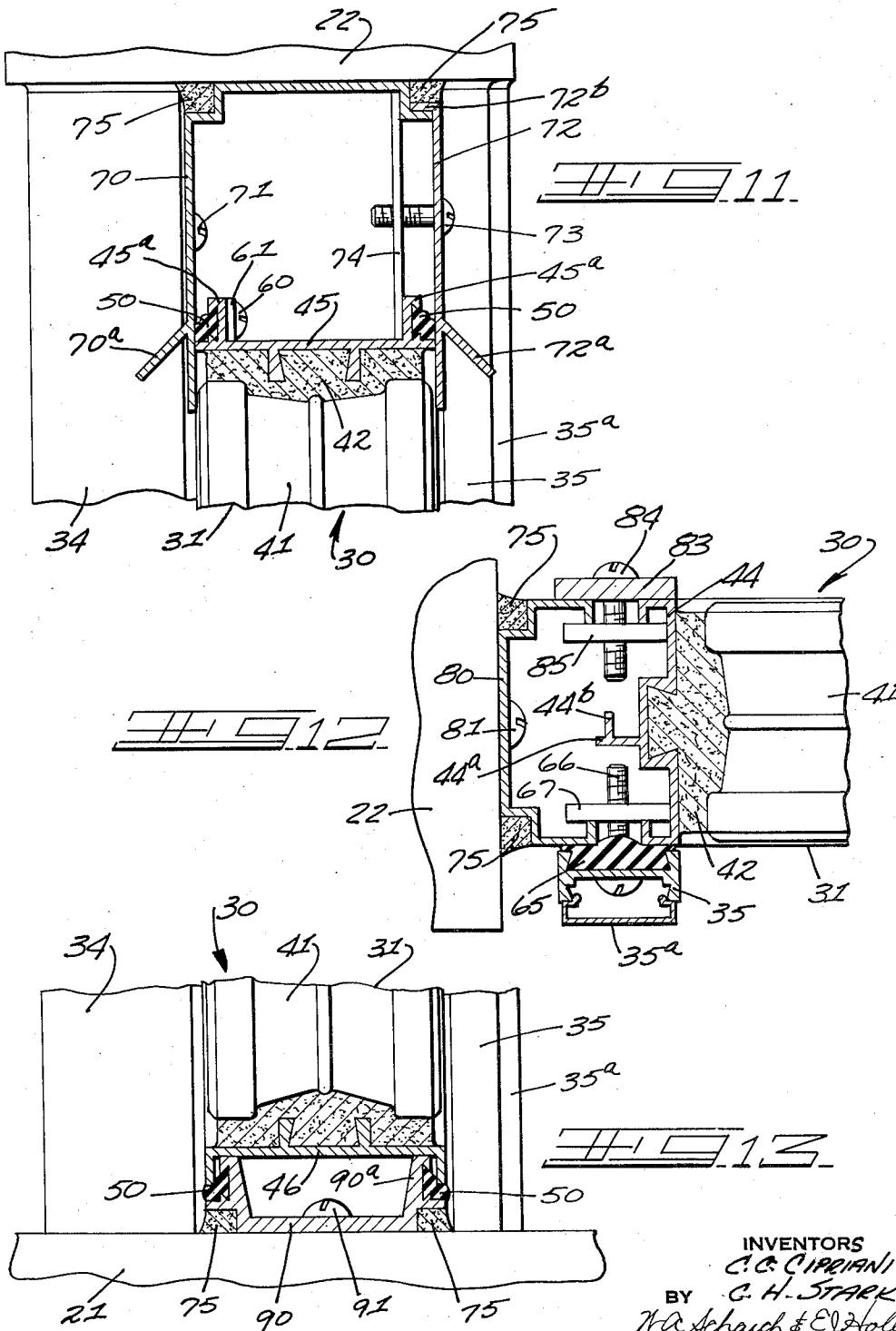
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7 Sheets-Sheet 4



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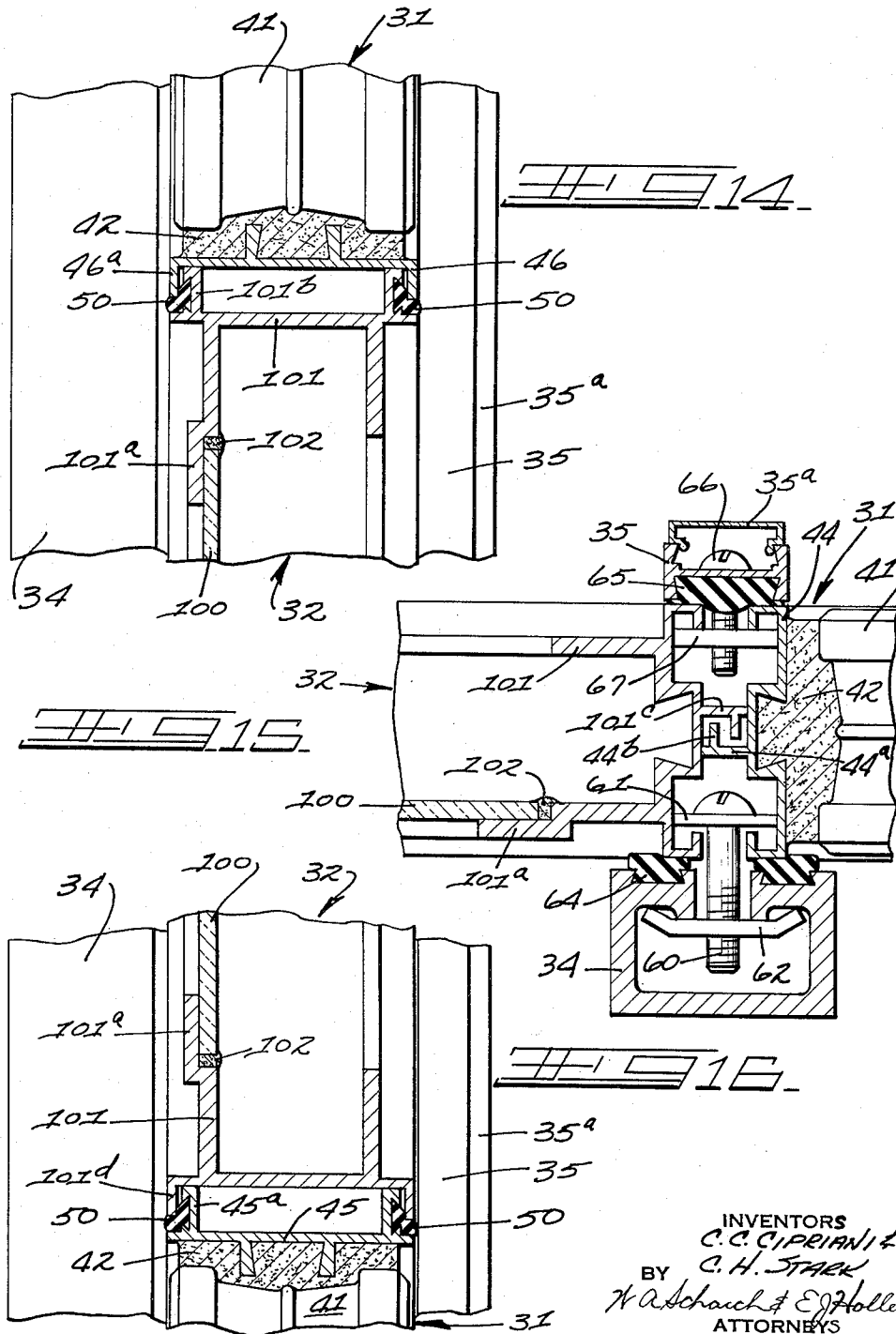
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7 Sheets-Sheet 5



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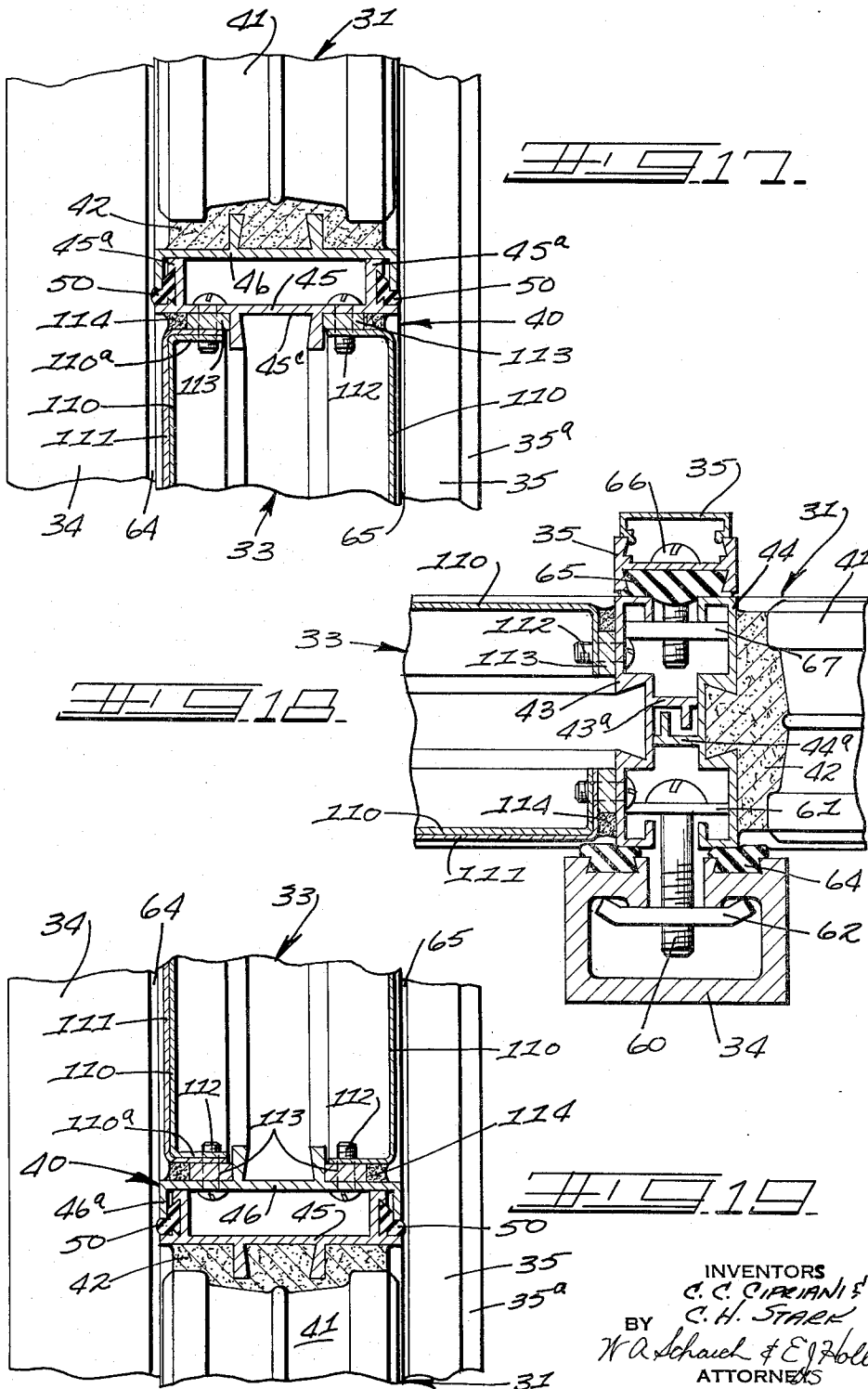
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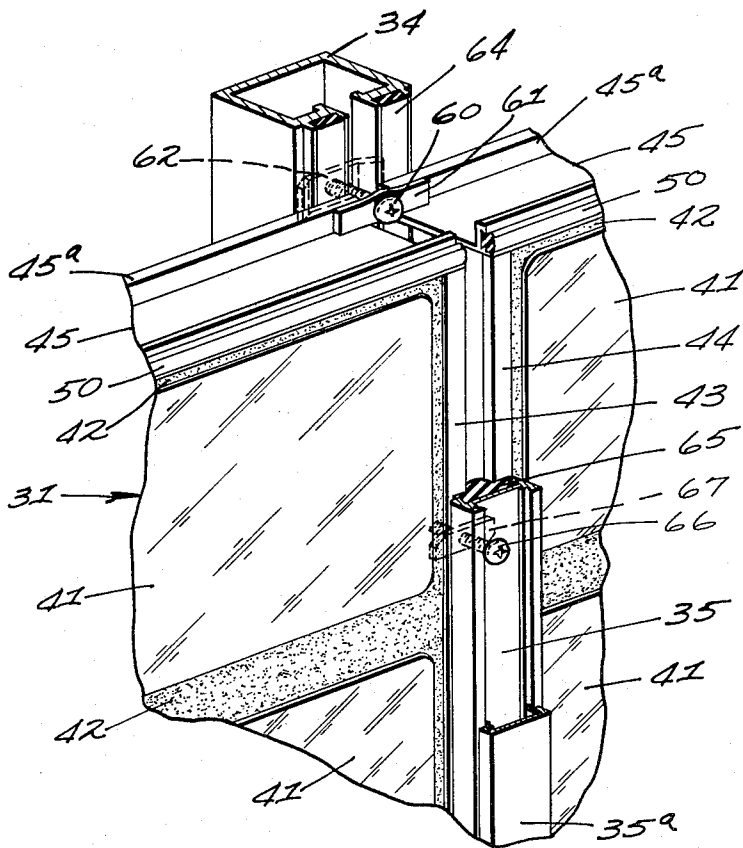
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7 Sheets-Sheet 7



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STRUCTURAL PANEL AND BUILDING WALL CONSTRUCTION UTILIZING SAME

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14 Claims. (Cl. 50—267)

The present invention relates to wall structures and more particularly to a wall structure comprised of panelized units of hollow glass blocks, other light-transmitting materials or opaque sheets of building materials.

The invention broadly relates to the field of constructing buildings and more specifically to a novel building wall formed of a plurality of panel units adapted to curtain wall assembly, the subject construction being especially attractive in appearance and economical to erect, disassemble and maintain.

The subject building wall may be expeditiously erected of prefabricated panels retaining a plurality of hollow glass building blocks, sheet glass windows, or opaque facing sheets, and the individual panels disassembled for reuse or replaced without damage to the retained blocks or other materials employed in their fabrication. The present invention is especially applicable to employing a series of glass blocks permanently retained within a metallic perimeter of distinctive contour.

In present-day building construction masonry costs have increased appreciably to such levels that continued effects have been made to considerably reduce or entirely eliminate this mode of construction as far as practicable. This trend has become particularly obvious in the erection of expansive structures such as business buildings, apartment buildings, hotels, schools, hospitals, and the like where large-size facing sheets of fenestration or opaque materials are widely used.

A number of types of wall units have previously been developed which either are prefabricated as small component parts in the manufacturer's plant for integration and erection on the building location or are fabricated on the building site by pouring plastic or cementitious material between spaced metal wall facing sheets after their erection utilizing the sheets as pouring forms. The resulting walls in the latter case are metal-faced with the interior fill bearing against the full back areas of the sheets. Obviously, this form of construction does not provide for light transmission therethrough and suitable windows and/or ventilators must be additionally provided.

In most forms of curtain wall construction adapted to light-transmission and particularly those which have heretofore employed hollow glass building blocks, the prevention of water vapor penetration and interior collection of moisture primarily due to condensation has presented serious problems difficult of solution in practice. Previously, a fully weather-tight panelized exterior wall sealed against water and moisture penetration has been considered virtually unobtainable in commercial production of curtain wall assemblies utilizing conventional glass blocks, for example. In the event that such seals are temporarily obtained in economically complete structures, such constructions are not expected to and actually do not withstand moisture penetration permanently or for any lengthy period due to inherent tendencies of heavy building walls to settle irregularly and ultimately crack. Additionally, a wall comprised of panel units utilizing metallic members must be capable of conjunctive movement without separation of panel joints to permit thermal expansion and contraction of the wall throughout the temperature range of the particular climate in which the building is located and throughout

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the life of the wall. Not to provide for thermal expansivity throughout widespread temperature variation of from -20° F. to 110° F. for the temperate latitudes, for example, permits joints between adjacent panels to gradually open to the atmosphere allowing the entrance of the elements to adversely effect the wall and interior conditions and to finally result in destruction of the wall. Also the panel units in erected form must employ a minimum amount of through metal between inner and outer wall surfaces to minimize thermal conductance therebetween.

The aforesaid difficulties may be overcome in a building wall construction in a convenient and economical manner by the teachings of this invention. We have provided as a new discovery a curtain wall assembly comprised of prefabricated structural panels joined into an integral structure with all panels having similar interconnecting perimeters which may be efficiently and expeditiously assembled. Furthermore, the subject panels may be employed as exterior building walls, as partition walls within a building to facilitate modification thereto, and for insertion or replacement of doors or windows in walls without damage to or alteration of remaining wall portions. The panels may be used in series in a vertical tier to provide a fully weather-tight exterior wall, no additional caulking or similar weather sealing material being required other than to surround the complete assembly wherever utilized. The panels may be variously employed with their faces providing both inner and outer wall surfaces. The panels may be removed or shifted from one location to another without damage to the blocks or other structure material retained therewithin. The panels are of such size and weight that they may conveniently be handled manually by several erectors in assembling and disassembling the wall. The panels of the assembly are generally designed for use on either a four-foot or five-foot horizontal module and a two-foot vertical module, for example, for manufacturing purposes, although no criticality as to dimensions is intended or implied in this disclosure.

The perimeters of all panels are of equal dimensions and basically alike in that each has distinctive engaging and interlocking features at its edges which are complementary to adjacent contacting panels. Utilizing a plurality of the subject preformed panels to construct a curtain wall with the majority of the panels containing a regular series of light-transmitting and/or light-directing thin glass cells or blocks provides a new type of glass wall that reduces glare and solar heat. Regular or conventional forms of glass blocks are generally unsuitable for use in the present assembly due to their thickness and weight when employed in series. This invention contemplates the use of thinner light-weight units of hollow glass cells which are especially applicable to factory fabrication of curtain wall panels.

The blocks or cells constitute light-weight hollow glass structural members about two inches in thickness, their structural features being fully described in the co-pending patent application of Robert A. Boyd, entitled "Light-Transmitting Wall Block," Serial No. 632,148, filed January 2, 1957, now abandoned, and assigned to the same assignee as the present application. The light-transmitting and directing blocks described in this application have prismatic internal surfaces with the distance between the crowns of opposing prisms being less than the height of the prisms. The blocks are capable of directing transmitted light at angles above the horizontal and rejecting excessive amounts of sunlight striking their faces from high-altitude angles. The blocks are capable of transmitting light interiorly from low altitude angles during fall and winter months. The blocks employ solar-selecting principles which heretofore have never been

utilized in panelized form. The blocks due to their thinness are such that they are not designed for masonry erection by conventional methods into self-supporting exterior walls, but for use in panels fabricated in accordance with this invention.

Accordingly, it is an object of the present invention to provide a novel and improved curtain wall assembly adapted to comprise building walls, the assembly being formed of a plurality of prefabricated panel units having similar peripheral contours, which panels are readily erectable "in situ" in tiered relation to form exterior and interior surfaces of a fully weather-tight wall.

Another object of this invention is to provide a curtain wall construction consisting of a series of structural panels adapted to retain permanently a series of hollow glass blocks, clear window fenestration, or opaque sheet-like facings, each of the panels having essentially the same peripheral contour and dimensions and adapted to economical production methods with their perimeters being complemental and engageable to other panels in edgewise relation, the panels being adapted to ready installation into a highly weatherproof wall.

Another object of this invention is to provide an improved curtain wall comprised of a plurality of rectangular prefabricated panel units stacked in edgewise vertical arrangement and having similar peripheral interconnecting contours retained in erected relation by spaced-apart vertical struts disposed either interiorly or exteriorly of the building wall, the subject curtain wall construction being completely fireproof, adapted to meet existing building code standards and to replace hand-masonry wall construction by its expeditious erection on the building site.

A further object of the present invention is to provide a structural wall panel applicable in series to vertical erection in side-by-side relationship fastened to regularly arranged vertical struts disposed coincidentally with the vertical joints between adjacent connecting panels, the panels providing full inner and outer wall surfaces and having gasketed joints adapted to complete and durable weatherproof sealing.

A still further object of the present invention is to provide a unitary prefabricated structural panel having a rectangular metallic perimeter adapted to curtain wall assembly, which panel is sufficiently light-weight to facilitate its erection in edgewise connecting relation with similarly framed panels without permanent scaffolding, each panel being sufficiently durable to permanently withstand stacking of other panels thereupon to appreciable heights, the retention of the series of panels in a vertical plane being effected by their positive attachment to spaced-apart vertical struts disposed either interiorly or exteriorly of the building in proximal alignment with vertical edges of interlocking panels, the fully fabricated assembly adapted to complete resistance to most severe weather conditions and to furnish long-term durability.

A still further object of this invention is to provide a novel structural wall panel adapted for use with like or unlike panels with all panels having the same peripheral metallic frame comprising complemental telescopic U-shaped channels on the upper and lower exterior edges of the frame and oppositely facing L-shaped flanges on the vertical edge surfaces of the frame, the panel carrying its own gasketing means for consummating sealed horizontal joints and having a continuous inner recess for the retention of solidified mortar to retain a plurality of light-transmitting hollow glass blocks within the panel unit, the panel lending itself to economical fabrication and expedient erection within an original or existing building.

The specific nature of this invention, as well as other objects and advantages thereof, will become apparent to those skilled in the art from the following detailed description, taken in conjunction with the annexed sheets of drawings on which, by way of preferred example only,

are illustrated the preferred embodiments of this invention.

On the accompanying drawings:

FIG. 1 is an elevational view of a building wall employing the subject curtain wall assembly providing both interior and exterior wall surfaces.

FIG. 2 is a top plan view of the curtain wall assembly taken along the line 2—2 of FIG. 1.

FIG. 3 is a view similar to FIG. 2 showing a modification of the invention.

FIG. 4 is an elevational view of a single panelized unit containing a plurality of hollow glass blocks as an example of the unitary structural panel.

FIG. 5 is an enlarged fragmentary horizontal sectional view taken along the line 5—5 of FIG. 4.

FIG. 6 is an enlarged fragmentary vertical sectional view taken along the line 6—6 of FIG. 4.

FIG. 7 is a further enlarged fragmentary sectional view of the upper corner of the panel unit illustrated in FIG. 6.

FIG. 8 is a fragmentary vertical sectional view taken along the line 8—8 of FIG. 1 illustrating a horizontal joint between similar adjacent panels containing hollow glass blocks, the latter not shown in section.

FIG. 9 is a fragmentary horizontal sectional view taken along the line 9—9 of FIG. 1 illustrating a vertical joint between adjacent panels.

FIG. 10 is a fragmentary horizontal sectional view taken along the line 10—10 of FIG. 1 illustrating the panel retention and gasketing arrangement at the interconnecting upper corners of adjacent panels.

FIG. 11 is a fragmentary vertical sectional view taken along the line 11—11 of FIG. 1 showing the head portion of the subject curtain wall assembly where joined to an existing building wall.

FIG. 12 is a view similar to FIG. 11 taken along the line 12—12 of FIG. 1 illustrating a jamb portion of the assembly.

FIG. 13 is a view similar to FIG. 11 taken along the line 13—13 of FIG. 1 illustrating a sill portion of the curtain wall assembly.

FIG. 14 is a fragmentary vertical sectional view taken along the line 14—14 of FIG. 1 illustrating the horizontal upper joint between glass block type and clear fenestration type panels.

FIG. 15 is a fragmentary horizontal sectional view similar to FIG. 14 taken along the line 15—15 of FIG. 1 of the vertical joint between such panels.

FIG. 16 is a fragmentary vertical sectional view similar to FIG. 14 taken along the line 16—16 of FIG. 1 illustrating the horizontal lower joint between such panels.

FIG. 17 is a fragmentary vertical sectional view taken along the line 17—17 of FIG. 1 showing the horizontal upper joint between glass block type and opaque facing type panels.

FIG. 18 is a fragmentary horizontal sectional view similar to FIG. 17 taken along the line 18—18 of FIG. 1.

FIG. 19 is a fragmentary vertical sectional view also similar to FIG. 17 taken along the line 19—19 of FIG. 1.

FIG. 20 is a perspective view illustrating two similar glass block type panels in erected form.

While the present invention will be described hereinafter as specifically relating to the manufacture of novel prefabricated structural wall panels of several specific forms, it will be readily apparent to those skilled in the art that the principles of the invention are equally applicable to the manufacture of any size or shape of panelized unit employing the prescribed peripheral frame which is adapted to erection with other similarly framed panels for installation as the subject permanently aligned and positively interlocking curtain wall construction.

Multi-storied buildings of the types to which the panels and wall structure of the present invention are especially applicable conventionally comprise the usual load-bearing upright columns and structural steel spandrels such as

I-beams which may be encased in concrete extending between the columns for supporting concrete or other types of flooring. The actual form and dimensions of the load-bearing structural elements of the building are well-known and do not specifically comprise the subject matter of this invention. Our invention pertains to curtain walls which generally bear at least a part of their own weight as erected in tiered relation and do not normally carry the weight of the building, its upper floors or roof.

Referring now to the drawings, certain sidewall portions of the building 20 as shown in FIG. 1 may be formed of conventional walls indicated by the numeral 22, which sidewalls may surround a vertical opening in an existing building or may provide an original expanse in a new building for installation of the subject curtain wall therewithin. Similarly, it is to be fully understood that the subject curtain wall may be employed to form all of the original walls of a new structure, however, only for purposes of describing the invention does the present specification relate to its adaptation to an existing structure.

As illustrated in FIG. 1, a plurality of building wall panel units is employed to form a curtain wall designated by the numeral 30. The curtain wall 30 fully encloses the expanse within conventional building walls 22. Each individual panel of the curtain wall 30 is formed with a rectangular metallic frame surrounding a series of uniformly-spaced hollow glass blocks, one or more sheets of transparent material such as glass to provide fenestration, or one or more facing sheets such as porcelainized sheet metal to provide a panel having opaque face planes. Each panel possesses the properties of being both moisture proof and water impermeable interiorly of its metal perimeter and exhibits features of being thermally insulating due to a minimal amount of heat-conductive material employed in its fabrication.

The joints between adjacent rectangular panels which reside in horizontal and vertical lines are fully gasketed to provide weather-tight seals. All joints are capable of excluding adverse weather conditions such as snow, rain, wind, hail, and even rain driven by winds of hurricane force. The space interior of all fully-sealed joints is interconnected to facilitate the removal of moisture, water or water vapor. The sealed interconnecting interior passageways which extend through the joints in both vertical and horizontal directions exist between the series of contacting panels to provide adequate interior ventilation of the panel joints for the removal of moisture and/or water should any leakage of an exposed exterior face of the curtain wall temporarily occur.

Referring to FIG. 1 as a typical installation of the subject curtain wall 30 employing several basic types of wall panels each having distinctively different forming characteristics, but all possessing the same peripheral frame contour for their mounting in interlocking arrangement, each of the panels which are designated by the numeral 31 contain hollow glass blocks or cells of essentially square dimensions which blocks have properties of being light-transmitting and/or light-directing. Each of the panels which contain clear sheets of transparent material such as glass or plastic are designated by the numeral 32 and the panels containing opaque metal or vitreous facings by the numeral 33. Panels 31 each contain hollow glass building blocks which are considerably thinner than any existing forms and serve as light gathering and directing fenestration may be either transparent, translucent or colored. The plurality of blocks contained within a given panel 31 may all be similar in appearance and in light-transmitting properties or varied as to color and/or light-directing features to produce distinctive colored patterns within a given panel. Each of the panels 32 contain at least one pane of window glass, plate glass, or plastic sheet to furnish a ventilator and/or viewing window. Each of the panels 33 have

sheet metal facing retained within its frame which facing may be porcelain covered, painted or enameled to furnish a particularly pleasing coloration to opaque portions of the wall structure.

Building 20 has a horizontal sill 21 for supporting the subject curtain wall 30 and conventional brick, masonry, or other forms of sidewalls 22. As shown in FIG. 1, the lower row of glass block panels 31 are erected in side-by-side relation in the same horizontal plane resting on the building sill or foundation 21 and the next row of panels 31 and 33 are supported in edgewise position on the lower row to create a vertical tier. The third row of panels 31 and 32 are supported by the second row of panels 31 and 33. All panels 31, 32, and 33 are attached to upright stud-like members 34.

A series of vertical struts or mullions 34 are mounted in essentially a common vertical plane extending between sill 21 and the overhead portion of wall 22 near the uppermost area of curtain wall assembly 30. Each strut 34 is firmly fixed at its ends to the sill and wall and is sufficiently rigid to maintain its wall supporting surface in permanent alignment in a vertical plane with like members while in service.

Each strut 34 is preferably a hollow U-shaped member such as those referred to as "Unistrut" having a continuous lengthwise opening or recess facing its supporting surface. Panels 31, 32 and 33 are mounted in tiered relationship fastened against the supporting surfaces of the series of struts 34. Struts 34 are arranged in uniformly spaced-apart location with their lineal axes in alignment with the vertical joints between adjacent panels in the same horizontal row. Thus, the spacing between vertical struts 34 is essentially equivalent to the horizontal modular of similarly framed panels 31, 32 and 33.

As shown in FIG. 2, struts 34 may all be located on one side of the wall such as the exterior indicated by the letter "O," for example. Alternatively, as shown in FIG. 3, a number of struts 34 may be located interiorly as indicated by the letter "I" with one or more struts 34 disposed exteriorly of the building on side "O." Any desired alternating arrangement of struts 34 may be employed on one or both sides of the wall to enhance the appearance of the curtain wall assembly 30 and to achieve distinctive architectural effects. The supporting surface of each strut 34 is placed in alignment with either the inner or outer surface of the vertical joints. Struts 34 serve to retain the series of panels 31, 32 and 33 in upright tiered relation by fastening elements engageable therewith which penetrate their longitudinal openings. The fastening elements are preferably disposed at intersecting corners of adjacent panels. Struts 34 also serve to seal one side of the vertical joints.

Lineal batten elements 35 which carry resilient gasketing material to further weatherproof the joints between adjacent panels are arranged on the opposite side of the panel joints from each individual strut 34 as shown in FIGS. 2 and 3. Batten elements 35 which are employed with supporting struts 34 may also be employed interiorly or exteriorly of the building in opposing relationship from the vertical struts to seal the particular side of the joints to which applied. Struts 34 have a considerably greater depth of section than batten strips 35 to perform the function of supporting the panels units in upright edge-to-edge arrangement without undue deformation of the wall during its life. Batten elements 35 do not serve to retain the panels upright but to conform to and complete the sealing of the vertical joints. The batten elements may be employed on one or both sides of the vertical joints as desired, two such strips being disposed at the vertical sides of assembly 30 adjacent to jamb areas of building walls 22.

As shown in FIG. 4, panel 31 has a rectangular shape with a peripheral metallic frame 40 of uniform thickness enclosing a plurality of hollow glass blocks 41 hav-

ing generally equal face panel dimensions. Blocks 41 are disposed within the frame 40 in uniformly spaced-apart relation with an interconnecting gridwork of solidified mortar or cementitious material 42 bonding the sides of adjacent blocks 41 to each other and to the inner surfaces of peripheral frame 40. Blocks 41 which are employed within panel 31 are essentially square and have an approximate thickness of two inches, which dimension is essentially half the thickness of ordinary glass blocks. The blocks may measure about 12 inches on a side although these dimensions are in no way critical in practicing the present invention.

One method of fabricating such panels has been fully disclosed in the copending patent application of Russell, Stark, and Theisen, entitled "Method and Apparatus for Fabricating Glass Block Panels," Serial No. 700,205, filed December 2, 1957, and assigned to the same assignee as the present application. This application fully discloses fabrication of panels containing thin hollow glass blocks by utilization of a rapidly setting mortar or cement adapted to positively and durably bond metal frame 40 and the side surfaces of hollow glass blocks 41 to each other. The mortar completely fills the interconnecting voids between the blocks and surrounding frame and in completed form is fully tuck-pointed at its exposed surfaces to provide uniform sealed joints between component parts of the panel. The mortar joints may be of uniform width as shown in FIG. 4 or varied extensively as shown in FIG. 20.

As shown in FIGS. 4, 5, 6 and 7, panel 31 has a different contour on each of its four exterior sides. The vertical edges consist of framing members 43 and 44 and the horizontal edges of members 45 and 46. The right-hand side of panel 31 (FIGS. 4 and 5) consists of framing member 43 having outwardly and transversely extending L-shaped flange portions 43a and 43b in a medial portion thereof. The leg portions 43a and 43b which constitute the integral flanges extend throughout the length of member 43, being shown in section in FIG. 5. Leg portion 43b extends transversely through the axial plane of the panel 31. The inner surface of framing member 43 has a dovetailed recess 43c extending coextensively with its length adapted to receive and durably retain solidified mortar 42 for durable joinder of glass blocks 41 to frame 40. Member 43 thus furnishes one vertical edge of panel 31. An opening 43d may be provided in a central region of member 43 to facilitate its fabrication by the introduction of fluidized mortar therethrough in a manner such as disclosed in the referred to patent application, Serial No. 700,205, while the blocks and frame are retained by suitable apparatus.

The other vertical edge of metallic frame 40 consists of framing member 44 as shown in FIGS. 4 and 5 having exteriorly extending coextensive right-angled flange portions 44a and 44b in a medial region in oppositely disposed arrangement from similar flange portions 43a and 43b. The interior surface of member 44 is also provided with a continuous dovetailed recess 44c for the reception and permanent retention of solidified mortar 42.

As illustrated in FIGS. 4, 6 and 7 horizontally extending framing members 45 and 46 furnish the upper and lower edge surfaces of panel frame 40. Frame members 45 and 46 comprise complemental telescoping U-shaped channels having twin right-angled flanges 45a and 46a respectively extending exteriorly. Upper flange member 45 is provided with a pair of dovetailed exteriorly facing recesses 45b arranged within and perpendicular to upstanding flanges 45a. Twin coextensive dovetailed areas 45c and 46c extend interiorly from framing members 46 and 45 respectively having an internal contour comparable to vertical recesses 43c and 44c of members 43 and 44 adapted to receive the mortar 42 to bond the enclosed blocks 41 and frame 40 together into a unitary durable rigid structure.

The upper portion of framing member 45 is shown in

section in FIGS. 6 and 7 having two lineal strips 50 of resilient gasketing material such as rubber or plastic retained within the dovetailed areas 45b for weathersealing both sides of the horizontal joints of the wall as described below. The twin strips 50 are preferably carried by each panel and extend coextensively with its upper corner regions. FIG. 7 shows in an enlarged sectional view the preferred contour of a single resilient gasketing strip 50 and the manner in which it is retained within exteriorly facing recess 45b of upstanding flange 45a.

Referring to FIG. 8 of the drawings which consists of a vertical sectional view between similar glass block containing panels 31, upper and lower framing members 45 and 46 engage telescopically to form a horizontal joint between adjacent and interconnecting panels 31 in erected arrangement. The upwardly extending twin flanges 45a of the lower panel interiorly support the downwardly facing inner surface of U-shaped channel member 46. Frame member 46 has a greater width between its flanges 46a than lower flanges 45a of member 45 for telescopic assembly of the channeled members into positive engagement when erected vertically. Flanges 45a have a greater depth of section than flanges 46a for supporting the base portion of member 46 internally. Framing member 46 surrounds and essentially covers the flanged portion of member 45 in joined relation therewith to offer improved weatherproof sealing.

The two lineal strips 50 of resilient gasketing material which are retained by the dovetailed recesses 45b of member 45 are compressed between flanges 46a and the base portion of member 45 to compact each strip therebetween with prescribed loading. Its outer surfaces are distended exteriorly to completely seal the horizontal joint. Interior surfaces of strips 50 are positively held in place by uniform compression with the weight of upper panels being carried by the upper edges of flange portions 45a. A single strip 50 of gasketing material may be employed facing the exterior surface of the panels 31 or twin strips 50 as shown in FIG. 8 may preferably be retained within both exposed areas of the joint to provide complete weatherseal of inner and outer surfaces of the horizontal joint. Strips 50 may be inserted into frame member 45 immediately following panel fabrication and be carried therewith as an integral part thereof for sealing erection of the panels on the building site, or alternately the strips 50 may be affixed thereto immediately prior to assembly of the curtain wall 30.

As shown in FIGS. 9 and 10 the contacting panels 31 which are arranged in side-by-side relation are joined to vertical strut 34 by a fastening bolt 60 and small connecting members 61 and 62 which will be described more fully hereinafter. Twin vertical strips 64 of resilient gasketing material are retained by the supporting face of strut 34 within two dove-tailed areas 34a (FIGS. 9 and 10). Strips 64 extend contiguous with the strut on both sides of its lineal opening to seat and seal the panel edges on one side of the vertical joints.

On the opposite side from strut 34 batten strip 35 is utilized having a resilient strip 65 of gasketing material carried coextensively therewith to contact the other side of the vertical joint and the adjacent panel edges. Strips 64 and 65 carried by struts 34 and batten elements 35 respectively extend throughout the full vertical height of the wall assembly 30 to seal both sides of vertical joints by contacting the edges of near and parallel vertical framing members 43 and 44 of two interlocking panels 31.

FIG. 9 shows a typical vertical joint between adjacent panels 31 having their respective framing members 43 and 44 in interlocking relation. The L-shaped vertical flange portions of the two panels 31 are assembled in engaging contact with leg portions 43a and 44a of the flanges which extend in the same axial plane as the panels limiting their near relationship and the transverse flange portions 43b and 44b of the flanges in connect-

ing arrangement adapted to limit lateral movement of the panels relative to each other. Thus, the several panels 31 have vertical joints adapted to facilitate limited expansivity. Expansion and contraction of vertical joints is thereby controlled by the locking contour of inter-connecting L-shaped flanges 43b and 44b and the clearance permitted between outermost areas of the axial leg portions 43a and 44a of the flanges. Batten strips 35 which are essentially rectangular in cross section and carry sealing strip 65 are fastened at spaced intervals to corner areas of framing members 43 and 44 respectively. Strip 35 is connected to near panel edges by a threaded bolt 66 which interconnects with a small cross member 67 which is of such width as to be fitted interiorly within inner recessed areas of framing members 43 and 44 and then rotated through a right-angle into locked relation. The exterior of batten strip 35 may be covered by a cover plate 35a fitted in place thereover and extending coextensively so that bolts 66 are unexposed.

As shown in FIG. 10 horizontal and vertical gasketing strips 50 and 65 which are employed on the side of the wall having batten strip 35 affixed thereto are adapted to furnish weatherproof sealing at the corners of the panel which may tend to become open on slight shifting or movement of panel units due to atmospheric changes. Strips 50 have a higher durometer hardness than strip 65, the latter being composed of sponge rubber of durometer 30 or lower and the former of durometer 50 or more. In FIG. 10 the retention means which consists of bolt 60 and twin cross members 61 and 62 is shown in fastened arrangement between two adjacent panels 31 with one cross member 61 contacting the inner surfaces of upwardly extending flanges 45a of the two interlocking panels. Bolt 60 is connected to a threaded opening in cross member 62. Both members 61 and 62 are sufficiently narrow to pass between near flanges 45 of the two panels and the opening in strut 34. When bolt 60 is drawn tight cross member 62 seats within vertical strut 34 and member 61 is drawn tight against the inner surfaces of upstanding flanges 45a by the bolt head. Member 62 is sufficiently narrow to permit its insertion within the longitudinal opening in strut 34. By angular movement through a right angle it is located in locking arrangement. Member 61 is of lesser width than the height of flange 45a to provide clearance for full telescopic engagement of U-shaped channels 45 and 46.

The locking arrangement of retainer bolt 60 and its cross arms 61 and 62 is shown in perspective in FIG. 20 with similar panels 31 firmly held against strut 34. Intersecting gasketing strips 50 and 64 are drawn into compressed relation when bolt 60 is tightened in place against members 61 and 62. Strips 50 have a higher durometer hardness than strips 64, the latter preferably being composed of sponge rubber of durometer 30 or lower, so that the horizontal and vertical gasket strips contact and conform to each other in sealing relation.

The wall 30 is assembled by connecting bolt 60 and clamping plate 61 to the upper corners of each pair of adjacent panels 31, 32, and/or 33 during erection of each horizontal row. Bolt 60 is located at each intersecting corner of four panels to retain both the several panels in the row below to which it is positively connected by plate 61 and the row next above consisting of two panels fitted into engaging contact with framing members 45 of the two lower panels.

After all panels 31, 32 and 33 are erected in retained relationship held against struts 34 with cross gasketing strips 50 and 64 compressed, batten elements 35 are connected to the open areas of the vertical joints on the opposite side from struts 34. As shown in FIG. 20 a fastening element consisting of bolt 66 and a narrow cross member 67 is used to compress the resilient strip 65 between the batten and the adjacent vertical edges of panel frame members 43 and 44. Cover plate 35a may be telescopically snapped in place within an exterior re-

cess of batten 35 to cover the fastening means and present an improved appearance to the joint.

At any time subsequent to erection of the curtain wall should leakage of either horizontal or vertical joints develop, batten strips 35 may be tightened by taking up bolts 66 or the batten strips may be first removed and retention bolts 60 retightened with all panels in place to further compress the resilient sealing strips after which batten strips 35 are replaced and again resealed.

As shown in FIG. 11, the head portion of the curtain wall assembly 30 terminates in near relationship to upper enclosing wall 22. The upper portion of glass block panel 31 having upper framing member 45 is contacted by an L-shaped member 70 fitted into the corner portion between wall 22 and vertical strut 34 and extends below member 45. Member 70 is retained in place by a plurality of bolts 71 threaded into a clamping member similar to cross member 62 disposed interiorly of strut 34. The lower portion of L-shaped member 70 has an outwardly and downwardly extending flashing section 70a to weatherproof the upper area of panel 31 adjacent to gasket strip 50. The upper corners of two adjacent panels may be held in place by bolt 60 and twin cross members 61 and 62 as described above after head member 70 is installed. The upper portion of L-shaped member 70 may be sealed with caulking material 75 on both its interior and exterior surfaces. The opposite side of the joint from member 70 is enclosed by a head plate 72 having a short flange 72b on its upper end interconnecting with member 70. Member 72 also has an outwardly and downwardly extending flashing section 72a adjacent to the other resilient strip 50. Member 72 is held in place by bolt 73 engaging a threaded opening in vertical cross member 74 held firmly against the inner surfaces of head member 70 and upwardly extending panel flange 45a. Batten strip 35 and cover plate 35a are employed exteriorly of head member 72 in areas where flashing section 72a is interrupted to facilitate its insertion. Head members 70 and 72 are sealed at the vertical joints by gasket strips 64 and 65 carried by strut 34 and batten 35.

The jamb portion of the curtain wall assembly 30 is sealed at an edge portion of panel 31 in near relationship to vertical wall 22 as shown in FIG. 12. A U-shaped channel 80 is fastened to wall 22 in vertical arrangement by bolts 81. Jamb member 80 is essentially equal in width to the panel thickness. One side of the joint is sealed by a longitudinal bar 83 and spaced-apart bolts 84 interconnecting with cross members 85. Each cross member 85 contacts the inner surfaces of corner flanges of both jamb member 80 and the panel frame member 44. Batten member 35 is connected at spaced intervals to the other side of jamb member 80 and frame member 44 by bolts 66 and cross members 67 adapted to compress the gasketing strips 65 therebetween. Cover plate 35a as described may be placed over batten strip 35.

The sill portion of the curtain wall is provided with a shallow U-shaped member 90 firmly secured to the sill 21 by bolts 91 with upstanding flange portions 90a retaining a pair of resilient gasket strips 50. The lower frame member 46 of panel 31 is adapted to seating on the upstanding flanges of sill member 90 for sealing engagement of the curtain wall assembly 30 at its base. Caulking material 75 may be similarly employed at inner and outer areas of the sill member 90 to seal fully the assembly base.

As shown in FIG. 14 a window panel 32 containing a sheet 100 of transparent material is employed within panel frame 101. The upper portion of frame 101 consists of a U-shaped channel having a pair of upstanding flanges 101b similar to frame member 45 containing a pair of gasket strips 50. The lower channel member 46 of glass block panel 31 mounted above window panel 32 is joined in sealing relationship therewith in a manner similar to which two glass block panels 31 are joined. The window member may either be cemented in place by

glazing material 102 or the window may be operable as a ventilator to be opened as desired. Window 100 is shown glazed in place against framing portion 101a extending interiorly of frame 101. Panel 32 may either have a single sheet 100 of fenestration or a pair of transparent sheets in spaced-apart relation.

The vertical joint portion of the clear fenestration containing panel 32 joined to glass block containing panel 31 is shown in FIG. 15. The vertical edge portion of frame 101 has an inwardly extending flange portion 101a adapted to receive and retain the sheet of clear material 100 held in place by glazing material 102. The outer vertical edge of frame 101 consists of an L-shaped flange 101c having a contour complementary to L-shaped flanges 44a and 44b of panel 31. Panels 31 and 32 have essentially the same peripheral contour and are adapted to be restrained conjunctively against strut 34 by fastening bolt 60 and cross members 61 and 62 contacting upper portions of the two panels and the interior portion of strut 34 respectively. Batten strip 35 carrying gasketing layer 65 is held against the other side of the joint by bolt 66 which engages cross member 67 interiorly of the panel frames.

The lower portion of the panel 32 which consists of framing member 101 has an interiorly extending flange portion 101a and a downwardly extending U-shaped channel portion 101d complementary in contour to framing member 46 of panel 31. Channel portion 101d thus contacts the upper U-shaped channel 45 of panel 31 and is seated thereon compressing resilient strips 50 as described above.

As shown in FIGS. 17, 18 and 19 opaque panels 33 utilize the same rectangular peripheral frame 40 as glass block panels 31. The upper edge of frame 40 is comprised of framing member 45 having upstanding flanges 45a and gasket strips 50. Within the interior of frame 40 is fastened an opaque facing panel 110 consisting of sheet metal faced with an enameled or vitreous coating 111. Panels 110 have inwardly directed right-angled flanges 110a extending around their periphery which are held in place within frame 40 by bolts 112 and spacing members 113. Panels 110 are shown coated with a distinctively colored enamel 111 on one exterior side of panel 33 and uncoated on the other side in FIG. 17. Exposed areas between the facing panel edges and metallic frame 40 are sealed with a suitable caulking material 114 on both sides of panel unit 33.

As shown in FIG. 18, the vertical side surfaces of panel 33 comprise framing members 43 and 44 which are adapted to interconnect with oppositely disposed complementary framing members of panels 31. As shown in FIG. 19 the lower edge surface of panel 33 is comprised of channel member 46 adapted to engage and be supported by channel member 45 on the upper edge of panel unit 31. Thus, non-transparent panel 33 is fully moistureproof within perimeter 40. Sheets of thermal insulating material such as fiber glass or rock wool may be inserted between the twin facing panels 110. Thus, each panel unit 33 has the same perimeter for interlocking engagement with other panels 31 or 32.

Extensive weathering tests have shown the durability of the panels and a curtain wall fabricated therefrom. Experimental structures comprising the features of this invention have been subjected to weather tests simulating hurricane conditions without leakage of the joints or undue deviation of the wall from its vertical alignment either temporarily or permanently. Individual panels have been subjected to various loading tests without damage or deformation.

Various modifications may be resorted to within the spirit and scope of the appended claims.

We claim:

1. In a building structure, a curtain wall assembly providing inner and outer wall surfaces comprising a plurality of structural panel units disposed in side-by-side

relationship in a vertical tier, each of said panel units having an integral rectangular peripheral metallic frame, said frame having shallow U-shaped channels of complementary telescoping contour on its top and bottom exterior surfaces and oppositely-facing L-shaped flanges on its exterior side surfaces, both said channels and flanges adapted to engage and interlock with contiguous edge portions of adjacent panels, a series of the hollow struts vertically disposed adjacent and in alignment with the proximal vertical edges of the tiered panel units, and fastening means internally engaging said hollow struts adapted to retain upper corner portions of each panel unit in vertical alignment, said channels and said flanges extending substantially coextensive with the horizontal and vertical surfaces of each frame for telescopic and locking engagement respectively with adjacent similar panel frames.

2. In a building structure, a curtain wall assembly in accordance with claim 1, including resilient gasketing means horizontally disposed and retained between exteriorly facing areas of said telescoping channels of contacting panel frames being coextensive therewith adapted to weatherseal the horizontal joint between adjacent panel units.

3. In a building structure, a curtain wall assembly in accordance with claim 2, including lineal batten strips carrying coextensive gasketing material of different resilience from said horizontal gasketing material, said batten strips being oppositely disposed from and in vertical alignment with said hollow studs adapted to weatherseal one side of the vertical joint between adjacent panel units.

4. In a building structure, a curtain wall assembly in accordance with claim 1, wherein each of said hollow struts has a U-shaped cross-sectional configuration with a longitudinal opening on its supporting surface, and a pair of lineal strips of resilient gasketing material on opposite sides of said opening adapted to contact and engage vertical edges of two adjacent panel units to weatherseal the vertical joint of one wall surface.

5. In a building structure, a curtain wall assembly in accordance with claim 1, wherein each of said vertical struts comprises a hollow member having a longitudinal opening facing the supported vertical edge surfaces of adjacent panel units, and said fastening means comprises a threaded bolt member and a pair of retention plates at least one having a lesser width than said opening for engaging internal surfaces of said strut and flanged surfaces at the upper corners of adjacent panel units for their positive retention.

6. In a building structure, the curtain wall assembly in accordance with claim 1, wherein the majority of said panel units each comprise a series of light-transmitting hollow glass blocks having a thickness of about two inches arranged in uniformly spaced-apart relationship within the said peripheral metallic frame of substantially equal thickness by a solidified gridwork of cementitious material.

7. In a building structure, the curtain wall assembly in accordance with claim 1, wherein the majority of said panel units comprise a series of light-transmitting and light-directing hollow glass blocks about two inches in thickness retained within said metallic frame in uniformly spaced-apart relation by a solidified gridwork of cementitious material adhered to the side surfaces of said blocks and frame, and a minority of said panel units contain at least one sheet of light-transmitting fenestration essentially coplanar with one face plane of said hollow glass blocks in the majority of said panels.

8. In a building structure, the curtain wall assembly in accordance with claim 1, wherein the majority of said panel units comprise a series of light-transmitting and light-directing hollow glass blocks about two inches in thickness retained within said metallic frame in uniformly spaced-apart relation by a solidified gridwork of cementitious material adhered to the side surfaces of said

blocks and frame, and a minority of said panel units contain twin facing sheets of light-opaque material essentially coplanar with the face planes of said hollow glass blocks in the majority of said panels.

9. As a new article of manufacture, a structural wall panel for curtain wall assembly having inner and outer wall surfaces comprising a rectangular peripheral metallic frame surrounding weatherproof structural material, said frame having a uniform thickness with at least one continuous dove-tailed channel extending around its interior surfaces adapted to retain solidified cementitious material, the top and bottom exterior surfaces of said frame having shallow U-shaped channels of complementary telescoping contour and the side exterior surfaces of said frame having L-shaped flanges disposed in a medial region in oppositely facing relation.

10. The structural wall panel for curtain wall assembly defined in claim 9, wherein the U-shaped channel extending downwardly from said bottom exterior surface comprises a greater cross-sectional width than the U-shaped channel extending upwardly from said top exterior surface for telescopic engagement of two or more similarly framed panel units in vertical tiered arrangement.

11. The structural wall panel for curtain wall assembly defined in claim 9, wherein the L-shaped flanges extending exteriorly from the vertical side surfaces of said frame comprise right-angled ribs having their transversely projecting leg portions extending through the axial plane of said panel for positive engagement of two or more panel units in horizontal arrangement.

12. The structural wall panel for curtain wall assembly defined in claim 9, wherein the U-shaped channels and the L-shaped flanges on the exterior surfaces of said frame extend throughout the horizontal and vertical dimensions respectively of said panel.

13. The structural wall panel for curtain wall assembly defined in claim 9, wherein each upwardly projecting leg portion of the U-shaped channel on the top surface of said frame has an exteriorly facing dove-tailed recess and a

coextensive lineal strip of resilient gasketing material retained within said recess adapted to uniform compressive loading into a weather-tight seal on telescoping of flanged portions of two tiered panels.

14. As a new article of manufacture, a structural wall panel for curtain wall assembly having inner and outer wall surfaces comprising a rectangular peripheral metallic frame, a series of hollow glass blocks having light-transmitting and light-directing properties interiorly disposed within said frame in essentially uniform spaced-apart relation, said blocks and frame being of essentially equal thickness, an interconnecting gridwork of solidified cementitious material retaining said glass blocks within said frame, said frame having a continuous dove-tailed recess extending around its interior surfaces containing solidified cementitious material for integrally bonding said blocks to said frame, the top and bottom edge surfaces of said frame having shallow U-shaped channels of complementary telescopic contour and the side edge surfaces of said frame having right-angled L-shaped flanges disposed in a medial region thereof in oppositely facing relation.

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