

March 27, 1962

K. G. LUSHER ET AL

3,026,575

SKYLIGHT STRUCTURE AND METHOD OF FABRICATION

Filed Nov. 27, 1957

4 Sheets-Sheet 1

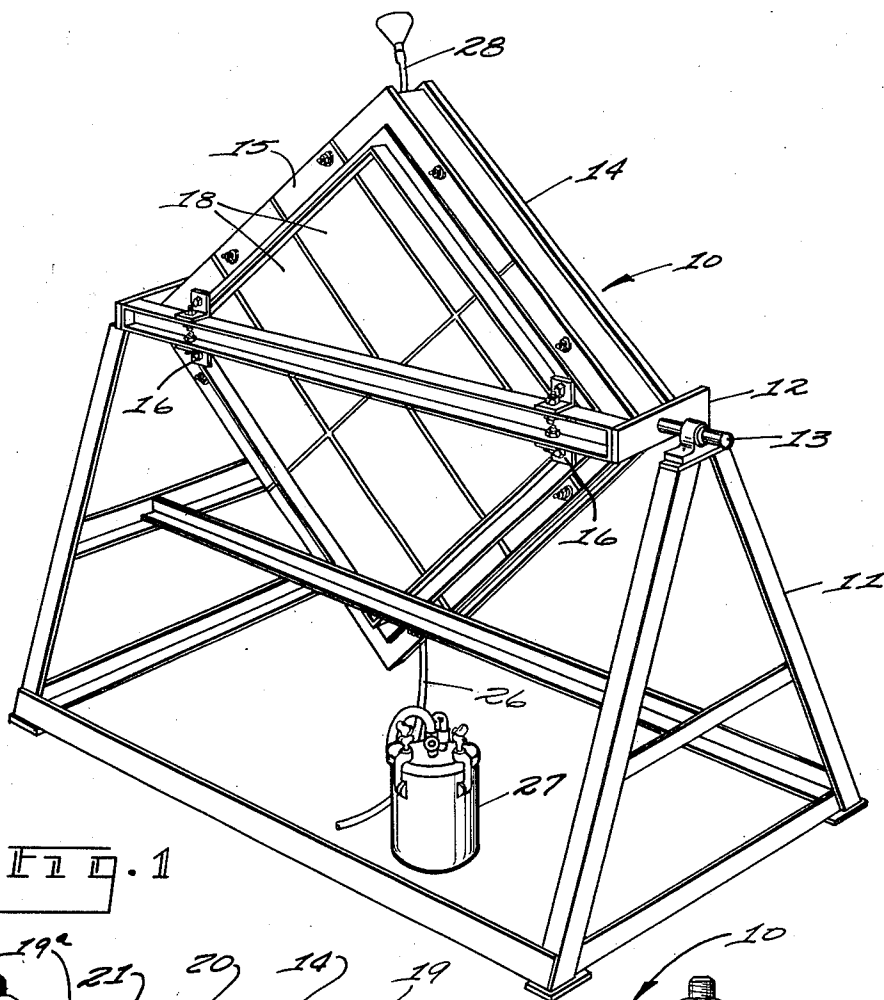


FIG. 1

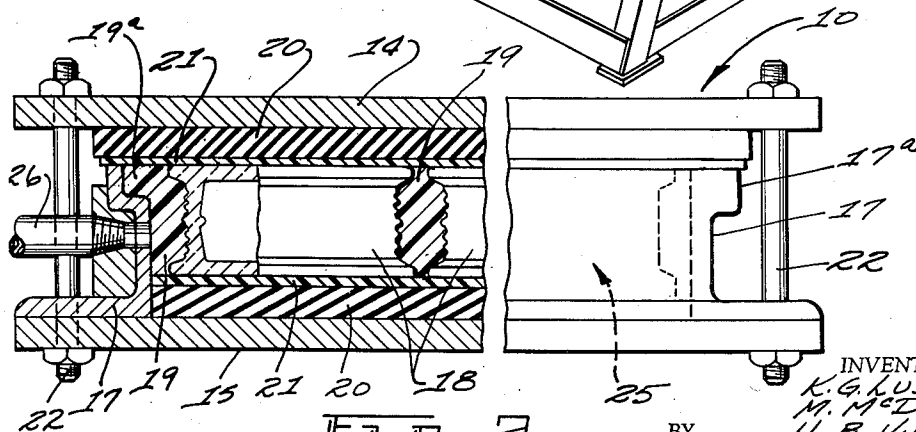


FIG. 2

BY

INVENTORS
K. G. LUSHER
M. McDAVITT
H. B. VINCENT
E. J. HOLLER &
W. A. SCHAICH
ATTORNEYS

March 27, 1962

K. G. LUSHER ET AL

3,026,575

SKYLIGHT STRUCTURE AND METHOD OF FABRICATION

Filed Nov. 27, 1957

4 Sheets-Sheet 2

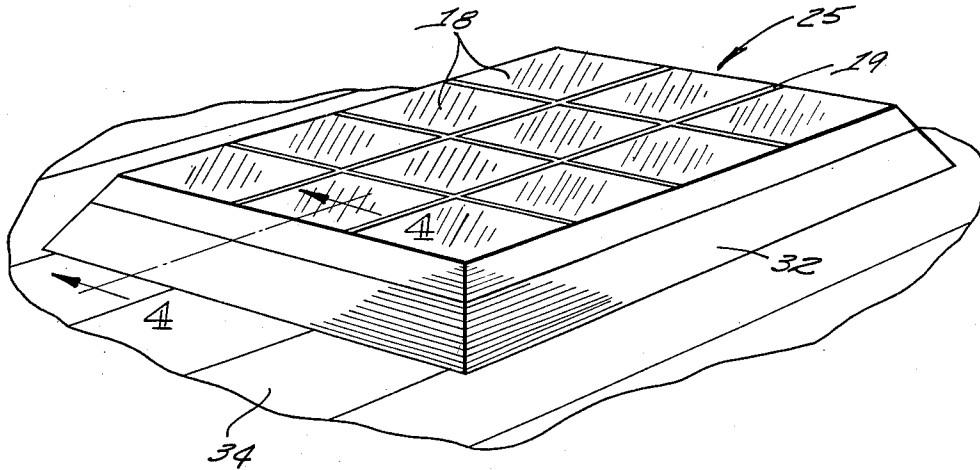


FIG. 3

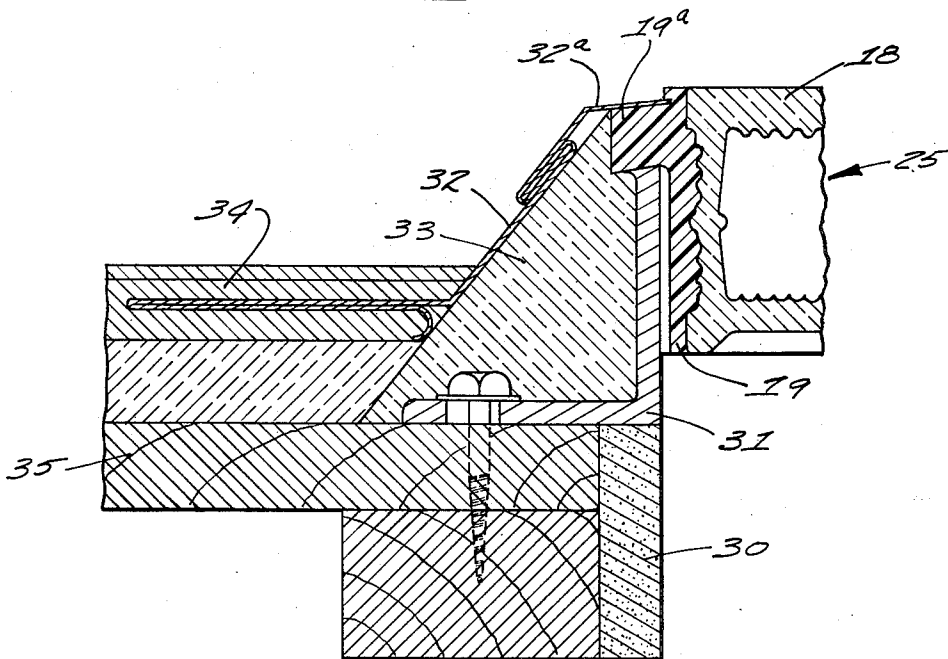


FIG. 4

BY

INVENTORS
K. G. LUSHER
M. McDAVITT
H. B. VINCENT
E. J. HOLLER &
W. A. SCHAICH
ATTORNEYS

March 27, 1962

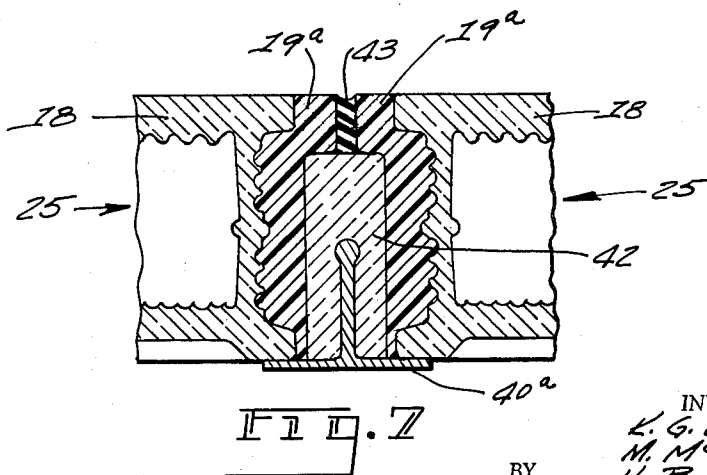
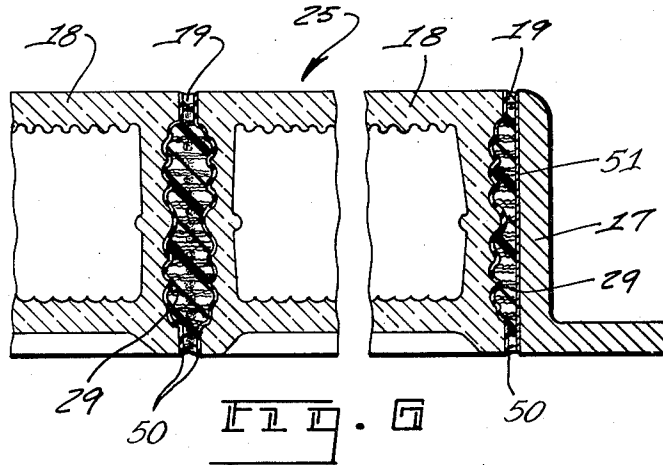
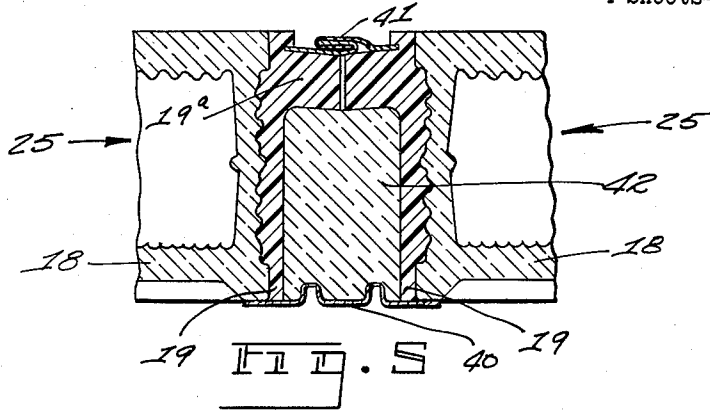
K. G. LUSHER ET AL

3,026,575

SKYLIGHT STRUCTURE AND METHOD OF FABRICATION

Filed Nov. 27, 1957

4 Sheets-Sheet 3



BY

INVENTORS
K. G. LUSHER
M. McDAVITT
H. B. VINCENT
E. J. HOLLER &
W. A. SCHAICH
ATTORNEYS

March 27, 1962

K. G. LUSHER ET AL

3,026,575

SKYLIGHT STRUCTURE AND METHOD OF FABRICATION

Filed Nov. 27, 1957

4 Sheets-Sheet 4

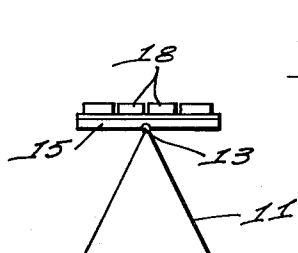
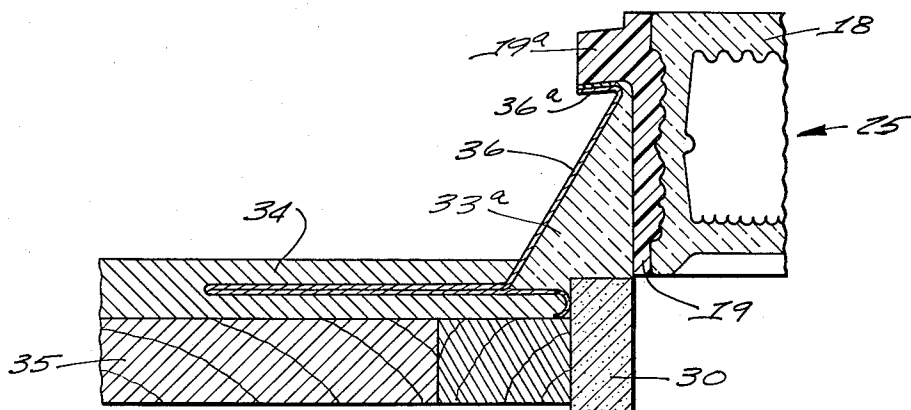


Fig. 9

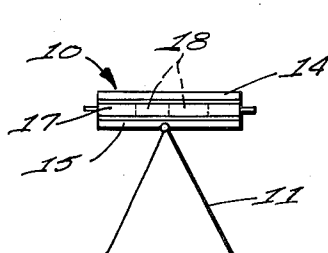


Fig. 10

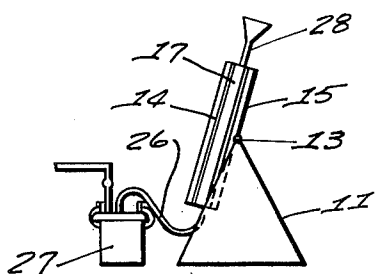


Fig. 11

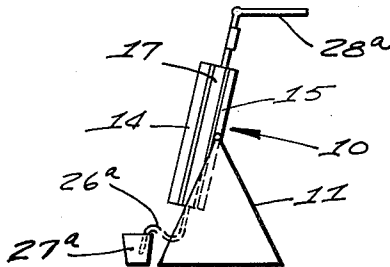


Fig. 12

INVENTORS
K. G. LUSHER
M. McDAVITT
H. B. VINCENT
BY E. J. HOLLER &
W. A. SCHAICH
ATTORNEYS

1

3,026,575

SKYLIGHT STRUCTURE AND METHOD OF FABRICATION

Kenneth G. Lusher, Perrysburg, and Murray McDavitt and Harvard B. Vincent, Toledo, Ohio, assignors to Owens-Illinois Glass Company, a corporation of Ohio
Filed Nov. 27, 1957, Ser. No. 699,311
2 Claims. (Cl. 18—59)

The present invention relates to light-transmitting panels and has for its object an improved skylighting or roof-lighting structure and method of providing a unitized panel construction which is simple in fabrication and more readily formed than those heretofore proposed. The subject panels which are termed skylights or roof-lights for purposes of describing this invention may be equally referred to as wall panels.

Previously, grid structures for rooflights have been comprised of structural members consisting of extruded metallic strips or elements arranged in intersecting or interlocking relationship with each other to conjunctively form a frame and plurality of hollow individual cells. Into each cell is fitted a light-transmitting member preferably of glass or equivalent transparent and/or translucent material retained in place by cement or mortar.

These structures for application to roof or wall openings of simple construction have involved the utilization of a considerable number of grid parts to support the light-transmitting glass units or blocks by rather wide flanged metallic members grasping the lower corners or edges of each block. Thus, the amount of available light-transmitting area per unit of skylight has been considerably reduced by the various forms of metal strut and cement gridwork utilized heretofore.

Accordingly, it is an object of the present invention to provide a skylight having a primarily plastic grid construction characterized by simplified assembly means which permit the skylight to be completely prefabricated into finished panel or slab form for subsequent ready application to a roof or wall opening, the skylight having superior light conducting properties with its gridwork comprising minimal exposed surface areas.

Another object of the present invention is to provide a method of assembling a plurality of glass block units into durably and permanently retained form within a cast or molded framework which may be easily and effectively secured to a roof or wall opening.

A further object of the present invention is to provide a novel method of molding a skylight having a plurality of glass blocks permanently retained in uniformly spaced, weathertight arrangement within a reinforced plastic grid.

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.

Referring to the accompanying drawings forming a part of this specification and in which like numerals designate like parts in all of the views:

FIG. 1 is a perspective view of one embodiment of fabricating apparatus for forming the subject skylight panel.

FIG. 2 is an elevational view partially in section of a portion of FIG. 1 illustrating the glass block assembly jig only for practicing the present method of fabrication.

FIG. 3 is a perspective view of one form of the subject skylight structure installed within a roof opening.

FIG. 4 is a fragmentary vertical sectional view of an edge portion of the skylight structure and roof opening taken along the lines 4—4 of FIG. 3.

2

FIG. 5 is a fragmentary vertical sectional view of unsupported edges of two panels in side-by-side bridged relationship.

FIG. 6 is an enlarged fragmentary vertical sectional view of a single completed panel and mold side member.

FIG. 7 is a view similar to FIG. 5 of a modification of the joint between bridged panels.

FIG. 8 is a view similar to FIG. 4 of another modification of the panel in skylighting arrangement.

FIGS. 9, 10, 11 and 12 pictorially illustrate in stepwise sequence the present method of fabrication, with FIGS. 11 and 12 showing alternate methods of injecting the bonding material into the molding assembly.

The present invention pertains to a skylight panel formed by the method hereinafter described. The preferred method utilizes square or rectangular hollow glass blocks, cells, or units having twin light-gathering and/or directing panels which are essentially planular on their exterior surfaces, the glass blocks being of approximately equal overall thickness. The interior surfaces of the block faces may be provided with light-controlling prismatic surfaces such as known in the art. Otherwise, the glass blocks may be formed having any desired pattern, shape, or configuration, for employment in this invention.

A preferred form of the subject glass block panel consists of the blocks being arranged in adjacent relationship with minimized spacing between the extremities of adjacent blocks. Although the present invention will be described as pertaining to a skylight, it is fully contemplated that the panelized structure be equally applicable to a suitable wall or floor opening.

Before the glazing units are taken for assembly into panelized form, each of the blocks 18 may be sprayed over its side surfaces with a layer (not shown) of metal-organic containing material such as tetrabutyl titanate solution, for example, to provide adhesion-promoting and bonding surfaces for joining organic moldable materials to the glass. It is preferred that only the sides of each block be coated with a thin layer of the material. The coating of tetrabutyl titanate can be deposited from an organic or aqueous solution, a solution of toluene being suitable as a carrier for the tetrabutyl titanate. The coating may be thermally cured on the glass surfaces by heating to about 250° F. for one hour.

Alternatively, a coating of "Volan" which is Werner-type chromium complex may be sprayed from an aqueous solution over the side surfaces of the blocks. The "Volan" comprises a methacrylate chromic chloride in isopropanol. Also, certain silicones of the polysiloxane type, such as Product No. Y-1100 sold by Linde Air Products Co., may be utilized to coat the block sides.

After the blocks are coated with the metal-organic containing material, if desired, the sides may or may not be spray-coated with a layer 50 of a synthetic elastomeric material such as "neoprene" as shown in FIG. 6. "Neoprene" comprises a line of synthetic elastomers based on polymers of chloroprene. The "neoprene" coating over the blocks is considerably thicker than the first-applied metal-organic containing material and furnishes a cushioning layer which permits the glass blocks in panelized form to better withstand both changes in temperature as well as physical shock. Differences in coefficients of thermal expansion and contraction between the glass and plastic molding materials can satisfactorily be tolerated with a layer having such resilient characteristics.

Referring again to the drawings and particularly to FIG. 1, the present method employs a jig assembly 10 mounted on an upright triangular supporting base 11 having a horizontally pivoted frame or yoke member 12 at its apex. The jig assembly 10 is rotatably mounted within yoke member 12 in diagonally retained relation-

ship. Thus, a diagonal horizontal axis of the assembly 10 is coincidental with the central axis of mounting frame or yoke member 12. Yoke 12 is supported on the stand or base 11 by outwardly extending support rods 13 which pass through and are rotatable in surrounding sleeves or brackets.

The jig assembly 10 is formed of upper and lower glass block retention plates 14 and 15 respectively. Lower plate 15 is firmly attached to rotatable yoke 12 by a series of brackets and machine bolts designated by the numeral 16. The jig assembly 10 is illustrated in FIG. 1 in an upright position with diagonally opposed extremities in essentially vertical positions for the molding operation.

As shown pictorially in FIG. 9, bottom plate 15 is initially disposed in a horizontal position and a series of similar glass blocks 18 are arranged thereon in adjacent spaced-apart alignment. As shown in FIG. 10 upper plate 14 and surrounding and enclosing mold frame 17 are brought into near relationship with lower plate 15 to completely enclose and surround the blocks 18.

As shown in FIG. 2, the interior molding surface of each of the revolution plates 14 and 15 is provided with a resilient layer 20 of sponge rubber, for example, co-extensive with their molding area. Each layer 20 has an inner sheet or layer 21 of impervious unretractable materials such as polyethylene or "Mylar" film thereover which is also coextensive with the molding area. "Mylar" film consists of polyethylene terephthalate resin. Layer 21 is selected as one which is unreactable with the resinous bonding material 19 which comprises the gridwork and frame. The film 21 has outstanding strength, electrical properties and chemical inertness.

After the glass blocks 18 are aligned on the resilient essentially plane surface of lower plate 15 with their light-transmitting panels in contact with lower impervious film layer 21, strands 29 of glass fiber roving, for example, or other fibrous material are inserted into the open channels between and around the blocks 18. Strands 29 consist of bundles of glass fibers which may or may not be previously joined by a plastic material similar to bonding agent 19.

The similar interior facing of uppermost plate 14 is brought into aligned position with the upper surfaces of the blocks 18, as shown in FIGS. 2 and 10. The assembly is drawn together by a series of machine bolts 22 located around and extending through openings in the periphery of the two plates 14 and 15. Other known clamping means could be substituted therefor. When the plates 14 and 15 are drawn together, the resiliently-backed unreactable film 21 conforms to the entire light-transmitting face of each of the blocks 18. Also as shown in FIG. 2, the perimeter of the panel 25 is formed by an annular member 17 which completely surrounds the exteriorly disposed sides of blocks 18 and is spaced therefrom to form a circumscribing frame. The width of member 17 may be substantially the same as the block thickness. Member 17 is also drawn tight between the two layers 21 of impervious film. Member 17 has an exteriorly extending enlarged area 17a near upper plate 14 which is applicable to forming a radial flange 19a around the molded panel 25.

The enclosing frame 17 of the molding assembly 10 is provided with an internal coating 51 which consists of a mold release agent as shown in FIG. 6. Methyl cellulose or other material may be used for this purpose. Coating 51 furnishes an interface for the molding frame 17 to prevent bonding of the resinous material 19 thereto. Coating 51 may be comprised of a sheet similar to layer 21.

The lower corner of jig assembly 10 is provided with an inlet 26 suitable for injecting a bonding material 19 into the open spaces between the series of retained blocks 18. Inlet line 26 is connected to a containing vessel 27 capable of supplying the bonding material into the interstices or spaces between the blocks 18. Assembly 10 is also provided with a venting outlet 28 diagonally op-

posed from inlet 26 capable of dispelling and/or displacing air within the spaces between the blocks 18 during the insertion of the bonding material 19.

When the jig assembly 10 has been drawn tight around the series of glass blocks 18, the open spaces between the blocks are entirely air-tight except for the inlet 26 and outlet 28. The inlet line serves to introduce the resinous and/or plastic material which comprises the panel frame and grid work. Assembly 10 is then rotated about one diagonal axis to place its opposite diagonal axis in a nearly vertical or upright position. The resinous material 19 contained within vessel 27 under pressure of approximately 6-10 lbs. is then forced upwardly through the inlet 26 to completely fill the open spaces between the blocks.

The resinous material 19 consists of an epoxy or polyester resin. The resinous material is sufficiently flowable to horizontally rise through the open spaces between the blocks which are retained in diagonally spaced relationship. The resinous material is allowed to completely fill the open area between the blocks 18. The resinous bonding material is utilized to completely fill the frame and ribs of the panel grid and is forced upwardly within the jig assembly until it is visible in either a sight glass or transparent section in the outlet line 28. The resinous material encompasses and surrounds the strands 29 of glass fiber roving which were previously inserted in the open spaces during the mounting of the blocks within the jig.

After the required amount of bonding material 19 is introduced, the panel is allowed to remain in an upright position for a short period of time and then is rotated back to its horizontal position. Bubbles of occluded or pocketed air are upwardly and outwardly displaced to the outer edges of the panel by following this procedure. The panel is allowed to remain within the jig for a period of at least an hour and perhaps several hours depending upon the selection of particular resinous bonding material. With proper control of temperature and humidity, the curing time of the resinous material may be modified to the most desirable setting condition.

As stated, the resinous bonding material 19 consists of an epoxy or polyester resin, one example of the former being catalyzed diethylene triamine. A filler is also utilized along with the resin which may be fine sand or pulverized calcium carbonate, such as Surfex sold by the Minnesota Mining and Manufacturing Company. The preferred filler has a fineness of less than 400 mesh. A catalyst is normally employed along with the resinous material. The catalyst may be any suitable material designated for plasticizing the resin, one of which consists of cobalt naphthalate accelerator and "Lupersol" as a catalyst.

After the panel 25 is allowed to set into integrally bonded form, the jig is removed therefrom.

As shown in FIG. 3, the completed glass block panel 25 is installed within a roof opening.

As shown in FIG. 4, roof opening 30 is surrounded by a right-angled skylight support member 31 having an upper surface adapted to supporting the light-transmitting panel 25. Member 31 has a horizontal surface attached to the roof 35 around its opening 30. Flange 19a of the panel frame is supported by the upper surface of fixed support member 31. A continuous annular flashing 32 which extends downwardly and outwardly around the panel perimeter is employed to weatherseal the perimeter of the panel around the roof opening. Flashing 32 extends outwardly in its lower region intermediate of the roofing materials 34. The upper edge of the flashing 32 covers at least partially the upper surface of panel flange 19a. A triangularly-shaped annular layer 33 of insulating material is placed between support member 31 and flashing 32.

As shown in FIG. 5, the unsupported edges of two panels 25 are illustrated in adjacent bridged relationship.

5

The lower edges of the blocks and panel frame are supported by a channel member 40. The lengthwise space beneath the panel flanges 19a and above channel member 40 is filled with insulating material 42. The upper surfaces of at least a portion of adjacent panel flanges 19a are covered with a lengthwise section of flashing 41.

As shown in FIG. 7 in another modification of adjacent unsupported edges of two panels 25, a T-shaped member 40a is utilized to retain the lower surfaces of the panel frames. The interior space between the frames is filled with insulating material 42 and a layer of caulking compound 43 such as tough resilient cured polymers of synthetic rubber (Thiokol) is inserted between panel flanges 19a.

FIG. 8 illustrates a modification of FIG. 4 in which the panel flange 19a is supported by a flashing member 36 having an outwardly curved, essentially horizontal supporting surface 36a upon which flange 19a rests. The lower extremity of flashing 36 extends outwardly intermediate of the roofing material 34. A similar layer 33a of insulating material is placed beneath flashing 36 surrounding the roof opening 30 in contact with the side surface of the panel frame.

In a modification of the invention shown in FIG. 12, the bonding material 19 may be inserted into the jig assembly 10 by drawing a vacuum on outlet line 28a to reduce the internal pressure within the open spaces between blocks 18. The resinous material 19 is contained within an open container 27a and drawn into the open spaces through inlet line 26a. A sight glass may be provided in outlet line 28a to show when the jig assembly 10 is entirely filled. The bonding material is allowed to set to bind the blocks together. The completed unitary panel is removed from the jig assembly for subsequent installation as a skylight structure.

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

We claim:

1. In a method of fabricating a plurality of glass blocks having opposing planar faces and peripheral edges join-

6

ing the faces into a composite unit, the steps of coating the peripheral edges of the blocks with glass-adherent elastomeric material, positioning the blocks in their finally assembled and spaced relation, enclosing the perimeter of the assembled blocks within a polygonal mold frame, sealing the interstices between adjacent coated block edges and between the block edges and the adjacent portions of the mold frame while maintaining interconnecting flow passages therebetween, positioning the mold frame with its assembled blocks so that a diagonal of the frame is vertical, injecting a liquid resinous bonding material into the sealed assembly through an aperture in the frame located at the lowermost extremity thereof so as to fill the sealed interstices by flow through said interconnecting passages, at least partially curing the bonding material to a solid state to secure the coated edges to one another through the bonding material and removing the mold frame to expose the complete composite unit.

2. The method of claim 1, wherein the interstices are partially filled with fibrous reinforcing material prior to sealing thereof, and the injection of the bonding material imbeds and impregnates the fibrous material therewith.

References Cited in the file of this patent

UNITED STATES PATENTS

1,203,154	Stevenson	Oct. 31, 1916
1,601,029	Ligonnet	Sept. 28, 1926
2,020,178	Haas	Nov. 5, 1935
2,266,510	Pottinger	Dec. 16, 1941
2,299,552	McGregor et al.	Oct. 20, 1942
2,402,717	Winer	June 25, 1946
2,495,640	Muskat	Jan. 24, 1950
2,544,668	Goebel et al.	Mar. 13, 1951
2,572,580	Almroth et al.	Oct. 23, 1951
2,610,593	Wasserman	Sept. 16, 1952
2,677,165	Copenhauer et al.	May 4, 1954
2,751,321	Sans	June 19, 1956
2,835,623	Vincent et al.	May 20, 1958