Aug. 20, 1968 R. WATSON, JR 3,397,500

BUILDING STRUCTURE WITH ALTERNATING STRUCTURAL MEMBERS AND PANELS IN COMPRESSION

Filed July 20, 1966 2 Sheets-Sheet 1

FIG. 1

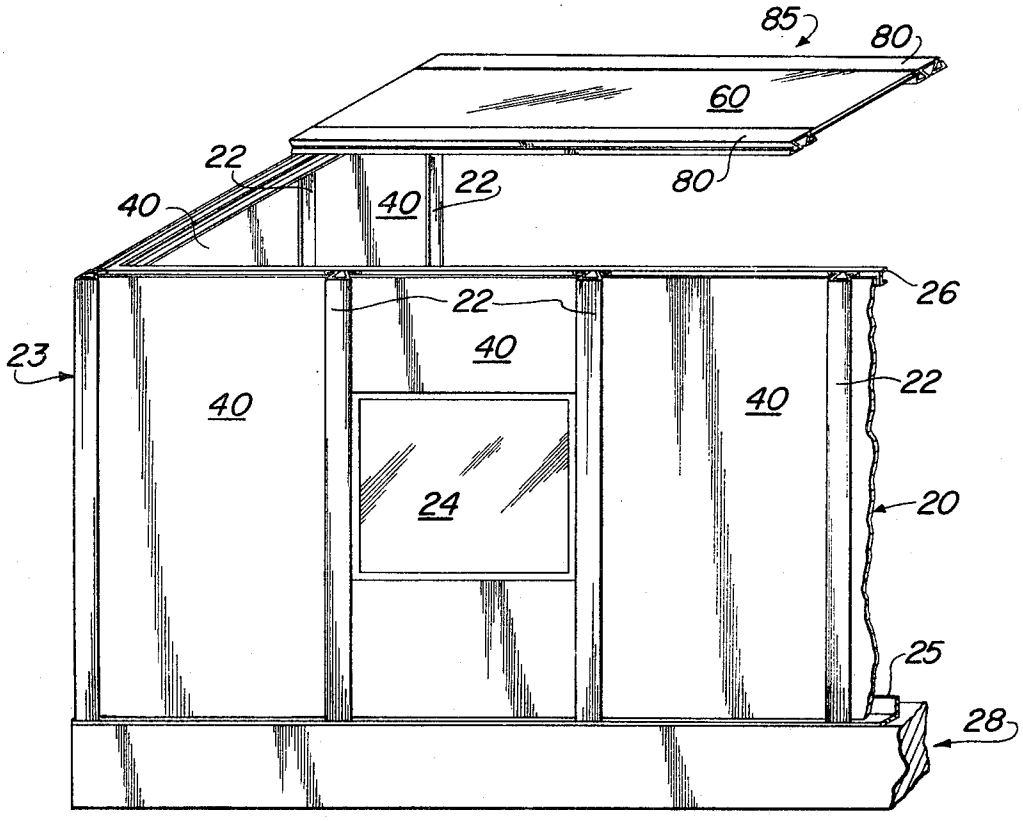


FIG. 2

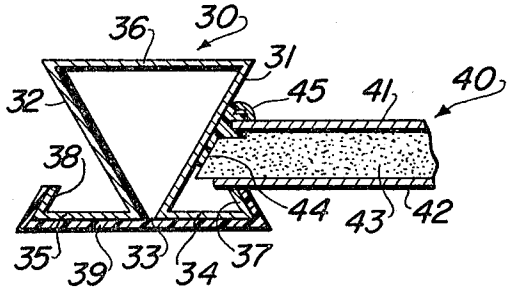
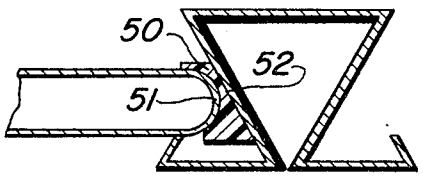


FIG. 3



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BUILDING STRUCTURE WITH ALTERNATING STRUCTURAL MEMBERS AND PANELS IN COMPRESSION

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FIG. 4

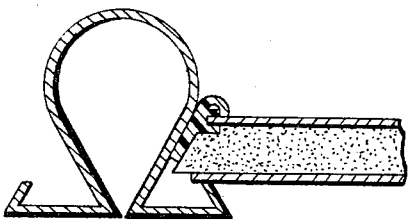


FIG. 5

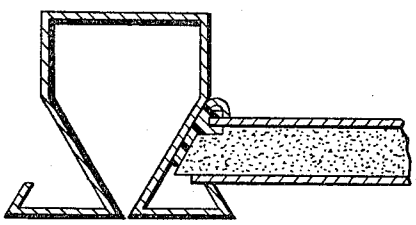


FIG. 6

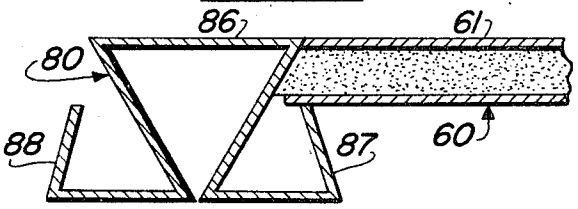


FIG. 7

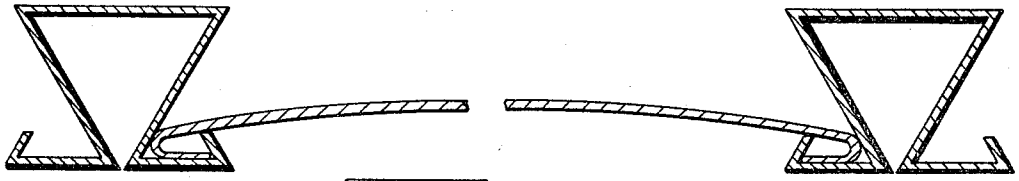


FIG. 9

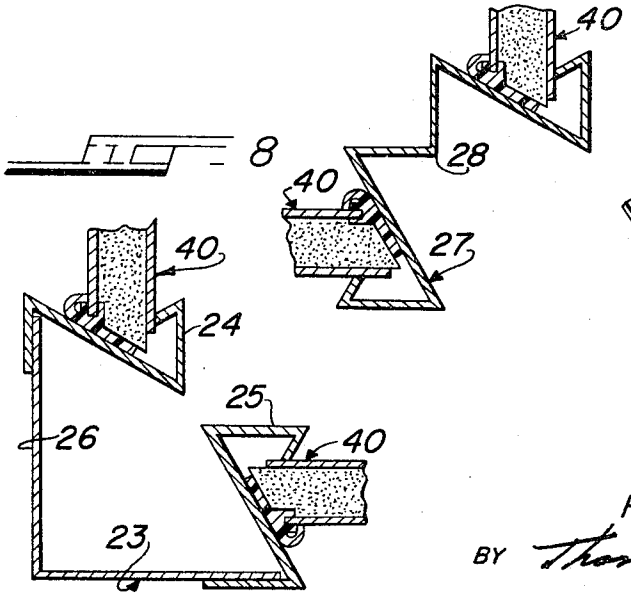
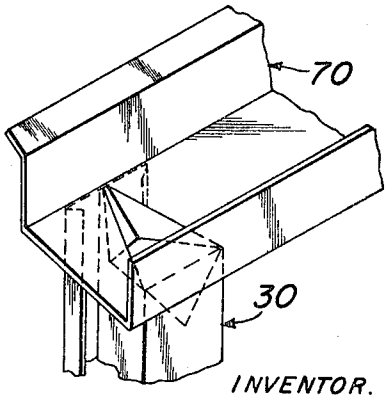


FIG. 8

FIG. 10



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BUILDING STRUCTURE WITH ALTERNATING STRUCTURAL MEMBERS AND PANELS IN COMPRESSION

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4 Claims. (Cl. 52—495)

ABSTRACT OF THE DISCLOSURE

An improved building structure comprising alternating structural shapes and panels wherein the panels are maintained under compression between the structural shapes resulting in a wedging action between each junction of a panel and structural shape, forming a generally weathertight seal.

This invention relates to an improvement in building structures, and more particularly to a novel structural assembly especially suitable for floor, wall, and roof construction, and the method of assembly thereof.

Present day building structures generally either have load carrying beam and structural supports which are provided primarily for their load support with the wall structure primarily considered for its enclosing features, or panels which due to their over-all shape or elaborate internal structure provide suitable load carrying characteristics and when a plurality of such units are structurally interlocked provide a load carrying wall system.

Present day construction methods require a large amount of on-the-site fabrication of wall structures, and generally the erection of scaffolding for the entire height of the structure. This is particularly true with conventional insulated double wall construction wherein the structural framework is first erected, then girts, inner walls, sub-girts, insulation and finally the outer walls. Further, the abundant use of fasteners creates leakage problems and sources for initiation of deterioration. Still further, the usual complex surfaces of many present day building panels and materials do not lend themselves to the most flexible utilization of modern materials and coatings.

The present invention overcomes these problems by providing building structures comprising a combination of structural shapes and panels wherein the panel is firmly held between two structural shapes by a wedging action.

Another object of the invention is to provide a structural building assembly which greatly reduces the number of fastenings, girts, and sub-girts used in present building structures.

Still another object of this invention is to provide structural building components which may efficiently utilize materials and coatings requiring non-formed flat panel units.

Yet another object of the invention is to provide a building structure having great structural flexibility in the size of units and placement of doors, windows, etc.

Another object of this invention is to provide a novel structure suitable for walls, floors and roofs.

Still another object is to provide a structural building assembly method which requires a minimum of on-the-site erection labor and allows erection without the requirement of scaffolding, requiring access only to the bottom and top of the structure.

These and other objects and advantages of the invention will become more apparent from the ensuing description and claims, when taken with the accompanying drawings, in which:

FIGURE 1 is a cutaway perspective view of a portion of a structure embodying the principles of the present invention;

FIGURE 2 is a cross-section of a basically triangular structural shape in combination with a sandwich insulated construction panel according to this invention;

FIGURE 3 is a cross-section of a basically triangular structural shape in combination with a spiral tube panel;

FIGURE 4 is a cross-section of a basically oval structural shape in combination with an insulated sandwich panel;

FIGURE 5 is a cross-section of a modified rectangular-triangular structural shape in combination with a sandwich panel;

FIGURE 6 is a cross-section of a modified triangular structural shape in combination with a flush panel;

FIGURE 7 is a cross-section of a basically triangular structural shape in combination with a non-insulated single skin wall panel;

FIGURE 8 is a cross-section of an outside corner mullion assembly in combination with two sandwich panels at right angles;

FIGURE 9 is a cross-section of an inside corner mullion assembly in combination with two sandwich panels at right angles; and

FIGURE 10 is an isometric view illustrating use of a mullion as a downspout.

With particular reference to the drawings and in the first instance to FIGURE 1, the numeral **20** generally designates a wall structure defined by a course of plural panels **40** and alternating mullions **22** which incorporate the principle of the invention. Wall structure **20** is illustrated as including corner assembly **23** which provides for panels **40** on each side of it to extend at right angles to each other. As can be generally observed from FIGURE 1, the building structure comprises a plurality of alternating structural shapes and panels, the structural shapes defining an elongated, formed, load bearing element of cross-section having opposing sides converging to an apex and a flange extending laterally from each side of the apex, each of the flanges terminating with a leg extending toward the proximate of the opposing sides so as to exert a wedging action when a panel is maintained with one edge adjacent the proximate side in a plane approximately parallel to the flange and subject to a force directed toward the proximate side. The panels are maintained under a lateral compressive force due to the adjacent structural shapes being firmly secured from lateral movement while holding the panel in position under a lateral compressive force. It is readily observed that due to the angle of the side of the structural shape, lateral force upon the panel forces the face of the panel against the end of the leg of the shape directed toward that side, thus causing a wedging action. Thus, due to the wedging action of the combination of the structural shape and panel, a generally weatherproof and rigid building structure may be obtained without the necessity of fastenings to hold the panels in position. The same structure may be utilized for exterior walls, interior walls, floors, roofs, and interior ceilings. As may be seen in FIGURE 1, the load imparted to the panels, such as wind load in walls or vertical loading in floors or roofs, is directly transferred to the structural shape through the leg which rests firmly against the panel as a result of the wedging action described above. The structural shapes may be of various cross sections, dimensions, gauge of material, and spacings to accommodate a wide variety of loading factors. Generally, spacing is from about 2 to 4 feet, with 2 feet being preferred.

FIGURE 1 also illustrates window unit **24** as a part of wall structure **20**. The window unit being of proper width and having vertical edges finished in a similar

manner as the panel is firmly held in place by the wedging action of the adjacent mullions **22**. Any other desired unit such as a door, louver, translucent panel sections, etc. may be utilized in like fashion. The flexibility of this building structure is especially apparent when combinations of different units are utilized and the panels are simply cut to appropriate lengths without the necessity of any further structural framing and flashing. Frames for any of the above units also may be welded into the assembly thus eliminating the need for structural framing and flashing.

As shown in FIGURE 1, wall structure **20** may be mounted on supporting wall **28** of any suitable design and of any desired height. For example, wall structure **20** may be mounted on concrete footings or may be mounted atop a masonry wall, or atop a wall of any suitable building material, adapted so that the lower ends of the mullions **22** and corner assembly **23** are firmly secured in position. The mullions may, for example, be set in a suitable angle **25** or on any appropriate shape and fastened firmly thereto by any suitable means such as clipping, bolting, riveting or welding, etc. The upper ends of mullions **22** and corner assembly are firmly held from movement by any appropriate means such as clipping, bolting, riveting or welding to any appropriate structure such as channel **26** on the inside wall structure **20**. Alternatively, the framing structure may be positioned atop the wall or along the exterior at the top of the wall structure. It is to be noted that the structure at the upper terminus of wall structure **20** may be readily adapted to accommodate any style of roof such as flat or pitched.

FIGURE 1 also illustrates an embodiment of a roof deck structure according to this invention and generally referred to as **85**. Roof beams **80** are firmly secured at the ends to channel **26** and roof panel **60** is firmly held without fastenings in a generally weatherproof fashion between roof beams **80** by the same wedging action described in reference to the wall structure. Additional transverse roof joists may span the building at any spacing interval beneath beams **80** to accommodate a wide variety of loading requirements. The exterior roof surface is generally smooth to accept any conventional surfacing material such as tar and gravel, or on pitched roofs the joints can be sealed by an appropriate means and the surface left exposed.

Each of the panels **40** is formed by sandwich construction having inner and outer walls of sheet material such as steel, aluminum or plastic which is bonded to an inner core of closed cellular foam insulating material such as polyurethane, polystyrene, etc. Such panels provide excellent insulating qualities and enable different materials to be utilized on each side of the panel. Further, such panels may be entirely finished at the point of manufacture since no panel fastenings are utilized. Due to their smooth surface and lack of fastenings, the walls of the panels are especially well suited to plastic coatings which require factory application.

To further illustrate specific embodiments of the invention, attention is directed to FIGURES 2 through 9 each of which shows a cross section of the combination of a structural shape and panel according to this invention.

FIGURE 2 shows an enlarged cross section detail of the wall structure shown in FIGURE 1. Specifically, the structural shape generally referred to as **30** is triangular shape having first side **31** and second side **32**, sides **31** and **32** being opposing sides, converging to apex **33** and flanges **34** and **35** extending from each side of apex **33** parallel to third side **36** of the triangle, each of flanges **34** and **35** terminating with legs **37** and **38** respectively, extending toward the proximate of opposing sides **31** and **32**. The panel generally referred to as **40** is a sandwich-type panel having outer surface **41** and inner surface **42** which are preferably plastic or metal such as steel or aluminum bonded to central core **43** which is preferably

a closed cell synthetic foam such as polyurethane or polystyrene. The panel of this construction is extremely rigid and will not deform from the lateral compression to which the panel of this structure is subjected. Edge **44** of panel **40** adjacent side **31** of structural shape **30** is preferably shaped to fit the contour of side **31** and may have the core **43** slightly extended beyond the ends of surfaces **41** and **42**, and the end of outer surface **44** adjacent side **31** may have compressible weather seal **45** applied along its length. In any case, the contact of edge **44** with side **31** is such as to form a generally weatherproof seal along the entire length as a result of the wedging action obtained by the combination of forces between leg **37** and panel surface **42** and side **31** and panel edge **44** when a force is applied to panel **40** toward structural shape **30**. It is readily seen that panel **40** does not afford thermal transference continuity between exterior side **41** and interior side **42**, thus rendering a panel structure having very low thermal conductivity. As illustrated, legs **37** and **38** make an acute angle with flanges **34** and **35** respectively thus enabling plastic condensation molding **39** to snap into a firmly held position covering the entire surface of structural shape **30** which is exposed to the interior of the structure. Such a condensation molding on the interior of the metal structural shape is effective to lower thermal conductivity and thereby substantially reduce the formation of condensation. Utilizing the structure shown in FIGURE 2, the entire inner surface of the structural wall or roof may be thermally insulated from the outer surface.

FIGURE 3 illustrates a specific embodiment of the invention utilizing a spiral tube panel which may be filled with loose wool-type insulation material or a synthetic closed cell foam material. When utilizing a panel having an end shape which does not conform to the adjacent surface of the structural shape, compression pad **50** of compressible material having side **51** to conform to the shape of the end of the panel and opposite side **52** to conform to the surface of the structural shape may be placed along the entire length of the juncture to assure a generally weatherproof seal.

FIGURES 4 and 5 illustrate other specific embodiments of the invention which utilize different structural shapes to obtain the same wedging action between the structural shape and a panel to achieve the objects of the invention set forth above. Obviously, many different structural shapes are suitable in the building structure of the invention.

FIGURE 6 shows a detail cross section of the roof structure illustrated in FIGURE 1. Legs **87** and **88** of structural shape **80** are extended to a suitable length so that surface **61** of panel **60** is approximately flush with side **86** of structural shape **80** and the panel is firmly retained between the structural shapes by the wedging action described above. This embodiment results in a structure having one smooth surface and is especially suitable for floor and roof construction. Panel **80** may suitably be a structural panel such as plywood or precast concrete. Conventional roofing materials are then readily applied over the smooth surface afforded by this structure, if desired.

FIGURE 7 illustrates a specific embodiment of this invention utilizing a single wall panel such as plastic or metal such as steel or aluminum.

FIGURE 8 illustrates an enlarged cross section of the corner assembly generally referred to as **23** in FIGURE 1. It is seen that structural shapes **24** and **25** are longitudinal halves of the typical mullion section as shown in FIGURE 2 arranged so that panels **40** are at right angles to each other. Of course, it is obvious that by use the two separate structural shapes **24** and **25**, two panels may be held at any angle from 0° to 180° to each other to form an outside corner by modifying the corner flashing **26**. Corner flashing **26** may be held in place by welding or simply by the wedging action. This permits extreme flex-

ibility in building construction with a minimum of specialized components.

FIGURE 9 shows an inside corner according to this invention. The structural shape generally referred to as **27** is a standard mullion as shown in detail in FIGURE 2 wherein said third side of the triangle is bent at **28** to form a 90° angle and thus hold panels **40** at a 90° angle. Of course, the mullion may be bent to any desired angle to form the inside corner as required. The space between the flanges separated by such bending may be covered by any type of flashing desired.

The structural shapes used in the invention may be fabricated by roll forming from sheet metal of about 10 to 18 guage. If desired, some structural shapes may be filled with concrete as required to extend their load capacities and span range. The plurality of generally hollow shapes throughout the building structure permits great flexibility in providing ducts to accommodate piping, wiring, and other utilities. For example, as shown in FIGURE 10, when structural shape **30** is used as a mullion it may be sealed to render it water-tight and gutter **70** may be mounted directly atop the wall structure so that openings from the gutter will lead water into mullions as desired, thus providing integral vertical downspouts.

The erection method of this invention requiring minimum on-the-site labor is especially unique. The structure may be erected by firmly securing each end of a first structural shape against lateral movement; holding a full length panel or composite of panel sections, windows, etc. in position with a first edge adjacent to the secured structural shape; placing a second structural shape into position adjacent the second edge of said panel opposite said first edge, applying a force to said second shape toward said first shape to impart a laterally compressive force to the panel and causing a wedging action on opposite edges of the panel by the first and second shapes; and while applying said force firmly securing each end of said second shape against lateral movement. Thus, in wall erection, a mullion may be rigidly positioned, then a panel set in place, the next adjacent mullion roughly positioned and pulled toward the rigid mullion by any suitable means such as chain jacks located near the top and bottom to impart a lateral compressive force to the panel causing the panel to become positioned due to the wedging action, and then fastening the second mullion.

A minimum of skeletal structure is necessary in the building structure of this invention; only that which is necessary to provide for firm securing of the ends of the structural shapes and for additional structural reinforcement as may be necessary in floor and roof construction. Thus, even for insulated wall construction, scaffolding is not generally required since erection of the finished wall panel requires access only at the top and bottom. Additional stiffeners such as girts are not generally required, and sub-girts are never required.

Structures coming within the invention provide architecturally pleasing wall structures, both interior and exterior, and efficient and economical floors and roof decks. Those skilled in the art will readily appreciate the versatility provided by the structure of this invention and the simplicity and economies afforded by the erection method.

While certain operative forms of the invention have been shown and described, it should be understood that these showings and descriptions should be taken in an illustrative or diagrammatic sense only. There are many modifications in and to the invention which will fall within the scope and spirit thereof and will be apparent to those skilled in the art. The scope of the invention should be limited only by the scope of the hereinafter appended claims.

I claim:

1. In a building structure comprising a plurality of alternating structural shapes and panels, the combination of a spaced first and second structural shape defining an elongated, formed element of cross section of opposing sides converging to an apex and flanges extending laterally in approximately opposite directions from each side of said apex, each of said flanges terminating with a straight leg extending toward the proximate of said opposing sides with the terminal ends of said legs in spaced relationship to said sides; and a panel connecting said shapes in a plane approximately parallel to said flange of said first and second shape and lying within planes defined by connecting extremities of said first and second shape, said panel having a first edge against said proximate side of said first shape and an opposite second edge against said proximate side of said second shape, and a face against said terminal end of a leg of said first and second shape; said panel maintained in compression between said first and second shape, forcing the face of said panel against said terminal ends in a wedging action to form a generally weather-tight seal between the terminal ends of the legs and the face of the panel and between the end of the panel and the adjacent side of the structural shape.

2. The structure of claim **1** wherein said structural shapes are mullions.

3. The structure of claim **1** wherein said structural shapes are triangular shape having opposing sides converging to an apex and a flange extending laterally from each side of said apex parallel to the third side of said triangle.

4. The structure of claim **1** wherein said structural shapes are triangular shape having opposing sides converging to an apex and a flange extending laterally from each side of said apex parallel to the third side of said triangle, said leg being of a length to hold said panel approximately flush with said third side.

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