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Cornland

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[54] **HOLLOW STRUCTURAL PANEL OF EXTRUDED PLASTICS MATERIAL AND A COMPOSITE PANEL STRUCTURE FORMED THEREOF**

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[21] Appl. No.: **355,376**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 122,531, March 9, 1971, abandoned.

[52] **U.S. Cl.** **52/586;** 52/536; 52/588; 52/630

[51] **Int. Cl.** **E04c 1/10;** E04c 1/30

[58] **Field of Search** 52/309, 534, 537, 588, 52/586, 536, 588, 615, 630

[56] **References Cited**

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Attorney, Agent, or Firm—Jones, Tullar & Cooper

[57] **ABSTRACT**

A hollow structural panel forms a number of cavities each of which is bounded by side walls and end or partition walls. The side walls have a concave outer surface and a convex inner surface, and the partition walls are formed as I-beams the flanges thereof being integral with the side walls and forming substantially planar outer surfaces separating adjacent side walls from each other.

1 Claim, 2 Drawing Figures

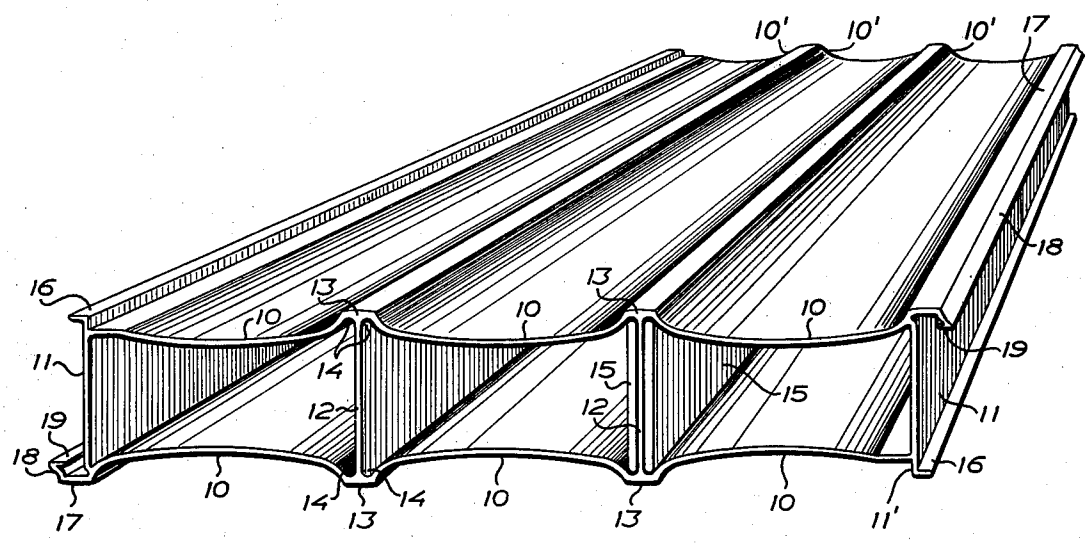
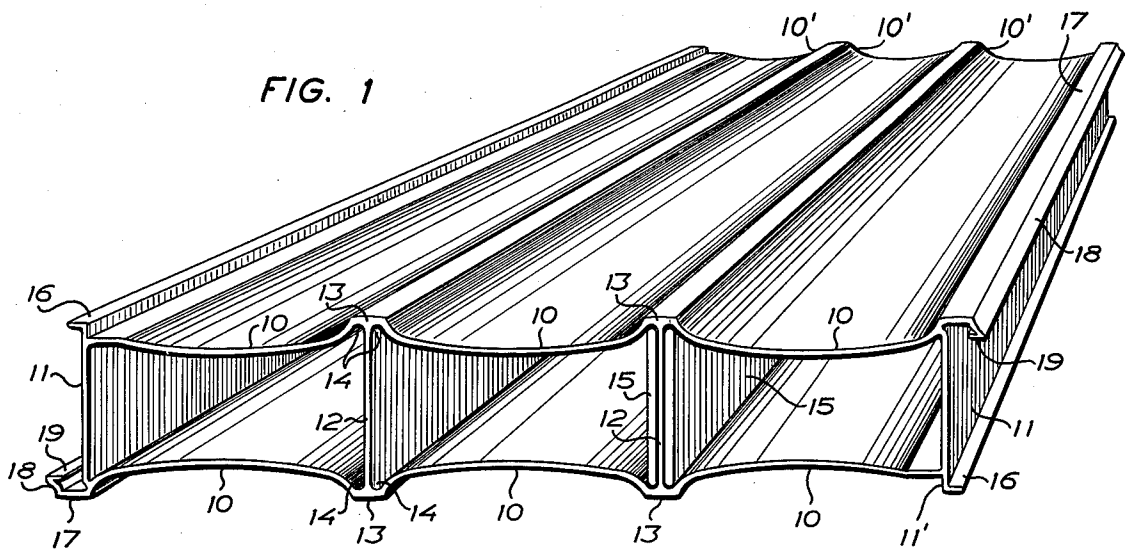


FIG. 1


10'
10'
10'
17
18
16
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19
11
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12
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19
18
16
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14
14
13
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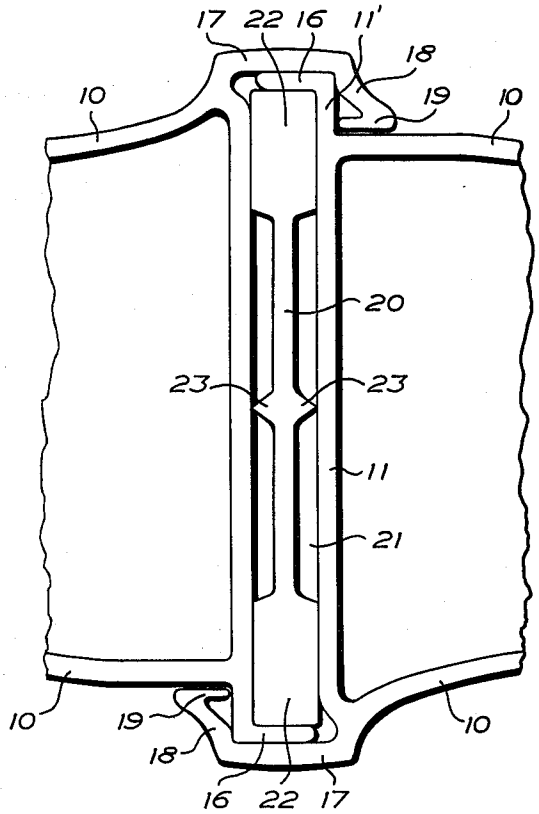
13
10
11'
17

FIG. 2


17
22
16
11'
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HOLLOW STRUCTURAL PANEL OF EXTRUDED PLASTICS MATERIAL AND A COMPOSITE PANEL STRUCTURE FORMED THEREOF

This application relates to a hollow structural panel of extruded plastics material forming between a pair of opposite side walls a number of individual cavities bounded by interparallel end walls and partition walls, and is a continuation-in-part of my pending patent application Ser. No. 122,531, filed Mar. 9, 1971 now abandoned.

Hollow structural panels of extruded thermoplastics material such as polyvinyl chloride are previously known having a single cavity or several cavities which are bounded by parallel end walls and planar or exteriorly convex and interiorly concave side walls. These panels are interconnected by the connecting means at the end walls to provide the width or length required. However, the form stability and, thus, the moment of inertia of such prior art panels, when loaded, is considerably decreasing on account of the panel being deformed when loaded even by its own weight. Such deformation under load is dependent of time and temperature, and in case the panel is mounted in such position that it will carry, for an extended period, a permanent load acting transversely to the main plane of the panel such as the load caused by the weight of the panel probably supplemented by a snow load, when the panel is used as a roof panel it is in most cases necessary to provide limited spans for the panel for example by arranging a bulky supporting structure in order to avoid that there will be obtained eventually a deformation of the panel, which cannot be accepted neither from a constructional point of view nor from an aesthetical point of view. The value of the decrease of the form stability and the moment of inertia up to the rupture limit is many times greater as compared with that of most structural panels or beams of other materials. The decrease of the form stability is principally caused by the side walls being deformed inwardly, and in such panels having convex/concave side walls there has been measured before the rupture limit a decrease of the moment of inertia of about one third of the original value. Structural panels having planar side walls are somewhat more satisfactory and so is a proposed design of the structural panel having convex/concave side walls, wherein a stiffening web is provided between the side walls at the largest spacing thereof to divide a single cavity of the panel into two individual sections, but also in these panels the great decrease of the form stability is of substantial disadvantage and renders impossible an exact static calculation without previous practical tests in each individual case.

The object of the invention is to reduce this decrease of the form stability of a hollow structural panel of the type referred to above and thus to enable the panel to be mounted as a self-supporting structure over large spans without bulky supporting arrangements including beams or other auxiliary members which are unaesthetical and may interfere with the translucency of the panel usually made of a translucent plastics material, in a substantially less inclined position than has been possible so far. This reduction of the decrease of the form stability is achieved by transforming the bending stresses in the side walls of the panel into compressive and tensile stresses, thereby inter alia enabling greater spans to be achieved.

According to the invention there is provided a hollow structural panel of extruded plastics material comprising mutually spaced interparallel end walls, I-beams spaced from the end walls and extending along the end walls in parallel therewith, flanges on the I-beams and integral therewith, which flanges form substantially planar end surfaces of the beams, opposite side walls integral with the flanges and the end walls and spanning the spaces therebetween, the side walls forming a concave outer surface and a convex inner surface and bounding together with the end walls and the I-beams a number of individual cavities, and connecting means on the end walls for the interconnection of panels adjoining each other.

In a preferred embodiment of the invention the marginal portions of the side walls, joining the flanges of the I-beams, form together with the flanges and the web of the I-beams interior channels extending along the webs on each side thereof, for the reception of stiffening members. When a panel of substantial length is supposed to be under heavy strain due to the load of the panel itself possibly increased by snow resting on the panel as may be the case when the panel forms a roof panel, or due to the wind pressure as may be the case when the panel forms a more or less vertical window closure, stiffening elements may be provided in the interior of the panel cavities where they are protected from the surroundings and where they do not substantially interfere with the light transmission afforded by the panel.

The invention also provides novel connecting means for interconnecting adjacent panels, which facilitate the mounting of the panels in a substantially less inclined position than has been possible so far, without the necessity to make special arrangements for sealing the joint between the panels against penetrating water.

According to the invention there is also provided a composite panel structure including a number of hollow structural panels of extruded plastics material, each comprising mutually spaced interparallel end walls, I-beams spaced from the end walls and extending along the end walls in parallel therewith, flanges on the I-beams and integral therewith, which flanges form substantially planar end surfaces of the beams, opposite side walls integral with the flanges and the end walls and spanning the spaces therebetween, the side walls forming a concave outer surface and a convex inner surface and bounding together with the end walls and the I-beams a number of individual cavities, and connecting means on the end walls, interconnecting panels adjoining each other and comprising first and second flanges at each of said end walls, of which said first flanges on the opposite end walls are hook-shaped and diagonally opposed to each other and said second flanges on the opposite end walls are diagonally opposing each other and are formed each on an extension of the end wall, extending beyond the adjoining side wall, said hook-shaped first flanges on adjacent end walls of adjoining panels receiving each one of the second flanges on such end walls.

In order to explain the invention, an embodiment thereof will be described in greater detail in the following with reference to the accompanying drawing, in which

FIG. 1 is a perspective view of a structural panel according to the invention; and

FIG. 2 is a fragmentary end view of the panel showing the connecting means for interconnecting the panel with a similar adjoining panel to a composite panel structure both panels being partly shown.

The structural panel according to the invention is to be made of extruded thermoplastics material such as rigid polyvinyl chloride preferably of the translucent type. It is formed as a hollow or boxed panel having a pair of opposite side walls **10** and a pair of opposite end walls **11** as well as two partition walls **12** extending in parallel to the end walls. The end walls **11** and the partition walls **12** are plane webs each partition wall **12** being formed as an I-beam with end flanges **13** which are integral with the side walls **10.** These flanges **13** form substantially planar sections of the side walls **10,** the portions of the side walls between the end and partition walls being concave on the outer surface and convex on the inner surface and "hanging down" between the end and partition walls. The hanging down may amount to for instance 10 percent of the span between the end and partition walls. Thus, the hollow structural panel is divided into three individual cavities, the partition walls being provided as reinforcing and stiffening beam elements in the box construction, and the sections of the side walls **10,** which bound each individual cavity, have already from the beginning an ideal shape for load conditions, the outer surface being concave and the inner surface being convex, this shape being maintained during loading of the panel.

However, when large spans are concerned it may be necessary to stiffen up the panel in order to avoid deformation thereof when the panel is loaded. For this purpose marginal portions **10'** of side walls **10,** joining flanges **13** form together with such flanges and web **12** semi-circular channels **14** which extend along the I-beams on each side of web **12** adjacent each flange **13.** These channels are adapted to receive stiffening elements two of which are shown at **15,** which are formed as flat bars of a metal such as steel or light metal or alloy and have longitudinal edges curved in cross section to substantially match the form of the channels. These stiffening elements are slid into the cavities of the panel the longitudinal edge portions thereof being guidingly received by the channels. Elements **15** have slip fit in the channels in order to be easily slid to position in the panel along web **12** and they should have the same length as the panel to extend over the full length thereof. If the panel is curved the stiffening elements must have the same curvature as the panel. Thanks to the slip fit and the clearance provided thereby between the elements and the surfaces bounding the channels minor differences in the curvatures of the panel and the stiffening members, respectively, will be accounted for.

For the interconnection of a panel of the embodiment described and a similar panel each of the end walls **11** is provided with connecting means. Such connecting means comprise a flange **16** on an extension **11'** of end wall **11** at one end thereof, projecting perpendicularly from the side of the wall which is opposite to the adjacent cavity of the panel, and a hook-shaped flange **17** projecting in the same direction as flange **16** from a reverse curve connecting web portion of end wall **11** but at the other end thereof. Flange **17** terminates in an outwardly projecting and outwardly curved lip **18** which forms a ledge **19** projecting inwardly towards end wall **11.** The two flanges **16** are opposing each other diagonally on end walls **11** as are the two flanges **17,** and the interconnection with an adjoining panel is provided as shown in FIG. **2.** Flange **17** is of a size to receive flange **16** as is shown in FIG. **2,** and the length of extension **11'** is substantially the same as the length of lip **18** including ledge **19** such that flange **16** abuts flange **17** when ledge **19** is close to the outer planar strip surface portion of side wall **10** which joins extension **11'** from which flange **16** projects. Thereby will be provided a water tight connection between adjoining panels. Due to the concave form of the outer surface of side walls **10** water collecting on the panel will flow in a direction away from the joints between the panels to be drained off by the gutter formed by the concave surface. Thus, no water will collect or will be retained at the joints. Of course, the panel will always be arranged such that it is inclined more or less in the longitudinal direction of the I-beams in order that water collecting on the surface of the panel will be easily drained off. Lip **18** and ledge **19** form together with extension **11'** a labyrinth seal preventing water to be forced by wind pressure into the joint between the panels and this seal makes it possible to arrange the panel or a composite panel structure according to the invention at a minimum angle of inclination which is substantially smaller than that accepted for prior art panels and panel structures. According to the invention a minimum angle of the order of 6° may be allowed.

Locking means formed as wedges **20** may be disposed between the connecting means. These wedges may be of a length which corresponds to the full length of the interconnected panels or they may be of a substantially shorter length in which latter case two or more wedges are provided between two adjoining panels. The wedges are inserted between end walls **11** of two adjoining panels to define a space **21** therebetween. Each wedge **20** has along its longitudinal edges a bulge **22** which has tight fit in space **21** between flanges **16** such that the adjacent panels will be positively held in a firm interengagement by the wedges at flanges **16** and **17** when the wedges are driven into space **21.** Spacing ribs **23** may be arranged on the plate between bulges **22.**

The width of the hook-shaped flange **17** preferably should be as large as the width of the flanges **13** formed by the partition walls **12,** so that the side walls of a composite structural panel will have a number of concavities on the outside, the concavities being regularly interrupted by planar sections of the same width, formed by the flanges **13** and the flanges **17,** respectively.

What I claim is:

1. A composite panel structure including a number of hollow structural panels of extruded plastics material, each panel comprising mutually spaced interparallel end walls, at least two intermediate I-beams spaced from the end walls and extending along the end walls in parallel therewith, each I-beam having a web and flanges on each end and integral therewith, which flanges extend along the web and project on both sides of the web generally perpendicular thereto to form substantially planar outer surfaces of the beams, portions on the inner surface of each flange forming channels extending along the web one on each side of the web, the channels formed by opposite flanges of an I-beam opposing each other on the respective sides of the web to receive a stiffening member extending along the web, opposite side walls extending between and joined to the I-beam flanges and the end walls and spanning

the spaces therebetween, the side walls having a concave outer surface and a convex inner surface and bounding, together with the end walls and the I-beams, a number of individual cavities, and connecting means on the end walls for interconnecting panels adjoining each other and comprising first and second flanges formed at first and second ends of each of said end walls, of which said first flanges on the opposite end walls of adjoining panels are formed as hook-shaped portions and are diagonally opposed to each other and are joined to said first end of each said end wall by a reverse curve connecting web, said side wall being joined to said reverse curve connecting web portion of said end wall, said second flanges on the opposite end walls of adjoining panels are diagonally opposing each other and have a planar surface generally parallel to said I-beam flanges and are formed each on an extension of the second end of each said end wall extending beyond the adjoining side wall, said hook-shaped first flanges on adjacent end walls of adjoining panels receiving each one of the second flanges on such end walls, each said first flanges including a substantially planar surface extending generally parallel to said planar I-beam flanges and being of substantially the same width and at the same level as said I-beam flanges, an outwardly projecting slanting lip extending from the free end of said planar surface of said first flange and terminating in a ledge projecting inwardly substantially in parallel with said planar surface of said first flange, said planar surface of each said first flanges together with the associated lip and ledge forms said hook-shaped portions, outer planar strip surface portions on said side walls and connected to said extensions, each said strip surface portion extending along an associated extension, each said outer planar strip surface portions abutting said ledge portion of an adjacent panel when said panels are joined, and forming, together with said ledge portion and said extension, a labyrinth seal between said panels, and at least one wedge insertable between adjacent end walls of adjoined panels for forming a spacer between said panels, said wedge having edge surfaces which extend along the first and second flanges formed at the end walls of each of said adjoined panels, pressing each said first flange into firm engagement with each said adjacent second flange.

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