April 6, 1965 J. PAVLECKA 3,176,807

INTERLOCKED PANEL STRUCTURE

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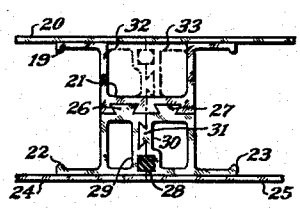


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

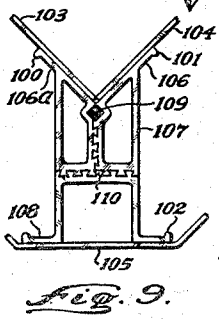


Fig. 9.

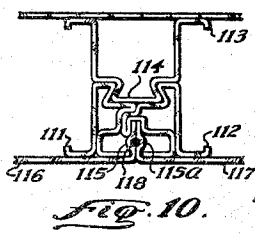


Fig. 10.

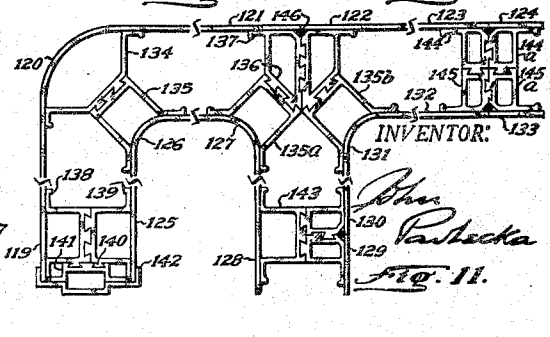


Fig. 11.

INVENTOR:

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INTERLOCKED PANEL STRUCTURE

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This invention relates to structures such as walls, floors and partitions in buildings, decks, platforms, bill boards, cabinets and furniture, etc., in general, and more particularly to a novel type of such structures which consists of spaced apart panels and stress members in the form of stringers on them, which stringers are dovetailed into one another to lock the panels together in both adjoining as well as facing relationships.

One object of my invention is to devise a structure of the aforementioned type which is fabricated with full accessibility as a number of duplicate components, and is assembled easily in situ without any loose fastening parts such as screws, rivets, bolts and nuts, etc., and can equally easily be dismantled for relocation, repair, or inspection.

A further object resides in a structure for the aforementioned purposes which possesses unusual strength for its weight because of the use of interior stress members of a large section modulus in the form of stringers which serve also as the carriers of the interlocking means for the components of the structure.

Another object is a hollow structure which has an inaccessible interior and must have a smooth and unblemished exterior, devised so that it can be fabricated as a number of panel units with full accessibility and with the use of such rapid processes as resistance welding and adhesive bonding, and which is assembled by sliding the panel units into an interfitted or dovetailed engagement with one another.

An object of importance from the standpoint of both manufacture, appearance, and utility of the new structure resides in that the widest available panels can be employed so that the least number of parting lines is necessary, and moreover, effective sealing means are provided for the parting lines extant so that the structure becomes a unitary elementproof body.

The structure fulfilling the above objects and distinguished by other advantages and advanced features is disclosed in the following paragraphs first in its principle with reference to all the figures in the drawing forming an integral part of this specification, and then with reference to the individual figures therein each of which represents a distinct embodiment of that principle.

The exterior surface or surfaces of the structure are provided by a number of panels or panel units that meet at parting lines either in a coplanar or a right angle relationship in spaced apart rows; the panel units have a number of parallel stress members extending on them which confront one another in juxtaposition at panel parting lines, and in opposition with one another both at panel parting lines and at intervals apart therefrom, and are slidably interlocked with one another so that they function jointly as beams, studs, columns, spars, etc., depending upon the application of the structure. For this function the stress members are made in the form of stringers, preferably of the "hat" type and of a large moment of inertia, well suited for sustaining compressive loads as in studs, bending loads as in beams, and combined bending and torsional loads as in spars.

The stringers, in addition to functioning as stress members, perform an equally important function as the carriers of means for interlocking the panel units relatively immovably in their various relationships; to this end, each two oppositely alined stringers on facing spaced apart panel units carry longitudinal complementally shaped formations in a slidable engagement with each other.

These formations may be of any shape or configuration, one of the most advantageous types being reentrant or dovetail mortise-and-tenon formations.

Such reentrant or dovetail mortise-and-tenon formations on each two oppositely alined stringers may consist either of one longitudinal dovetail tenon on one of the stringers, and of a conforming mortise on the other one, or any larger number of such congruently and slidably interfitted tenons and mortises may be used on each pair of matched stringers. By means of such paired stringers located at parallel and equal intervals from one another, spaced apart panels or panel units become locked with one another face-to-face by being telescopically slid into an engagement of their stringers; in this union the dovetail shape of the interlocking tenons and mortises offers an advantage in that a certain amount of wedging action can be introduced into their slip fit without impairing their slidability and yet eliminating all lash and looseness; a further improvement in relative immobility of the interlocked stringers and their panel units is obtained by locating the reentrant flanks at which such wedging takes place on the opposed stringers as far apart as practicable; to this end, the formations have their marginal tenons and mortises only one half as wide as their normal ones; such half-tenons and half-mortises provide substantially flat shoulders by their respective tops and bottoms along the stringer extreme width next to their corners, which shoulders on the opposed stringers are in contiguity with each other and afford a maximum base of abutment for the stringers against swaying motion; panel units braced relatively immovably by the stringers so abutted on them may employ panels of thin gauge stock.

For interlocking panel units with each other in either a coplanar or an angular relationship at a parting line, and thereby making it feasible to assemble structures of any size or length, the panels or panel units are provided with a novel type of stringer at and along two parallel edges, which type is hereinafter referred to as the "edge" or "juxtaposed" stringer in distinction to the hereinabove disclosed type referred herein as the "intermediate" one; the edge or juxtaposed type of stringer is distinguished, among other features, in that it represents generally one half of one intermediate stringer so that in lateral juxtaposition at each panel parting line two edge stringers on adjoining panels or panel units constitute a full equivalent of one intermediate stringer, and can be placed in opposite alinement and interlocked slidably with either one such intermediate stringer or with two edge stringers bearing interfitting formations and shoulders therealong congruent with their own.

In order to secure such edge stringers and their panel units together, a number of devices can be employed either singly or in conjunction with one another; one of them resides in the use of the same dovetail mortise-and-tenon formations that hold oppositely alined stringers together and which consist of multiple tenons and mortises; offsetting the parting plane between two edge stringers will cause two half-tenons on them to be engaged by a single mortise in a companion opposite intermediate stringer, or in an opposite edge stringer, whereby the union of such edge stringers obtains through the medium of a third one. Another device resides in a lengthwise portion of one stringer entered interlockingly in the other one; this construction may employ a single engaging tongue or it may employ the same kind of dovetail mortise-and-tenon means as used on the stringers frontally but located on their lateral confronting walls; by using a number, i.e., one or more dovetail tenons and mortises on the sides of the edge stringers, they and their panel units can thus be interlocked with one another independently of the stringers in opposition to them on panel units in a parallel or in a right-angle row, and such single row of panels can

be used in certain applications as a complete structure in itself. Yet another such device employs panels with flanges turned up from them at the parting line, both of the flanges being engaged by one of the stringers thereat by fitting into a lengthwise groove in it.

This function of the juxtaposed stringers as the carriers of means for securing panels or panel units together slidably both in spaced apart facing and laterally meeting relationships, besides providing indispensible stress members for them, is supplemented by yet another significant and important feature in that they allow panels or panel units of different widths to be integrated into continuity and, because of their equivalency with intermediate stringers, allow spaced apart facing panel rows to be slid into unity with one another in a random relationship of the parting lines therein; this feature endows the structure of my present disclosure with versatility and utility for an endless number of applications.

Moreover, by employing an even number of stringers in a particular arrangement on the panel units, which stringers bear symmetrical mortise-and-tenon formations on them, as disclosed hereinfurther, or by employing assymetrical mortise-and-tenon formations on stringers of either an even or an odd number on the panel units, such panel units may be duplicates of one another and in any case, are compatibly associable with each other in overlapping relationships of any portions thereof, or in full facing positions.

A further feature of utility resides in that a structure so assembled can be made impervious to elements by sealing strips deposited in it at the parting line, and compressed between the edge stringers as they themselves are held together by either a stringer opposed thereto, or by a direct interlocked engagement with each other in a location adjoining such sealing strips and between them and the frontal interlocking formations on the stringers.

These novel structural concepts and features are described in the following text in their application to a number of embodiments as represented in the figures in the drawing, and in which:

FIG. 1 is an end view of a structural union in which panels in two rows are held in adjoining and facing relationships by edge stringers interlocked slidably with an intermediate one;

FIG. 2 is an end view of a structural union of three panels in two spaced apart rows by means of edge and intermediate stringers dovetailed slidably into one another laterally and frontally;

FIG. 3 is a perspective view of a length of a building wall partly sectionalized to illustrate the interlocking instrumentalities on edge and intermediate stringers that hold adjoining as well as spaced apart facing panel units together;

FIG. 4 is a profile view of a structural union showing characteristic stringer shapes with interfitted dovetail tenons and mortises thereon;

FIG. 5 is another structural union with a modified configuration of the dovetail tenons and mortises on the stringers therein from that in FIG. 2;

FIG. 6 represents another configuration of interfitted tenons and mortises in a frontal union of two edge stringers with an intermediate one, and in a tongue-and-groove engagement of the edge stringers with each other;

FIG. 7 is a profile view of a union of four edge stringers with offset parting planes through each two juxtaposed stringers so that they are locked to each other by one of the opposite edge stringers;

FIG. 8 is a dovetail union of one intermediate and two edge stringers that form jointly a tubular member with their cross-webs;

FIG. 9 is an end view of a union of edge stringers dovetailed into each other and into an intermediate stringer, the edge stringers being attached to right-angle panels such as occur at wall intersections;

FIG. 10 is a union of two edge stringers with an intermediate one, the stringers being made of sheet material; and

FIG. 11 is a plan view of a wall structure in a building in which panel units are interlocked with each other by means of stringers on them and which in various relationships form hollow walls and intersections between them.

The union of FIG. 1 has for its purpose to conjoin slidably and separably three panels two of which, 1 and 2, are meeting with each other at a parting line, and the third one, 3, is in a spaced apart facing relationship to both of them; the panels are provided with stringers 4, 5 and 6, respectively, and with a number of such stringers on them become panel units and represent the basic components of a multitude of structures. The stringers 4 and 5, both alike, are of the "edge" type in that they are attached to their panels at and along the edges in juxtaposition to each other; the stringer 6 is of the "intermediate" type in that it is attached to its panel apart from two of its parallel edges, and its characteristic features include two spaced flanges such as 7, walls such as 8 standing on them, and a cross-web which connects the walls and forms two shoulders 11 next to the corners on the side walls; between these shoulders runs a number, i.e., one or more of longitudinal mortises of a reentrant shape; two of such mortises 9 and 10 in this case, with reentrant flanks, are separated by a tenon and have half-tenons running alongside them under the marginal shoulders 11, and represent the interlocking instrumentalities for the stringer.

The profile of the edge stringers includes an attaching flange 12 at and along the panel parting line and another flange 13 spaced from it, walls 14 and 15, respectively, standing on the flanges, and a cross-web which provides a marginal shoulder 16 along the stringer corner on the wall 15, and next to this shoulder a lengthwise tenon 17 with reentrant flanks; in juxtaposition, the twin edge stringers 4 and 5 jointly form a complement to the intermediate stringer 6 in that their shoulders 16 fall into contiguity with the shoulders 11 on the latter stringer, and their tenons 17 interfit slidably with the mortises in the latter and by thus becoming interlocked with it are also locked to each other, as are their panels 1 and 2. The usefulness of this union depends upon it being impervious to elements, and this is realized by sealing the parting line by means of a sealing strip 18 confined between lateral walls 14 of the edge stringers 4 and 5.

The stringers in the union of FIG. 1 represent the basic parts which are used in duplicate numbers to obtain panel units of any modulator width for structures of any extent or shape; such a union then is representative of a whole structure because the intermediate stringer 6 can be placed in opposed alinement with another intermediate stringer of a configuration corresponding to the combined edge stringers 4–5, and slidably interlocked therewith to conjoin two spaced apart panel units in a facing relationship; and, the edge stringers 4–5 can be interlocked with two other edge stringers in opposition thereto which are jointly an equivalent of the intermediate stringer 6, for conjoining the panels 1–2 with two other such panels in a facing row. Accordingly, all the other unions disclosed in the following figures are condensed embodiments of complete structures, mainly because of the application of the hereinabove established principle of equivalency between an intermediate stringer and two edge stringers; this principle is further documented in its full significance in the union of FIG. 2.

In this union an intermediate stringer 19 on a panel 20 corresponds to the stringer 6 of FIG. 1 in that it is of the same "hat" shape in which a cross-web 21 has two mortises running lengthwise therein between two marginal shoulders, both mortises in this instance being of a dovetail shape. Edge stringers 22–23 are attached to appertaining panels 24–25 at and along their parting line in opposition to the stringer 19, and each stringer carries one lengthwise tenon 26 and 27, respectively, between one

marginal and one central shoulder; these tenons and the half-mortises on the shoulders alongside them are complemental to the mortise-and-tenon formations on the stringer 19, and are in a slidable interfit with it.

A feature of importance in this union resides in that the stringer lateral walls 29 and 30 are formed with complemental dovetail formations as represented by a tenon 31 on one of them and a mortise receptible of it on the other one. These formations lock the stringers 22–23 and their panels 24–25 into unity without dependence in that respect upon the stringer 19, and such panels and stringers can be used either alone in a structure employing but one row of panel units, or in opposition to two edge stringers 32–33, shown in dot-and-dash lines, as equivalents of the stringer 19, and differing from it in the portions indicated by the dot-and-dash lines which represent lateral walls with the dovetail formations on them and a seal between them.

The importance of the edge stringers interlocked with each other and jointly providing an equivalent of one intermediate stringer, as the stringers 22–23, or 32–33, do in the union of FIG. 2, and in all the unions hereinfurther disclosed, lies in that panel units of different widths can be integrated into a structure without any regard as to whether the parting lines in facing panel unit rows fall into coinciding or non-coinciding positions.

The wall structure of FIG. 3, in addition to embodying the foregoing principles, possesses certain other novel and useful features; its exterior surfaces are provided by rows of panel units 34–35–36 and 37–38–39, of which certain ones have on their inner face edge stringers 40 and 41, and every alternate panel unit has on it one edge stringer such as 42, which is a mate to the stringer 40, and another edge stringer such as 41*a*, which is identical with the stringer 41. Between its edge stringers, each panel unit bears at spaced equal and parallel intervals intermediate stringers of two kinds 43 and 44, the former of which has a dovetail tenon 45 on its frontal face, and the latter a corresponding mortise on a cross-web 46, both the tenon and the mortise running between two marginal shoulders. Of the three types of edge stringers 40, 41 and 42, the types 40 and 42 are formed each with an attaching base 47, side walls 48 and 49 supporting a cross-web 50 on which runs lengthwise one half of a mortise with a reentrant flank 51 under a marginal shoulder on the corner extremity of the outer wall 49; in juxtaposition, these matched edge stringers jointly create a dovetail mortise in them between two shoulders; both stringers are formed with complemental interlocking means on their lateral wall 48 in that one carries a dovetail tenon 52 on it, and the other one a corresponding mortise in it, and both are grooved lengthwise at the parting line and next to the tenon 52 for accommodating a sealing strip 53.

The third edge stringer type 41, and its twin 41*a* on an adjoining panel, differ from their counterparts 40*a* and 42*a* on facing panels in that each one has but one supporting wall 54 which carries an overhanging cross-web with a marginal shoulder on it and a dovetail half-tenon 55 next to the parting line plane; in juxtaposition, the stringers 41–41*a* form one whole tenon between two shoulders, and are slidably interfitted shoulder-against-shoulder with the mortise in the opposite edge stringers 40*a*–42*a*, and in other locations are interfitted with an intermediate stringer of the type 44; in either association, the combined edge stringers 40*a*–42*a*, or the stringer 44, grip the stringers 41–41*a* and hold them and their panel units against separation; the engagement of all of the stringers in opposition with each other is effected at their reentrant flanks located as close to the outer stringer wall as practicable for a wide purchase on each other; furthermore, the opposed stringers are in contiguity with each other at their shoulders and are thus provided with an abutment base equal to their full width against relative swaying motion, in-and-out motion, and for improved slidable guidance at assembly; stringers so united with each other relatively immovably are able to brace their thin panels effectively as well as function as a unitary stress member in the wall.

The two intermediate stringer types 43 and 44 fall into opposite alinement with each other on identical panel units such as 35 and 38 when in facing positions, or if the parting lines in the two spaced rows do not coincide, they wall into alinement with their respective complemental sets of edge stringers such as 40–42 and 41–41*a*, and are interfitted slidably therewith as provided for by the principle of equivalency of these parts hereinabove disclosed.

The erection of the structure of FIG. 3 includes as one of its steps, setting up the row 37–38–39 on a sill 57, which is bolted down to a foundation 58, and securing the panel units to it by brackets 59 which are attached to the stringers as by rivets 60, and by bolts 61 to the sill; the panel units in the other row 34 to 36 are then dropped into their interlocked positions with one another and with the stringers on the first row.

There are infinite variations possible in all the components of my new structure without affecting their functions and relationships, one such modifictaion being shown in the union of FIG. 4; this union is applicable to structures such as floors that are subject to bending loads and in which it is of advantage to concentrate the material close to the side that carries compression stresses; this is done by reducing the height of the stringers on that side to a minimum so that an intermediate stringer 62, or two edge stringers equivalent to it, have a flat shape with a number of tenons 63 running lengthwise on it between marginal shoulders. Edge stringers 64–65, or an intermediate stringer equivalent thereto, on the opposite panel units are of a normal "hat" profile with shouldered mortises in them engaging the tenons 63, and with at least one tenon 66 and a corresponding mortise on their lateral walls for locking them to each other and thereby also locking together the two edge stringers that may take place of the stringer 62. A sealing strip 67 is included between the edge stringers and is compressed by the engagement of a tenon 66 with a mortised wall in the companion stringer.

Another modification, shown in FIG. 5, concerns the interlocking formations; a structure employing this union includes but one type of intermediate stringer, such as 68, and only two types of edge stringers as represented by 69–70, as contrasted with the structure in FIG. 3 wherein two intermediate and three edge types of stringers are needed to make the panel units universally associable. This advantageous configuration is the result of an inversion of the mortise-and-tenon formations on one half of the intermediate stringer 68 so that they become asymmetrical, with non-coplanar marginal shoulders and a tenon 71 and a mortise next to them, and with half-mortises running alongside the former and half-tenons such as 72 alongside the latter at the stringer corners. Edge stringers 69–70 are formed one with a tenon, and the other one with a mortise, each running between marginal shoulders, so that in unity they amount to an equivalent of the stringer 68. In addition, the edge stringers 69–70 are provided with lateral interlocking means in the form of tenons 73 and 74, respectively, extending thereon lengthwise next to a mortise in each stringer for the engagement of each other's tenon; a sealing strip 75 is lodged in between the edge stringers in proximity of the parting line.

The significance of the asymmetrical mortise and tenon formations on the stringers of FIG. 5 resides, as already pointed out, in a reduction to a minimal number of different stringer profiles needed for panel units constituting a complete wall, but extends even further because of the fact that intermediate stringers are congruent in opposition with each other, as are any two juxtaposed stringers with two other like stringers, or with one inter-

mediate stringer; the results of such universally associable stringers of only three profiles are that panel units are not limited to an even number of stringers on them to be identical and oppositely associable with one another, but can have either an even or an odd number of stringers on them, and will be congruent and associable with one another in any partially overlapping or fully facing relationships with each other; in consequence, the panel units can be of any width which is equal to or is a multiple of the distance between two intermediate stringers on them, and their parting lines in both rows in a hollow wall may occur in either coincidental or non-coincidental relationships.

The structural union of FIG. 6 presents further modifications of both the frontal and the lateral interlocking devices on stringers 76 and 77–78 therein; on a frontal face 79 provided by coplanar marginal shoulders on all three stringers on coplanar marginal shoulders, in distinction to the non-coplanar shoulders in the union of FIG. 5, extends a dovetail tenon 80 on the stringer 76, which is engaged by a mortise in the edge stringer 78, and inversely, a mortise running in this face in the other half of the stringer 76 is occupied by a tenon 81 on the other edge stringer 77. Again only one type of intermediate stringer 76, and of each of edge stringer types 77 and 78, is required to interfit congruently in any combination in a complete structure.

The lateral locking means on the edge stringers 77–78 is in this case of the groove-and-tongue profile, one of the stringers having a tongue 82 at and along the parting plane, and the other one having a groove between angularly connected walls 83 around the tongue 82. A sealing strip 84 is confined in a corner of the stringer 77 and held in compression therein under another tongue 85.

A configuration of the stringer frontal interlocking formations which functions also as lateral means for interlocking the edge stringers with each other is shown in FIG. 7; this union is between two oppositely alined pairs of edge stringers 86–87 and 87*a*–86*a* and is, of course, representative of a whole structure the same as all the other unions disclosed herein because an intermediate stringer equivalent to either pair of stringers can be substituted for such pair, or two intermediate stringers can take the place of both pairs apart from the parting lines on opposite panel rows. The mortise-and-tenon formations on the stringer frontal faces are again asymmeterical about a central or median plane so that a tenon runs on one side of it and a mortise on the other between non-coplanar marginal shoulders in both stringer pairs; the feature that characterizes this configuration resides in that the dividing plane between the stringers in each pair is offset laterally through the outer portion of the stringer from its central location so that it divides the tenon thereon into two halves such as 88, each half being borne on one of the stringers of unequal width; in addition, one of them, the stringer 87, has a mortise running therein between two half-tenons 88*a* and 89; with this mortise the wider stringer 87 engages the two half-tenons on the opposite pair of edge stringers 86*a*–87*a*, thereby locking them to each other, and is locked to its mate 86 in a reciprocal manner by the opposite stringer 87*a*.

For sealing the edge stringers 86–87, a soft strip may be lodged between them in the manner as disclosed in the preceding embodiments herein, or their profile may be modified to include a flange 90 next to the dividing plane at the parting line so that it stands side-by-side with a like flange 90*a* on the twin edge stringer, and a tongue 91 on the overhanging cross-web of one of the edge stringers in opposition to the flanges 90–90*a* and separated therefrom by a gap; into this gap is slipped a molding 92 which is grooved to straddle both the tongue 91 and the flanges 90–90*a*.

Other modifications may be effected in the stringer profile in order to secure any specific advantages such as increased strength in certain kinds of loading, and FIG. 8 shows stringers 92 and 93–94 so reinforced in their function as studs in a wall. In this case, the frontal interlocking means on the stringers is substantially the same as that in the union of FIG. 6, and consists of two inversed tenons 95 and 96, one on the intermediate stringer 92 and the other one on the edge stringer 94, and of coresponding mortises in the edge stringer 93 and in the intermediate stringer 92, respectively; these tenons and mortises are in widely spaced locations at the stringer marginal shoulders, and the stringer crosswebs 97, 98 and 99 between them are concavely arcuate so that jointly they constitute a tubular member in the center of the union which adds considerably to the capacity of this union in column type of loading. The lateral interlocking means on the edge stringers 93–94 may be of any of those disclosed in the preceding figures, such as for instance the one in FIG. 2, as shown.

All of the structural unions disclosed in the foregoing figures are applicable equally well to panel units meeting either in a coplanar or angular relationship at parting lines; this is documented in FIG. 9 wherein edge stringers 100-101 and an intermediate stringer 102 are attached to respective panels 103-104 and 105 which form a corner intersection between two walls, such as in a building, cabinet, bus or truck body, etc.; in this embodiment, the stringers 100–101 are inclined on their panels at an obtuse angle between their flanges such as 106 and side wall 107, which angle in this particular instance amount to 135 degrees. In the assembly, the stringer flanges 106–106*a* define a right-angle corner and so of course do their panels 103–104. The stringer 102 is shown, by way of an example, as having coplanar flanges such as 108 even though it is part of a panel unit continuous around a corner, the portion of the panel 105 on which the stringer stands being beveled off. A sealing strip 109 is compressed between the stringers by their lateral locking means which consists of interfitted dovetails on the stringer walls between the sealing strip and the frontal formations on the stringers.

The frontal and lateral interlocking formations on the three associated stringers 100–101 and 102 are of a plural dovetail mortise-and-tenon type, asymmetrical about the parting plane so that a tenon 110 runs on one side of it and a mortise on the other in the stringer 102, or in the combined stringers 100–101, and a number of other such mortises and tenons parallels them within the stringers' width; this central pattern at the parting plane can obviously be replaced by any one of those disclosed in the preceding embodiments but in reduced size and with other mortises and tenons added alongside the central ones. In this embodiment, the frontal engaging formations are borne by the stringers at right angles to a plane which bisects the angle between the panels 103–104 through their parting line, and the multiple reentrant mortise and tenon flanks on them provide for a uniform stress distribution in the stringer engagement between the marginal corners and shoulders therealong.

The asymmetrical mortise-and-tenon formations on the stringers shown in FIGS. 5 to 9 afford a useful result in that the intermediate stringers bearing such formations can all be identical with each other in a structure, and so can the pairs of the juxtaposed stringers be identical and congruent in opposition with one another; moreover, by providing the panels at their edges with one of each of the stringers from a juxtaposed pair of them, such panels can be of any modular width, and will interlock compatibly with each other both in adjoining and in overlapping or full facing relationships at all modular intervals.

Although extruded shapes are shown in most of the unions herein disclosed as the stringers, shapes rolled of sheet material are equally practicable as already ex-

emplified in FIG. 1, and again in FIG. 10, the latter showing a union of stringers **111–112** and **113** all of which are fabricated of sheet stock; for its frontal interlocking device this union employs a dovetail tenon **114** and a congruent mortise such as shown in the structure of FIG. 3; the interfitted tenon and mortise run between marginal shoulders on the respective stringers in frontal contiguity with one another; for interlocking the stringers **111–112** with each other, a tongue-and-groove device such as holds the edge stringers **77–78** in FIG. 6 together is used; in this device, the tongue is provided by confronting flanges **115–115***a* on panels **116–117** on which the stringers stand; these flanges are embossed with longitudinal grooves, and one of them, **115***a*, forms a permanent lateral wall in the stringer **112**, and both flanges are fitted into a groove created by rolling the stringer material across and downwardly beyond the parting plane; in the assembled union, the panel flange **115** abuts the flange **115***a* as it is slid into the stringer groove face-to-face with it, and with a sealing strip **118** included between them.

As stated hereinabove, anyone of the structural unions disclosed in the preceding figures contains all the basic components of even a complex structure because of the novel principle of equivalency of the combined edge stringers with one intermediate stringer therein; as an example, FIG. 11 shows a wall structure derived from the union of FIG. 2, with five different relationships of the components of that union used therein; the usefulness of those components is augmented immensurably by adapting the angularity of their flanges, side walls and cross-webs to any particular direction of panel units **119** to **124** which constitute the facade of the structure, or panel units **125** to **133** which form inner walls and partitions; thus, at an L intersection between two hollow walls, an intermediate stringer **134** with its side walls at right angles enables the panel unit **120** to be continuous around a rounded corner; similar rounded corners are obtained in the inner panel units by providing them with intermediate stringers of the type **135** in which the flanges are at right angles to each other; or, by placing the cross-web **136** in an edge stringer **137** on a bias, a T intersection can be constructed of two such stringers, or of an intermediate one substituting for them, and of two diagonally directed intermediate type stringers **135***a* and **135***b*; and by providing at least one of opposite intermediate stringers **138–139** with lateral interlocking dovetail tenons such as **140**, a third stinger **141** can be secured laterally into unity with them, which stringer may be part of any structural member, such as a transverse terminal member in a wall exemplified by a door stile or window jamb **142**. By far the largest number of stringers in such a structure are of the intermediate and edge types **143** and **144–145**, respectively, which stringers, as well as the ones hereinabove disclosed, serve as the carriers of interlocking means and as unitary stress members, such as joists, studs and columns, in the structure.

I claim:

1. In a structure, two panels meeting with each other along their edges, stringers extending on said panels, each of said stringers having a first wall at and along a plane through said panel edges and having another wall apart from said first wall and connected therewith to form a hollow section, reentrant mortise-and-tenon formations borne on said first wall of each stringer and being complemental with the formations on the other stringer, said stringers being joined relatively immovably by said formations thereof in a slidable engagement with each other for holding said panels together at said edges thereof and for providing jointly by said hollow section thereof a unitary stress member of a substantial hollow section for said panels.

2. In a structure, panel units in a row meeting with one another at parting lines, structural members extending along said panel units and bearing reentrant lengthwise mortise-and-tenon formations along said parting lines at a distance therefrom and bearing reentrant lengthwise mortise and tenon formations at a distance from said panel units at equal intervals apart from said parting lines, intermediate stringers extending on said panel units and bearing mortise-and-tenon formations congruent and slidably engaged with said structural member formations apart from said parting lines, juxtaposed stringers extending on said panel units at said parting lines and bearing mortise and tenon formations congruent and slidably egaged with said structural member formations thereat, said intermediate stringers and formations thereon being all of equal width, and each two of said juxtaposed stringers and formations thereon being jointly of a width equal to one of said intermediate stringer formations whereby said panel unit parting lines may occur at anyone of said structural members and said panel units may be of different widths equal to any number of said intervals between said structural members.

3. In a structure, components and their relationships as set forth in claim 2, said reentrant mortise and tenon formations on said structural members being asymmetrical about a median plane therethrough and being identical with each other whereby said members may be duplicates of each other, said reentrant mortise and tenon formations borne on said intermediate stringers being identical with said structural member asymmetrical formations and congruent in said engagement therewith whereby said intermediate stringers may all be duplicates of each other, and said reentrant mortise and tenon formations borne on each two of said juxtaposed stringers being jointly equivalent of said asymmetrical formations on one of said intermediate stringers whereby said two juxtaposed stringers at all of said parting lines may be duplicates of other such stringers in said structure.

4. In a structure, components and their relationships as set forth in claim 3, said reentrant asymmetrical formations borne on said structural members and on said intermediate and juxtaposed stringers consisting of multiple dovetail tenons and mortises and including marginal half-tenons and half-mortises at the extreme width of said members and stringers for locating the engaging flanks of said formations thereon a maximum distance apart from each other, said marginal half-tenons and half-mortises providing shoulders with the respective tops and bottoms thereof next to corners at said extreme width of said members and stringers, and said members and stringers being in contiguity with each other at said shoulders for a wide base of abutment against each other.

5. In a structure, two panels meeting with each other at a parting line, a structural member extending along said parting line and at a distance from said panels bearing reentrant lengthwise mortise and tenon formations frontally thereon, at the extreme width thereof alongside said formations said structural member bearing corners and substantially flat shoulders thereat, stringers extending on said panels at and along said parting line and each bearing mortise and tenon formations congruent and slidably engaged with a portion of said structural member formations, each of said stringers bearing a corner and a shoulder thereat in contiguity with one of said structural member shoulders, and means borne on said stringers for locking each one laterally to the other one, said means being borne on said stringers in a location between said panels and said formations thereof for abutment of said stringers against each other thereat and for joint maximum width of abutment of both of said stringers against said structural member at said shoulders in coacting as a unitary stress member therewith and for holding said panels together relatively immovably.

6. In a structure, components and their relationships as set forth in claim 5, said locking means for said stringers residing in said panels having flanges at said parting line abutted with each other, one of said stringers having a

lengthwise grooved portion, said stringer grooved portion fitting over and engaging slidably said abutted panel flanges, said panel flanges having registering recesses therein at and along said panel parting line, and a sealing strip lodged in said recesses and being compressed by said flanges in engagement with said stringer portion.

7. In a structure, components and their relationships as set forth in claim 5, said locking means for said stringers being located between said stringers at a distance from said panels, and a sealing strip for said panel parting line lodged between said stringers within said distance and being compressed by said locking means thereat.

8. In a structure, components and their relationships as set forth in claim 5, said structural member being a stringer, a third panel extending at a distance from said meeting panels and bearing said stringer thereon, said stringer holding said panel immovably in relation to said meeting panels by said engaged formations thereof with said stringers on said panels and by said abutment against said stringers at said shoulders.

9. In a structure, components and their relationships as set forth in claim 5, said locking means for said stringers residing in said stringers having lateral walls in confronting positions of each other at a plane through said parting line, and reentrant lengthwise mortise and tenon formations borne on said stringer walls in a congruent and slidable engagement with each other.

10. In a structure, components and their relationships as set forth in claim 5, said locking means for said stringers residing in said structural member formations consisting of one full mortise on one side of a plane through said panel parting line and one full tenon on the other side of said plane, the dividing plane through said stringer formations being offset from said parting line plane to divide said formations unevenly between said stringers, one of said stringers bearing a mortise in engagement with said tenon on said structural member, and each of said stringers bearing one half-tenon thereon and being in engagement with said mortise on said structural member jointly with the half-tenon on the other stringer.

11. In a structure, components and their relationships as set forth in claim 5, said two panels meeting with each other at substantially right angles at said parting line, said structural member bearing said mortise and tenon formations and shoulders thereon at right angles to a plane bisecting the angle between said panels through said parting line, and said stringers bearing said formations and shoulders thereon in engagement and contiguity, respectively, with said structural member formations and shoulders by standing at an inclination on said panels next to said bisecting plane.

12. In a structure, two spaced apart panels facing each other, stringers extending on said panels in opposition with each other, said stringers bearing reentrant lengthwise mortise and tenon formations in a congruent and slidable engagement with each other, and alongside said formations said stringers bearing corners at the extreme width thereof and substantially flat shoulders thereat, said stringers being in contiguity with each other at said shoulders for maximum width of abutment against each other and relative immobility with each other and for coacting is a unitary stress member between said panels.

13. In a structure, components and their relationships as set forth in claim 12, said mortise and tenon formations borne on said stringers being of dovetail configuration and including marginal half-mortises and half-tenons in engagement with each other at said stringer corners, said half-mortises and half-tenons in engagement providing said shoulders in contiguity on said stringers with the respective bottoms and tops thereof.

14. In a structure, components and their relationships as set forth in claim 12, said reentrant mortise and tenon formations on one of said stringers consisting of a central tenon and portions of mortises therealong, the reentrant flanks of said tenon being spaced apart close to said stringer corners for a maximum width of engagement of said stringers with each other said formations on the other stringer consisting of a central mortise and portions of tenons therealong, said mortise and tenon portions of said stringers providing said shoulders in contiguity with each other at said stringer corners.

15. In a structure, components and their relationships as set forth in claim 12, said mortise and tenon formations on each of said stringers being asymmetrical about a central plane through said stringers, said asymmetrical formations on both of said stringers in opposition being identical and congruent with each other whereby said stringers may be duplicates of each other.

16. In a structure, two panel units spaced apart from each other, stringers extending on said panel units at equal and parallel intervals, said stringers bearing reentrant mortise and tenon formations frontally thereon, said formations being asymmetrical about a cantral plane and being identical and congruent in opposition with each other, said stringers on said panel units falling into opposition with each other in partly overlapping to full facing relationships of said panel units, and each two of said stringers in opposition being in a slidable engagement of said formations thereof with each other in any of said relationships of said panel units whereby said panel units may be identical with each other.

17. In a structure, two panel units spaced apart from each other, stringers extending on said panel units at equal and parallel intervals, all alternate stringers on each of said panel units bearing reentrant mortise and tenon formations frontally thereon, said formations being symmetrical about a central plane therethrough, all stringers on each of said panel units between said alternate stringers bearing mortise and tenon formations frontally thereon congruent in opposition with said alternate stringer formations, said stringers on said panel units falling into opposition of said alternate stringers with said stringers therebetween in partly overlapping to full facing relationships of said panel units, and each two of said stringers in opposition being in a slidable engagement of said congruent formations thereof with each other in any of said relationships of said panel units whereby said panel units may be identical with each other.

18. In a structure, two panels meeting with each other at a parting line, two other panels spaced apart from said first panels and meeting with each other at a parting line parallel to said first parting line, stringers extending on each two of said meeting panels along said parting line therein in juxtaposition to each other and in opposition to the stringers in juxtaposition on said spaced panels, and means for locking each two of said meeting panels to each other slidably through said stringers in juxtaposition thereon, said stringers bearing interlocking means frontally thereon, said interlocking means on any two of said stringers in juxtaposition and opposition being of an identical profile and being complemental to the interlocking means on the other two stringers, each two of said stringers in juxtaposition forming jointly a complement to said stringers in opposition thereto and being congruently and slidably in engagement therewith for locking said spaced apart panels into unity.

19. In a structure, two panels meeting with each other at a parting line, two other panels spaced apart from said first panels and meeting with each other at a parting line parallel to said first parting line, stringers extending along said meeting panel parting lines in juxtaposition to each other and in opposition to each other on said spaced panels, lengthwise reentrant mortise-and-tenon formations carried laterally on said stringers in juxtaposition and interfitted slidably with one another, and lengthwise-wise reentrant mortise-and-tenon formations carried frontally on said stringers in opposition and interfitted slidably with one another.

20. In a structure, two panels meeting with each other at a parting line, two other panels spaced apart from

said first panels and meeting with each other at a parting line parallel to said first parting line, stringers extending on said meeting panels along said parting lines therein in juxtapostion to each other and in opposition to each other on said spaced panels, means for locking said meeting panels to each other slidably through said stringers in juxtaposition thereon, and lengthwise dovetail mortise-and-tenon formations carried frontally on said stringers in opposition and interfitted slidably with one another, said formations being positioned asymmetrically with respect to a plane through said panel parting line whereby said frontal mortise-and-tenon formations on each two of said stringers in juxtaposition are jointly identical and congruent with the formations on the other two stringers in opposition thereto and each two of said stringers in juxtaposition may be duplicates of the other two stringers.

21. In a structure, components and their relationships as set forth in claim 20, the dividing plane between said stringers in juxtaposition being offset from the panel parting line plane, each of said stringers carrying one half-tenon next to said dividing plane, two such half-tenons on each two stringers in juxtaposition being interfitted with a mortise in one of said stringers in opposition thereto and being locked to each other thereby for holding said meeting panels together at said parting line.

22. In a structure, components and their relationships as set forth in claim 18, said means for locking each two of said meeting panels to each other residing in said frontally borne interlocking means on each two of said stringers in juxtaposition being of unequal width, each two of said stringers being jointly in engagement with the wider portion of one of said stringers in opposition thereto.

23. In a structure, panel units in two spaced apart rows meeting at parting lines with each other, juxtaposed stringers extending on each two of said panel units at and along each parting line, means borne on said stringers for locking said meeting panel units to each other laterally, said juxtaposed stringers bearing frontally thereon interlocking lengthwise formations, each of said panel units having a first of said stringers extending thereon at and along one parting line and having a second stringer extending at and along the other parting line, said first and second stringers having said frontal formations congruent with each other in opposition whereby said panel units in said spaced rows are compatibly associable and are interlocked in facing relationships with each other by said first and second stringers juxtaposed with each other on said meeting panel units and in engagement with opposite respective second and first stringers juxtaposed on meeting panel units in the spaced apart row thereof, and said panel units may be duplicates of each other.

24. In a structure, components and their relationships as set forth in claim 23, each two of said juxtaposed stringers having said interlocking formations thereon divided into uneven portions by a plane offset from the central parting line plane, said first and second stringers on each of said panel units bearing each one of said uneven portions of said formations thereon, said panel units being compatibly associable with each other in said meeting relationship thereof at said parting lines and having said respective first and second stringers thereon complementing each other thereat and having said uneven portions thereof engaged by the wider portion of the formations on one of two unevenly divided juxtaposed stringers in opposition therewith at a coincident parting line in the other panel unit row, said unevenly divided formations providing said means for locking said panel units together laterally.

25. In a structure, components and their relationships as set forth in claim 23, said panel units having an even number of intermediate stringers extending at equal and parallel intervals thereon apart from said parting lines and said first and second stringers thereat and from each other, those of said intermediate stringers at each alternate interval from said first stringer bearing interlocking lengthwise formations frontally thereon equivalent to a double of said first stringer formations symmetrically about the parting line plane, said second stringer and intermediate stringers at each alternate interval therefrom bearing formations inversely complemental to said formations respectively on said first stringer and intermediate stringers at each alternate interval therefrom, said panel units in both spaced apart rows being compatibly associable with each other in full facing or in overlapping relationships at every alternate interval and being interlocked with each other congruently and slidably through said formations on said intermediate and juxtaposed stringers thereon in indiscriminate opposition with one another at all alternate intervals whereby said parting lines in said rows may occur in both coincident and non-coincident relationships.

26. In a structure, components and their relationships as set forth in claim 23, said panel units having one or more of intermediate stringers extending at equal and parallel intervals thereon apart from said parting lines and said first and second stringers thereat and from each other, said one or more of intermediate stringers bearing interlocking lengthwise formations frontally thereon, said formations on each of said intermediate stringers and on each two of said juxtaposed stringers being quivalent to each other and being asymmetrical about a central plane and being inversely identical and complemental to each other, said panel units in both spaced apart rows being compatibly associable with one another in full facing or overlapping relationships at everyone of said intervals and being interlocked with each other congruently and slidably through said formations on said intermediate and juxtaposed stringers thereon in indiscriminate opposition with each other whereby said parting lines in said rows may occur in both coincident and non-coincident relationships.

27. In a structure, panel units in two spaced apart rows meeting with each other at parting lines, intermediate type stringers extending on said panel units at equal and parallel intervals apart from said parting lines and from each other, juxtaposed type stringers extending on each two of said panel units at and along said parting lines, said stringers of both of said types bearing interlocking lengthwise formations frontally thereon, said formations on said intermediate stringers and on each pair of said juxtaposed stringers being of equal width and being identical on each two opposed intermediate stringers with the formations on each two opposed pairs of said juxtaposed stringers, said panel units in both rows falling into indiscriminate opposition at least at every other interval of one of said stringer types thereon with the same type or with the other type and said stringer types in opposition having said formations thereon engaged congruently and slidably with each other whereby said panel units may be of equal or of different widths and panel units of equal width may be duplicates of each other, and means for locking said meeting panel units together through said juxtaposed stringers thereon.

28. In a structure, components and their relationships as set forth in claim 27, said means for locking said meeting panel units together residing in interlocking lengthwise formations borne on said juxtaposed stringers laterally in a location between said parting lines and said frontally borne formations thereon, said laterally borne formations on each two of said stringers being congruent and slidably engaged with each other.

29. In a structure, components and their relationships as set forth in claim 27, said formations borne frontally on said intermediate and juxtaposed types of stringers being asymmetrical about a central plane and being inversely identical and congruent with each other, said stringers of both of said types falling into indiscriminate

opposition of one type with the same type or with the other type at every interval and being engaged congruently and slidably one with another through said formations.

30. In a structure, components and their relationships as set forth in claim 29, said means for locking each two of said meeting panel units to each other residing in said asymmetrical formations on said stringers of both of said types consisting of plural tenons and mortises, the dividing plane between each two of said juxtaposed stringers being offset from the parting line plane to divide said formations unevenly whereby each two juxtaposed stringers are in joint engagement with the wider portion of the formations on one of the juxtaposed stringers in opposition thereto.

31. In a structure, two spaced apart panels facing each other as portions of a hollow wall and having two edges parallel with each other, a terminal member positioned crosswise of said panel edges, said terminal member bearing lateral interlocking formations on the side thereof between said panels, stringers extending on said panels in opposition to each other at and along said edges thereof, at least one of said stringers bearing lateral interlocking formations on the side at said terminal member, said stringer formations being congruent and slidably engaged with said terminal member formations, and frontally thereon said stringers bearing interlocking formations congruent and slidably engaged with each other for uniting said panels with each other and for causing said stringers to coact as a unitary stress member for said panels and terminal member.

32. In a structure, panels in one straight row and panels in two angular rows forming a T-intersection between two hollow walls, stringers extending on said panels at said intersection, said stringers on the panels in each of said angular rows and in said straight row reaching into paired opposition with each other at two angularly set planes facing each one of said angular rows, said stringers on said panels in said angular rows reaching from said panels to said planes diagonally across said intersection at an inclination to said panels, and frontally thereon said paired stringers bearing interlocking formations at said planes congruent and slidably engaged with each other for uniting said angular panel rows with said straight panel row and thereby uniting said angular panel rows with each other and for jointly providing a unitary stress member at said intersection.

33. A structure including, panel units in spaced apart straight and angular rows forming hollow walls and L and T intersections therebetween, said panel units in each row meeting with one another at parting lines located in

said walls and at said intersections, intermediate type stringers extending on said panel units apart from said parting lines and bearing frontal interlocking means thereon, juxtaposed type stringers extending on said panel units at and along said parting lines and bearing frontal interlocking means thereon, said interlocking means on said juxtaposed stringers being complemental to each other in forming an equivalent of said intermediate stringer interlocking means, certain of said intermediate and said juxtaposed stringers at said parting lines and apart therefrom on said straight and angular spaced apart panel unit rows being directed frontally and others being directed angularly into opposition of one type indiscriminately with the same type or with the other type, said intermediate and said juxtaposed stringers in said indiscriminate opposition having said interlocking means congruent and slidably engaged with one another for conjoining said spaced apart panel units in said walls and at said intersections with one another in random coincidental and non-coincidental relationships of said parting lines thereof in said spaced apart rows and for providing unitary stress members therein, means for locking said meeting panel units with one another through said juxtaposed stringers thereon, and a terminal member disposed crosswise of certain of said walls and bearing interlocking means on the inward side thereof, two of said intermediate type stringers interlocked in opposition with each other extending in each of said walls at said terminal member and at least one of said stringers bearing laterally thereon means congruent and slidably engaged with said terminal member interlocking means.

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