July 16, 1940. W. H. STULEN 2,207,952

STRUCTURAL UNIT AND METHOD OF MAKING IT

Filed March 6, 1937 3 Sheets-Sheet 1

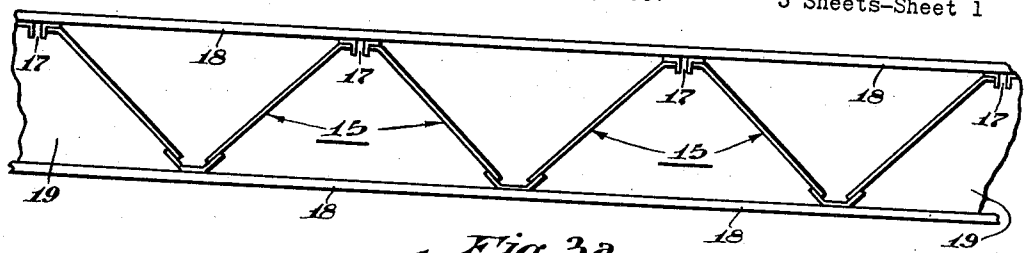


Fig. 3a.

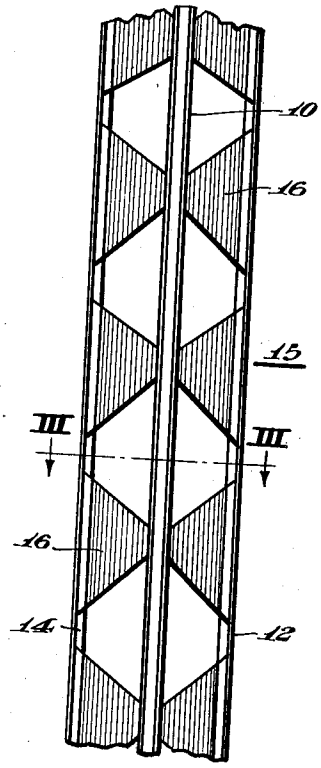


Fig. 1

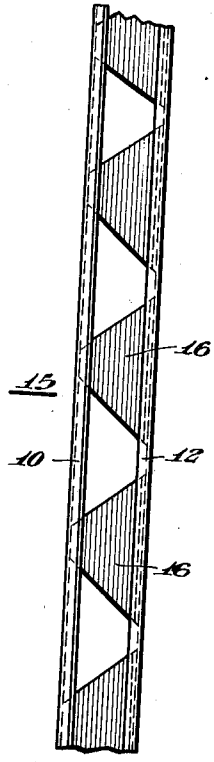


Fig. 2

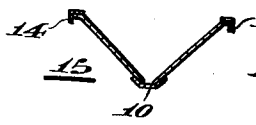


Fig. 3

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STRUCTURAL UNIT AND METHOD OF MAKING IT

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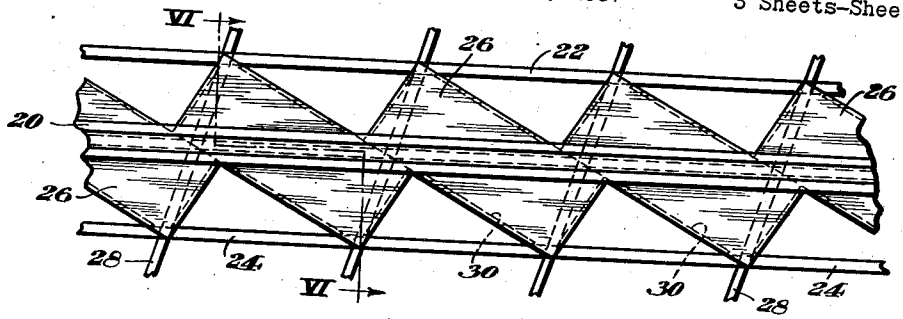


Fig. 4

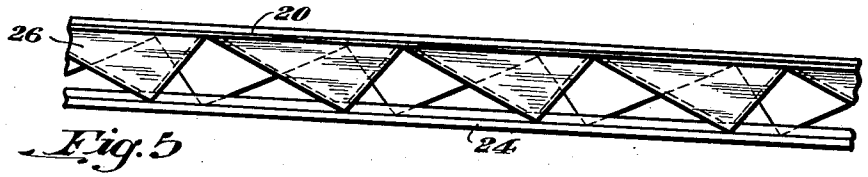
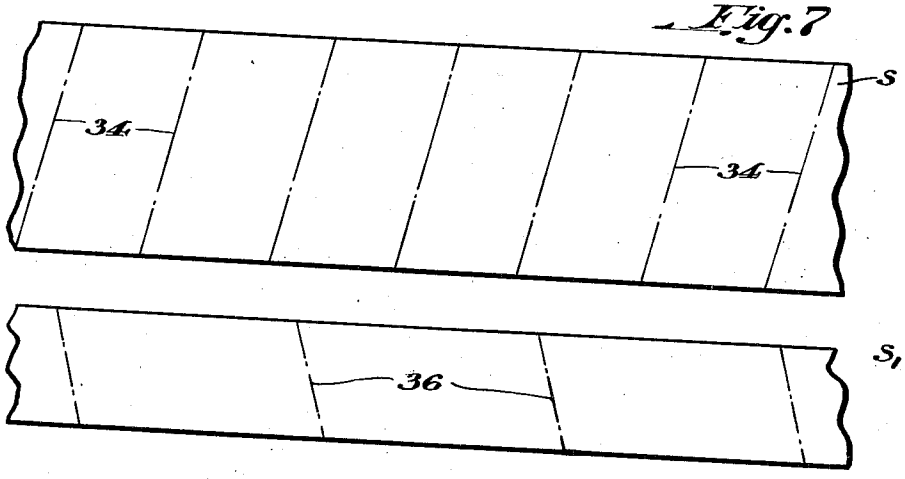


Fig. 5

Fig. 7



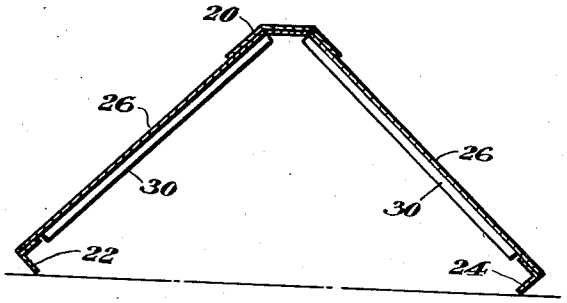


Fig. 8

Fig. 6

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STRUCTURAL UNIT AND METHOD OF MAKING IT

Filed March 6, 1937 3 Sheets-Sheet 3

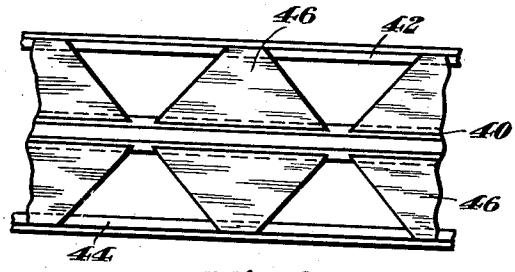


Fig. 9

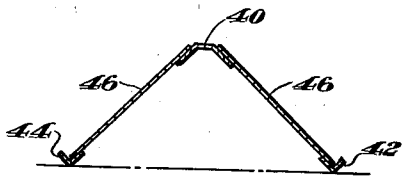


Fig. 11

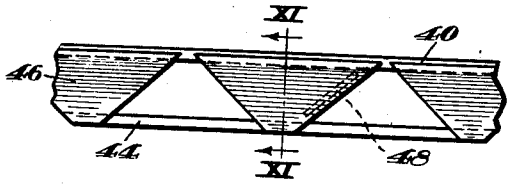


Fig. 10

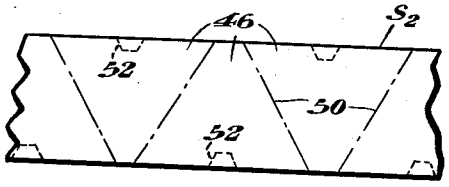


Fig. 12

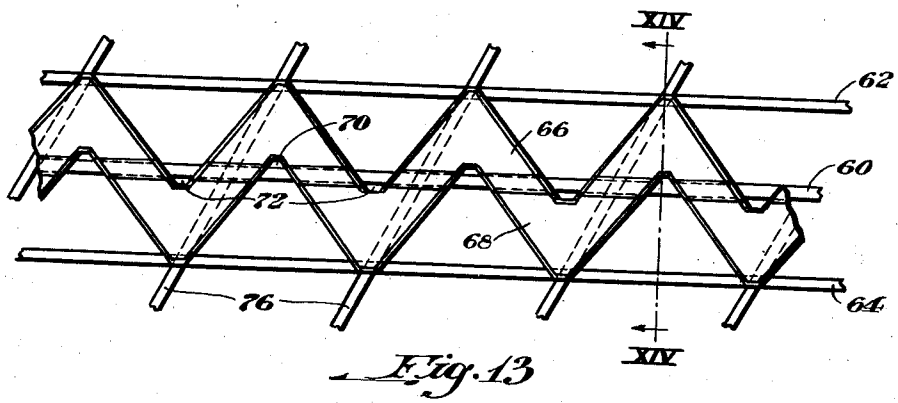


Fig. 13

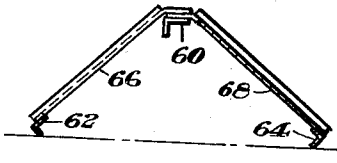


Fig. 14

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Patented July 16, 1940

2,207,952

UNITED STATES PATENT OFFICE

2,207,952

STRUCTURAL UNIT AND METHOD OF MAKING IT

Walter H. Stulen, Pittsburgh, Pa., assignor to Lida Foster Stulen, Bellevue, Pa.

Application March 6, 1937, Serial No. 129,391

22 Claims. (Cl. 189—34)

This invention relates to structural building units made from metal sheets or plates and longitudinally extending shaped metal sections and is particularly concerned with building units of the indicated character adapted to be built into panels and embodied in the fabrication of frameless buildings.

In my Patent No. 2,075,874, entitled Frameless building, I disclosed and claimed one type of building unit constructed from sheet metal and shaped metal load carrying members, such as channels and angle irons. Likewise, in the referred-to patent, I disclosed and claimed the use of my building unit in the fabrication of frameless buildings in which the usual isolated joists, beams and other structural members forming a skeleton framework for a building are replaced by individual structural units built into panels which form the walls, floors, ceilings and roof of the building and in and of themselves serve to carry the strains and loads imparted to the building in use.

My present invention is concerned with a structural building unit of the same general character as that disclosed and claimed in my identified patent and hence the fabrication of the building unit of my present invention into panels for a frameless building will not be discussed here. However, it should be understood that the structural unit of my present invention is particularly adapted to the formation of panels made from a plurality of units with the panels then being used in the construction of a frameless building.

It is the general object of my invention to provide an improved structural building unit made from sheet metal and shaped metal sections, and adapted for the fabrication of panels and frameless buildings.

Another object of my invention is to provide a building unit wherein sheet metal in the form of individual sections of polygonal shape is welded to three longitudinally extending shaped metal sections so that the sheet metal forms triangular areas repeated longitudinally of the unit and substantially in end to end contact.

Another object of my invention is the provision of improved methods for manufacturing structural building units of sheet metal by which the sheet metal parts of a unit can be rapidly cut from relatively narrow strips of sheet metal to form individual areas which are secured in longitudinally spaced relation to shaped metal sections.

Another object of my invention is to provide an improved structural unit in which individual pieces of sheet metal are secured in any of several particular relations with longitudinally extending load carrying shaped metal sections and in which the particular relation of the sheet metal areas is determined by the particular use to which the building unit is to be put.

The foregoing and other objects of my invention are achieved by the provision of a structural building unit comprising three longitudinally extending shaped metal sections positioned relative to each other to define in transverse section the corners of a triangle. Individual sheet metal sections of similar polygonal shape are welded to the sections at longitudinally recurrent points and provide longitudinally repeated triangular sheet metal areas between the sections.

In the method of my invention individual sheet metal areas of the desired polygonal shape, as for example, triangular or rhombic, are cut from a relatively narrow strip of sheet metal so that there is no waste metal and these areas are then welded with or without an intermittent bending operation to longitudinally extending shaped metal sections, as for example, channel shaped sections or angles positioned to define in transverse section the corners of a triangle.

For a better understanding of my invention reference should be had to the accompanying drawings wherein Fig. 1 is a plan view (if used horizontally) or an elevation (if used vertically) of a structural building unit embodying the principles of my invention; Fig. 2 is a side elevation of the building unit shown in Fig. 1; Fig. 3 is a transverse cross sectional view taken on line III—III of Fig. 1; Fig. 3a is a cross sectional view through a panel constructed from the units of Figs. 1 to 3; Fig. 4 is a plan or elevation of another embodiment of my invention; Fig. 5 is a side elevation of the building unit shown in Fig. 4; Fig. 6 is a transverse cross sectional view taken on line VI—VI of Fig. 4; Fig. 7 is a plan view of a strip of sheet metal marked for cutting into individual areas in accordance with the principles of my invention; Fig. 8 is a plan view of another strip of sheet metal illustrating a modified manner of cutting the strip; Fig. 9 is a plan or elevation of another structural unit constructed in accordance with my invention; Fig. 10 is a side elevation of the unit illustrated in Fig. 9; Fig. 11 is a transverse cross sectional view taken on line XI—XI of Fig. 10; Fig. 12 is a plan view of a strip of sheet metal marked for cutting to form the sheet metal areas of the building units of Figs. 1 to 3 and 9 to 11; Fig. 13 is a plan or

elevation of a structural building unit similar to that shown in Figs. 9 to 11 but wherein the individual sheet metal areas of similar shape are arranged to form a building unit of a modified form; and Fig. 14 is a transverse cross sectional view taken on line XIV—XIV of Fig. 13.

In the embodiment of my invention illustrated in Figs. 1 to 3, the numeral 10 indicates a longitudinally extending shaped metal section, ordinarily in the form of a rolled or pressed channel, having side flanges forming an angle of between about 120° and 150° with the flat base of the channel. Positioned parallel with the channel 10 and in alignment with the flanges are shaped metal sections 12 and 14, ordinarily formed angles, and together with the channel defining in transverse section the corners of a triangle, as best seen in Fig. 3. Completing the building unit are longitudinally spaced individual sheet metal members 16 of polygonal shape, as for example triangular, which are welded or otherwise secured to the longitudinally extending metal sections 10, 12 and 14, as illustrated in the several figures, so that a girder or truss member 15 is provided in which the sheet metal members form diagonally extending load carrying webs.

In the embodiment of the invention illustrated the sheet metal members 16 of triangular shape are secured to the angles 12 and 14 at their bases and the vertexes of the sheet metal members 16 are secured to the channel 10, preferably at the inside as shown in Fig. 3 so that the channel flanges lie to the outside of the ends of the sheet metal members 16. By aligning the flanges of the channel 10 with the plane of the sheet metal members the fastening of these parts together is facilitated and loads are transmitted directly therebetween. In use the building unit is employed with the channel 10 away from the load as shown in Fig. 3 but it can be used with the angles 12 and 14 positioned away from the load. In actual construction the individual building units 15 of this embodiment of my invention are adapted to be positioned side by side and welded into panels as fully described in my copending application Serial No. 13,868 heretofore mentioned. The fabricated panels are then adapted to be constructed into a frameless building, i. e., one in which the skeleton framework is entirely omitted.

Fig. 3*a* illustrates a cross section through a panel so constructed and wherein the individual units 15 of Figs. 1 to 3 are arranged in a give-and-take relation with each other. More particularly, where the total width of the wall, floor or other member to be formed by the panel is somewhat greater than the sum of the widths of the several units I space one or more of the units equal distances 17 apart so that together they provide a panel of the desired width. The units are then secured together as by transversely or obliquely extending tie straps 18 and boundary plates or channels 19 as fully described in my copending application Serial No. 13,868.

In the form of my invention illustrated in Figs. 4 to 6, the numerals 20, 22 and 24 indicate longitudinally extending shaped metal sections positioned relative to each other so that in transverse section they define the corners of a triangle. Ordinarily, the section 20 is a channel having side flanges making an angle from between about 120° to about 150° with the base, and the sections 22 and 24 are formed angles. Secured to the longitudinally extending metal sections 20, 22 and 24 are sheet metal members 26 which, as best seen in Figs. 7 and 8, may take the form of rectangles or rhomboids which are bent along a diagonal with the sheet metal member being welded or otherwise secured along the bent diagonal to the channel 20 preferably on the inside and welded or otherwise secured at its laterally projecting corners to the longitudinally extending metal sections 22 and 24. Thus the sheet metal provides triangular areas extending between the metal sections 20, 22 and 24 so that a load carrying member is provided.

The individual building units of Figs. 4 to 6 are adapted to be assembled into panels and the panels into a frameless building structure as heretofore described. When the individual units are built up into panels, the panels preferably include diagonally extending metal ties or straps 28 spanning the metal sections 22 and 24, preferably at the points where the sheet metal members 26 are secured to the shaped metal sections. To further strengthen each building unit I may provide upturned flanges or pressed beads 30 upon the edges of the sheet metal members.

As will be seen from Fig. 5, the use of individual sheet metal members for fabricating a building unit as described provides a plurality of longitudinally overlapping triangular areas for carrying strains between the metal sections 20, 22 and 24. It should be understood that the exact shape of the sheet metal members 26 may be varied within rather wide limits so that exact angles formed by the flanges 30 of the sheet metal members and the longitudinally extending metal sections, can be adapted to best transmit the strains imparted thereto in use.

An important part of my inventive concept is the provision of an improved method for making structural building units including individual sheet metal members and my method is clearly illustrated in Figs. 7 and 8. In Fig. 7, the letter S indicates a strip of sheet metal of relatively narrow width and of a thickness suitable for use in the construction of a particular building unit. The dot and dash lines 34 indicate how the strip is cut to provide a plurality of sheet metal members, as for example, the members 26. In Fig. 8, the letter S_1 indicates a narrower strip of sheet metal likewise marked with dot and dash lines 36 which indicate the position of cuts to be made in order to produce a plurality of sheet metal sections therefrom. From the foregoing it will be recognized that in the fabrication of building units including sheet metal members, the members can be cut from a strip of sheet metal without waste and this operation adapts itself to modern machinery and production methods so that individual sheet metal sections of the desired shape and size can be rapidly and efficiently produced.

In the form of my invention shown in Figs. 9 to 11, the numerals 40, 42 and 44 indicate longitudinally extending shaped metal sections positioned in parallel relation to each other so that in transverse section they form the corners of a triangle, as is evident from Fig. 11. Completing the building unit are sheet metal members 46 of substanitally triangular shape which are welded or otherwise secured by their bases to the metal section 40 and by their vertexes to the metal sections 42 and 44. In other words, this embodiment of my invention is substantially the same as that shown in Fig. 1 except that the sheet metal members of Fig. 1 are welded by

their bases to the outside of the shaped metal sections instead of to the inside of the metal sections. Moreover, in the embodiment of my invention shown in Figs. 9 to 11 the centrally positioned shaped metal section **40**, ordinarily in the form of a channel, as will be seen from Fig. 11, is in the horizontal use of the unit positioned at the top thereof. A pressed bead **48** may be included along one or more edges of the individual sheet metal members **46** whereby the strength of the sheet metal to resist buckling under compressive strains is improved.

As shown in Fig. 12 I contemplate cutting the individual sheet metal members **46** from a relatively narrow strip S_2 on lines **50** by modern production methods and apparatus as heretofore described. This operation can be performed without waste and the individual members produced can be rapidly welded or otherwise secured to the longitudinally extending shaped metal sections to form a structural building unit having the desired load carrying characteristics. If it is found desirable to provide additional space for fastening surfacing or like materials to the building unit or if additional venting of the unit is desired, the individual sheet metal members **46** may be cut with notches as indicated by the lines **52** in Fig. 12. I may also form the sheet metal areas with cut out portions as shown, for example, by the dotted lines A^3 in Rodgers Patent No. 1,324,982, if this be desirable.

The embodiment of my invention shown in Figs. 13 and 14 is identical with that shown in Figs. 9 to 11 and just described with the exception that the individual sheet metal members are longitudinally offset on the two sides of the unit. More particularly, in Fig. 13 the numerals **60**, **62** and **64** indicate longitudinally extending shaped metal sections positioned parallel to each other but in transverse section defining the corners of a triangle, as seen in Fig. 14. The individual sheet metal members **66** and **68** are of substantially triangular shape and are formed, in the embodiment of the invention illustrated, with notches **70** and **72**.

The sheet metal members **66** are longitudinally offset relative to the members **68** so that in plan view the members form a Z-shaped or zigzag strengthening member of sheet metal which is particularly adapted to transmit strains and loads between the shaped metal sections and provide a structural building unit having a large number of places for fastening surfacing materials to the unit and employing a minimum of sheet metal.

The individual building units of the embodiment of my invention shown in Figs. 13 and 14 can be formed into panels and the panels into frameless building structures as heretofore described. In connecting the individual building units together into panels I have found it advisable to employ diagonally extending metal ties or straps, identified by the numeral **76**, which are connected to the rolled metal sections **62** and **64** adjacent the points where the sheet metal members **66** and **68** are likewise secured thereto.

The individual sheet metal members **66** and **68** can be made from the same strip S_2 of sheet metal shown in Fig. 12 and cut as described in conjunction therewith.

From the foregoing description it will be appreciated that the objects of my invention have been achieved by the provision of an improved type of structural building unit adapted to be made from individual sheet metal members or areas and longitudinally extending shaped metal sections. The building units can take several different forms dependent upon the particular use to which the unit is to be placed. The sheet metal members can be cut without waste and by rapid commercial production methods and apparatus, and the sheet metal members can be positioned in fabrication at any desired longitudinally repeated positions to provide a building unit of the character desired.

A unit constructed in accordance with the principles of my invention can be made of any width and height and in any desired length, as will be recognized. Ordinarily the units are from between 3 and 10 inches in height and are from 6 inches to 3 feet in width but are usually about 7½ inches high and 18 inches wide. All of the units herein described are adapted to be readily fabricated into panels which in turn can be made into a frameless building. The individual units, the fabricated panels and the constructed frameless building are all adapted to be readily covered or surfaced in any desired way, as for example with metal, wood, brick or other building or surfacing materials, since the surfacing materials can be readily fastened to the building units at any of a plurality of spaced points thereon.

Although the expression "sheet metal" has been employed in the specification and claims, I contemplate using metal in sheet form of any necessary thickness to carry required loads. Particularly, metal plates can be employed and the expression "sheet metal" is intended to broadly cover plates or sheets.

While in accordance with the patent statutes several embodiments of my invention have been illustrated and described, it should be understood that my invention is not limited thereto or thereby but is defined in the appended claims.

I claim:

1. A structural building unit comprising a longitudinally extending channel, two longitudinally extending angles positioned relative to the channel to define in transverse section the corners of an isosceles triangle, individual sheet metal members of similar polygonal shape welded to the channel and to the angles at longitudinally recurrent points and providing longitudinally repeated polygonal sheet metal areas between the channel and each angle.

2. A structural building assembly comprising a plurality of units each comprising three longitudinally extending metal sections positioned relative to each other to define together in transverse section the corners of an isosceles triangle, individual sheet metal members of similar polygonal shape welded to the sections at longitudinally recurrent points and providing spaced apart longitudinally repeated polygonal sheet metal areas between the sections and means securing the units side by side into a flat panel assembly.

3. A structural building unit comprising a channel having flanges forming an angle of between about 120 and about 150 degrees with the base of the channel, angles parallel to the channel and positioned in alignment with the flanges of the channel, a sheet metal member of substantially triangular shape secured at its base to an angle and at its vertex to the inside of the flange of the channel, a sheet metal member similar to the first-named member and secured to the other angle and to the channel in opposed relation to the first-named member, and a plurality of opposed sheet metal members secured to the channel and the angles at longitudinally spaced points.

4. A structural building unit comprising a

channel having flanges forming an angle of between about 120 and about 150 degrees with the base of the channel, angles parallel to the channel and positioned in alignment with the flanges of the channel, a sheet metal member of substantially triangular shape secured to an angle and to the inside of the flange of the channel, a sheet metal member similar to the first-named member and secured to the other angle and to the channel in opposed relation to the first-named member, and a plurality of opposed sheet metal members secured to the channel and the angles at longitudinally spaced points.

5. A structural building unit comprising a channel having flanges forming an angle of between about 120 and about 150 degrees with the base of the channel, angles parallel to the channel and positioned in alignment with the flanges of the channel, a sheet metal member of substantially triangular shape secured at its base to a flange of the channel and at its vertex to an angle, a sheet metal member similar to the first-named member and secured to the other angle and to the channel in opposed relation to the first-named member, and a plurality of opposed sheet metal members secured to the channel and the angles at longitudinally spaced points.

6. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the corners of an isosceles triangle, the section at the vertex of the triangle being a channel and the sections at the base corners of the triangle being angle irons, a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded in the region of its bend to the section positioned at the vertex of the triangle and at each of its extending corners to one section positioned at the base corners of the triangle, the members being secured to the rolled metal sections at longitudinally repeated points and having their ends extending longitudinally past each other, strengthening flanges formed on at least some edges of the members, and straps extending between the metal sections at the points of joinder of the members thereto.

7. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the corners of an isosceles triangle, a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded in the region of its bend to the section positioned at the vertex of the triangle and at each of its extending corners to one section positioned at the base corners of the triangle, the members being secured to the rolled metal sections at longitudinally repeated points and having their ends extending longitudinally past each other, strengthening flanges formed on at least some edges of the members, and straps extending between the metal sections at the points of joinder of the members thereto.

8. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the corners of an isosceles triangle, a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded in the region of its bend to the section positioned at the vertex of the triangle and at each of its extending corners to one section positioned at the base corners of the triangle, the members being secured to the sections at longitudinally repeated points and having their ends extending longitudinally past each other, and strengthening flanges formed on at least some edges of the members.

9. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the corners of an isosceles triangle, a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded in the region of its bend to the section positioned at the vertex of the triangle and at each of its extending corners to one section positioned at the base corners of the triangle, the members being secured to the metal sections at longitudinally repeated points and having their ends extending longitudinally past each other, and straps extending between the metal sections at the points of joinder of the members thereto.

10. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the corners of an isosceles triangle, and a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded in the region of its bend to the section positioned at the vertex of the triangle and at each of its extending corners to one section positioned at the base corners of the triangle, the members being secured to the metal sections at longitudinally repeated points and having their ends extending longitudinally past each other.

11. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the corners of an isosceles triangle, and a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded in the region of its bend to the section positioned at the vertex of the triangle and at each of its extending corners to one section positioned at the base corners of the triangle, the members being secured to the metal sections at longitudinally repeated points.

12. A structural building unit comprising three longitudinally extending metal sections defining in transverse section the corners of an isosceles triangle, the section at the vertex of the triangle being a channel having flanges in alignment with the sections at the base corners of the triangle which are angle irons, individual sheet metal members of triangular shape secured at their bases to the metal section at the vertex of the triangle and secured at their vertexes to the metal sections at the base corners of the triangle, each of said sheet metal members having a notch cut in its base so as to form a V-shaped area, said members being secured to the metal sections so that a sheet metal area of repeated zigzag or Z-shape is provided, and strengthening means formed on at least some of the edges of the members.

13. A structural building unit comprising three longitudinally extending metal sections defining in transverse section the corners of an isosceles triangle, individual sheet metal members of triangular shape secured at their bases to the metal

section at the vertex of the triangle and secured at their vertexes to the metal sections at the base corners of the triangle, each of said sheet metal members having a notch cut in its base so as to form a V-shaped area, said members being secured to the metal sections so that a sheet metal area of repeated zigzag or Z-shape is provided, and strengthening means formed on at least some of the edges of the members.

14. A structural building unit comprising three longitudinally extending metal sections defining in transverse section the corners of an isosceles triangle, and individual sheet metal members of triangular shape secured at their bases to the metal section at the vertex of the triangle and secured at their vertexes to the metal sections at the base corners of the triangle, each of said sheet metal members having a notch cut in its base so as to form a V-shaped area, said members being secured to the metal sections so that a sheet metal area of repeated zigzag or Z-shape is provided.

15. That method of making structural building units from sheet metal and formed metal sections which comprises without waste continuously cutting from a strip of sheet metal individual sheet metal members, securing the individual members to longitudinally extending shaped metal sections positioned in transverse section to define the corners of a triangle, said securing operation being such that the members provide longitudinally repeated substantially triangular areas on each side of the section positioned at the vertex of the triangle.

16. That method of making structural building units from sheet metal and formed metal sections which comprises without waste continuously cutting from a strip of sheet metal individual sheet metal members substantially in the form of isosceles triangles, forming the edges of the members to better resist compressive forces, securing the individual members to longitudinally extending shaped metal sections positioned in transverse section to define the corners of a triangle, said securing operation being such that the members provide longitudinally repeated substantially triangular areas on each side of the section positioned at the vertex of the triangle.

17. That method of making structural building units from sheet metal and formed metal sections which comprises without waste continuously cutting from a strip of sheet metal individual sheet metal members substantially in the form of rectangles, bending each member substantially along a diagonal, securing the individual members to longitudinally extending metal sections positioned in transverse section to define the corners of a triangle, said securing operation being such that the members provide longitudinally repeated substantially triangular areas on each side of the section positioned at the vertex of the triangle.

18. A structural building unit comprising three longitudinally extending metal sections each of substantially angular shape in cross section and positioned relative to each other to define together in transverse section the corners of an isosceles triangle, individual sheet metal members of similar polygonal shape welded to the sections at longitudinally recurrent points and providing spaced apart longitudinally repeated polygonal sheet metal areas between the sections.

19. A substantially rectangular panel for use in constructing frameless metallic buildings, said panel comprising a plurality of elongated units which are joined together side by side by means of transverse members, each unit including a pair of spaced longitudinal base members, and a raised centrally disposed member, a plurality of plates having a central ridge portion and opposed triangular outwardly and downwardly depending side portions, the plates being joined to the central member along said central ridge portion, the opposed transverse corners of the plates being joined to the base angle, the several plates being disposed along the members in end to end relationship.

20. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the vertex and base corners of an isosceles triangle, a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded along the region of its diagonal bend to the section positioned at the vertex of the triangle and at each of its base corners to one section positioned at the base corners of the triangle, the members being secured to the metal sections at longitudinally repeated points and having strengthening flanges formed on the compression edges of at least some of the members.

21. A structural building unit comprising three longitudinally extending metal sections positioned parallel to each other and in transverse section defining the vertex and base corners of an isosceles triangle, a plurality of sheet metal members of substantially rectangular shape, each of said members being bent along substantially a diagonal and welded along the region of its diagonal bend to the section positioned at the vertex of the triangle and at each of its base corners to one section positioned at the base corners of the triangle, the members being secured to the sections at longitudinally repeated points and strengthening flanges formed on at least some edges of the members.

22. A structural building unit comprising three longitudinally extending metal sections positioned relatively to each other to define together in transverse section the corners of an isosceles triangle, a sheet metal member of substantially triangular shape secured at its base to one metal section defining a base corner of the isosceles triangle and at its vertex to the metal section defining the top of the isosceles triangle, a sheet metal member similar to the first-named member and secured at its base to the other metal section defining the base corner of the isosceles triangle and at its vertex to the metal section defining the top of the isosceles triangle and in substantially opposed relation to the first-named sheet metal member, and a plurality of opposed sheet metal members secured to the longitudinally extending metal sections at longitudinally spaced points and in a similar manner.

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