April 6, 1937. W. H. STULEN 2,075,875

FRAMELESS BUILDING UNIT

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FIG. 1

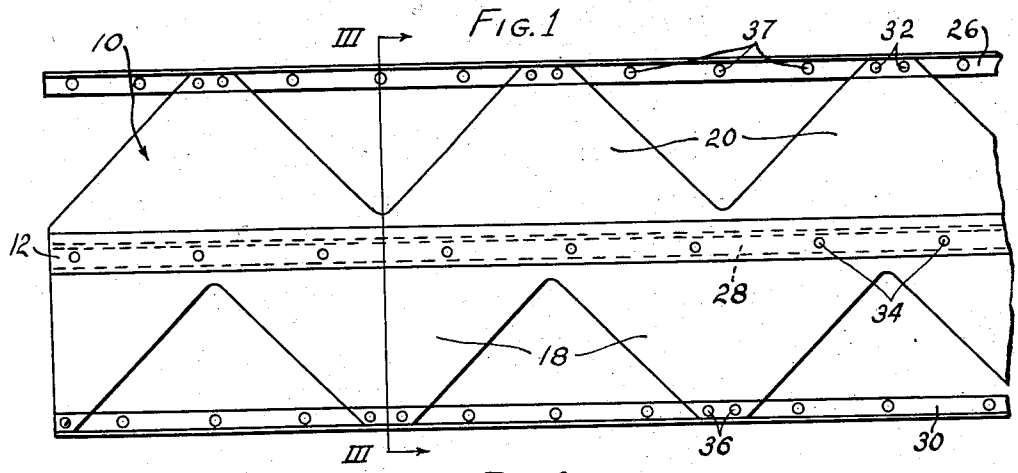


FIG. 2

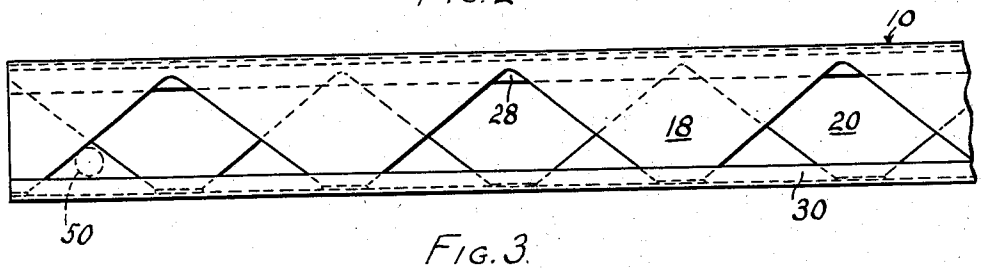


FIG. 3

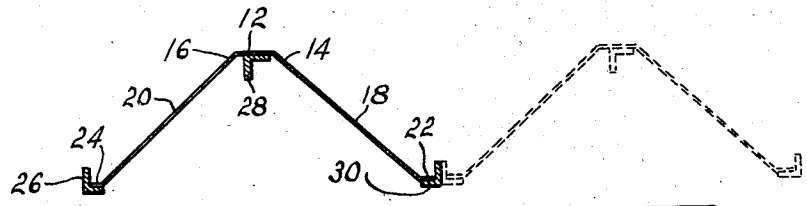


FIG. 4

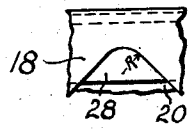


FIG. 5

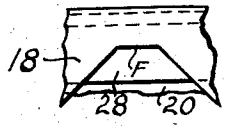


FIG. 6

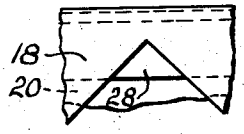


FIG. 7

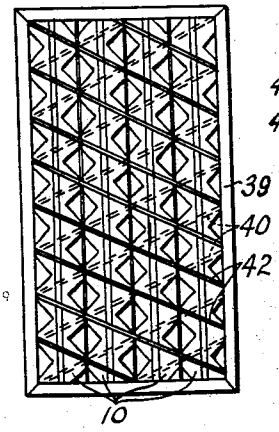
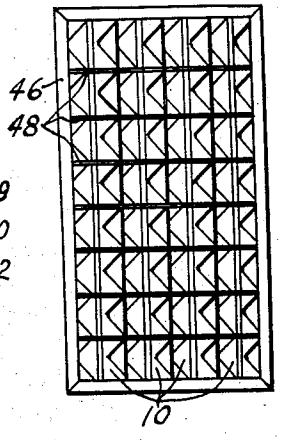


FIG. 8



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FRAMELESS BUILDING UNIT

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FIG. 9

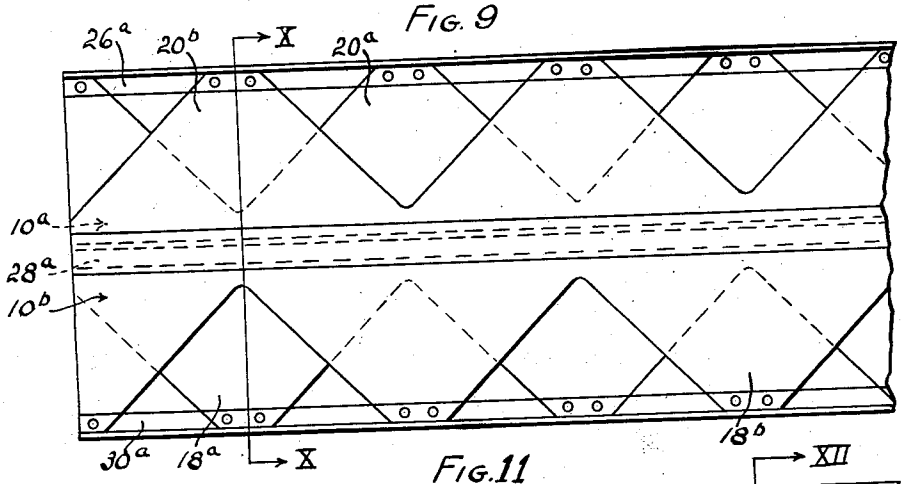
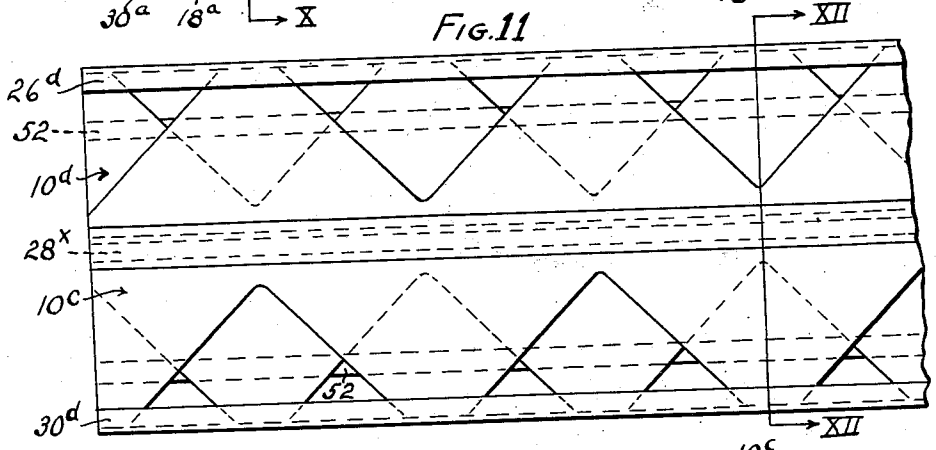


FIG. 11



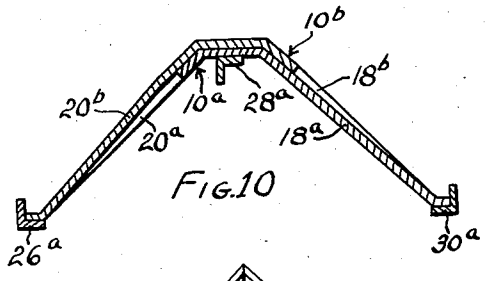


FIG. 10

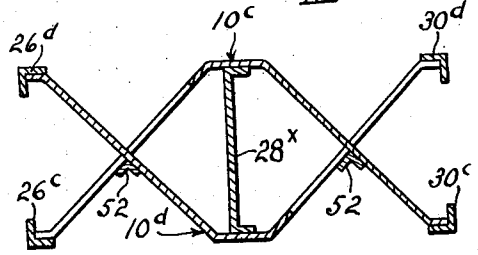


FIG. 12

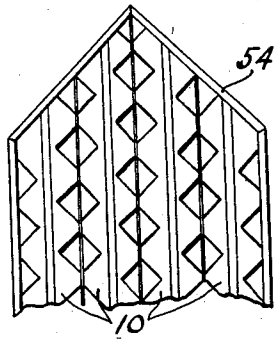


FIG. 13

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UNITED STATES PATENT OFFICE

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FRAMELESS BUILDING UNIT

Walter H. Stulen, Pittsburgh, Pa.

Application June 20, 1936, Serial No. 86,367

19 Claims. (Cl. 189—34)

This invention relates to frameless buildings and more particularly to fabricated metallic units adapted for the construction of such buildings. This application is a continuation-in-part of my application Serial No. 13,868 filed March 30, 1935, and entitled "Frameless building and method of making the same."

As completely discussed in my copending application referred to above, I have found that the construction of houses, stores, garages and other structures is facilitated and improved by the use of so-called frameless members adapted to form the various floors, walls, ceilings and the like of a building and to entirely eliminate the skeleton framework such as the joists, girders, and beams heretofore employed. In my copending application a particular type of structural unit is illustrated and described as being made up into panels, in turn formed into complete walls, floors, or ceilings to provide a frameless building. The present invention relates to an improved form of unit adapted for like purposes.

It is an object of my invention to provide a relatively inexpensive but light and strong unit capable of being readily employed in the construction of frameless panels adapted to be used in the construction of walls, floors, ceilings, etc. of a building.

Another object of my invention is the provision of an improved type of structural unit which for the same weight of metal provides increased strength. The unit is capable of being assembled by the unskilled laborer with a minimum of time and special tool requirements. It can be assembled readily into fabricated panels which in turn can quickly be made into frameless walls, floors, and ceilings. Furthermore, the unit is adapted to the production of columns, girders, etc., if desired.

A further object of my invention is to provide a structural unit of the character indicated which can be fabricated of similar parts and weights of metal to produce units or panels of various desired strengths as for example load-bearing partitions or ordinary partitions.

The foregoing and other objects of my invention are achieved by the provision of a metal building unit comprising a strip of sheet metal having a relatively narrow flat central portion with similarly bent but oppositely inclined edge portions. The edge portions are in the form of substantially triangular areas having the bases of the areas on one side of the central strip portion longitudinally intermediate of the bases of the areas on the other side of the central portion to provide a continuously repeated zigzag-shaped strip. Rolled metal sections are welded to the flat central portion and to the extreme lateral edges of the strip to provide a unit substantially triangular in transverse section.

Referring to the drawings, Fig. 1 is a plan view of a unit constructed in accordance with the principles of my invention; Fig. 2 is a side elevation of the unit illustrated in Fig. 1; Fig. 3 is a transverse cross-sectional view taken on line III—III of Fig. 1; Fig. 4 is an enlarged fragmentary view of the preferred manner of forming the meeting edges of the sides of the strip incorporated in the unit; Fig. 5 is a view similar to Fig. 4 but of a modified manner of practicing the invention; Fig. 6 is a view similar to Figs. 4 and 5 but of still another embodiment of the referred to feature of the invention; Fig. 7 is a plan view of a plurality of individual units connected together to form a panel adapted to be used in the construction of a building; Fig. 8 is a view similar to Fig. 7 but illustrates a modified manner of securing the individual units into panel form; Fig. 9 is a plan view of an overlapping compound unit providing greater strength; Fig. 10 is a cross-sectional view taken on line X—X of Fig. 9 but on a larger scale and with the thickness of the sheet metal exaggerated to better illustrate the construction; Fig. 11 is a plan view of an interlocked compound unit have increased strength; Fig. 12 is an enlarged transverse sectional view taken on line XII—XII of Fig. 11; and Fig. 13 is a plan view of a plurality of units assembled in a panel and illustrating how the units are adapted to form pointed panels.

Having reference to the accompanying drawings, the improved unit embodying the principles of my invention includes a strip metal portion, indicated as a whole by the numeral 10, having a longitudinally extending relatively narrow flat central portion 12 and similarly but oppositely inclined edge portions 14 and 16 making an angle ordinarily of about 120 degrees with each other. It will be appreciated that the smaller the angle between the edge portions 14 and 16 the greater is the thickness and strength of each unit. I therefore contemplate angles of between about 150 degrees (for weaker and flatter units) and about 30 degrees (for stronger and thicker units). Each of the inclined side portions 14 and 16 is formed with substantially triangularly-shaped areas 18 and 20 terminating in flanges 22 and 24 substantially parallel to the flat central portion 12.

As will be evident from Fig. 1, the triangular areas 18 and 20 of the metal strip 10 are longi-

tudinally offset from each other so that the resulting strip when viewed in plan is zigzag or of continuously repeated Z shape. Expressed in other words, the bases of the triangular areas **18** are spaced intermediate to the bases of the triangular areas **20**.

Preferably the triangular areas **18** and **20** merge into each other with rounded corners as best shown in Fig. 4. More specifically, I provide a radius R between the edges of adjacent triangular areas which is, for example, one inch on a unit of the size and character specifically hereinafter described. This provision of a radius avoids a sharp notch between the edges of adjacent triangular areas and improves the strength and durability of the unit as a whole. Furthermore, as shown in Fig. 5, I may employ a flat F between the meeting edges of adjacent triangular areas instead of a radius under certain conditions. Also, as shown in Fig. 6, the edges of adjacent triangular areas **18** or **20** may come together to form a V-notch particularly where the stresses to which the strip is subjected are of compression rather than tension.

Incorporated with the metal strip **10** are strengthening means adapted to be secured to the edges of the strip and to the flat central portion **12** thereof. Preferably these strengthening means comprise rolled metal sections such as angles **26**, **28**, and **30** which are securely fastened preferably by spot welding as at **32**, **34**, and **36** to the metal strip. Angles **26** and **30** are generally provided with apertures **37** to facilitate fastening expanded metal screen, brick veneer or other means to the unit. While the structural unit formed may obviously be made of strip metal of any desired thickness reinforced by metal sections likewise of desired strength, a specific example of a unit constructed in accordance with my invention comprises 16-gauge metal strip shaped as described and having an angle 1" x 1" x ⅛" at the central portion of the strip with angles ¾" x ¾" x ⅛" at the edges of the strip. The width of the unit is about 18" and the height about 6" to 8" and the length as desired. Ordinarily for structural purposes the unit is capable of being cut to any desired length to perform a particular operation.

As illustrated in Fig. 3, the units are adapted to function ordinarily as floors or ceilings in the position shown but may be inverted if desired. In the use of the units to form vertically extending walls they may be turned with either side out as best adapted for any particular installation. The units are placed side by side and formed into panels bounded by sheet metal channels in accordance with the description in my copending application above referred to, and as particularly shown in Figs. 7 and 8 I contemplate assembling the units either with alternate units being oppositely turned as shown in Fig. 7, or with all of the units extending in the same direction as shown in Fig. 8. When the alternate units are oppositely turned or of opposite hand, the several units are placed side by side to provide diamond-shaped openings and are connected by transversely extending tie straps preferably positioned both at the lower and upper surface of the assembled units although in certain installations the straps may be used on only one side or on neither side of the panel.

In Fig. 7 the transverse bottom straps, indicated by dotted lines **40**, extend at other than a right angle to the units and engage with the bottoms of the units adjacent the points where the triangular areas **18** and **20** are secured to the angles **26** and **30**. Upper straps **42** also extend at other than a right angle to the units. The straps are ordinarily of ⅝" x ¾" or 1" metal strip and are secured, preferably by welding, to the individual units at their points of contact therewith and at their ends are fastened to sheet metal channel members **39** surrounding the several units and defining the complete panel.

In the modified panel structure illustrated in Fig. 8, the individual units are not alternately turned end for end but are continuously repeated. In this construction the units are fastened preferably by welding in a sheet metal channel frame **46** and transverse tie straps indicated by the dotted lines **48** are fastened to the bottom of the units at their points of contact therewith and to the channels **46** at their ends. No straps need be employed on the top of the panel, but if desired can be, and these straps will ordinarily be oppositely of the straps **48**.

The individual panels as shown in Figs. 7 and 8 are ordinarily of such size that they can be completely fabricated in the mill and shipped by truck or freight-car to the building site. Once on location they can readily be assembled side by side to form a wall, floor, ceiling or other part of a building of substantially any size desired. This operation as particularly set forth in my referred to pending applicatilon is ordinarily a welding operation but I contemplate bolting, riveting or otherwise securing the individual panels together. Furthermore, it is part of my inventive concept to ship individual structural units to the building location and fabricate an entire wall, floor or ceiling from the units while on location. Likewise, the individual units can be employed to form columns, girders, or other load-carrying members as will be evident. Also the units or panels are adapted to be used in other than buildings, as for example bridge floors and the like.

As will be evident from Fig. 2, there is sufficient clearance between the outer and lower ends of the triangular areas **18** and **20** in a transverse direction to allow for the introduction of transversely extending wiring conduits, water pipes, etc., as represented by the dotted circle **50**. Longitudinally and diagonally extending conduits, pipes, etc., are likewise easily handled.

In the manufacture of fabricated units of the character described I cut the zigzag metal strips from relatively wide strip and avoid waste as more fully described in my referred to pending application. Preferably the cutting operation is effected by providing suitable dies on cooperating rollers with the strip being cut while progressively passing through the rolls as will be understood.

The form of my invention illustrated in Figs. 9 and 10 I term an overlapping compound unit. It is substantially similar to the unit illustrated in Figs. 1 to 3 except that an additional strip of sheet has been incorporated in the structure. Specifically, the numeral **10a** indicates a zigzag sheet metal strip having a flat central and inclined edge portions secured, as by welding, to longitudinally extending rolled metal sections **26a**, **28a**, and **30a**, all parts being identical to similar parts in the unit of Figs. 1 to 3. An additional zigzag sheet metal strip **10b** having a flat central portion and inclined edges is fastened, preferably by welding, to the top of the strip **10a** but in longitudinally offset relation thereto. Offset relation, as will be evident from Fig. 9, comprises positioning the lateral tabs or triangular areas of one strip midway between the tabs or

triangular areas of the other strip. Thus the lateral triangular areas 18b and 20b of the strip 10b extend into the openings between the triangular areas 18a and 20a of strip 10a and are fastened as by welding to the rolled metal sections 26a, 28a and 30a.

The resulting compound unit is stronger than the unit of Figs. 1 to 3 employing a single strip of sheet metal. The compound unit is readily assembled without requiring different parts or weights of metal and thereby the invention provides a unit made of like materials to various strengths as desired. For example, three strips 10 may be superimposed usually in longitudinally offset relation to form a compound unit. While the zigzag metal strips 10 of the unit of Figs. 1 to 3 are adapted to compounding as described, it should be understood that the strip of my copending application Serial No. 13,868 is also adapted to compounding or overlapping.

In the embodiment of my invention shown in Figs. 11 and 12 I have provided what I call an interlocked compound unit. Zigzag sheet metal strips 10c and 10d identical to the strips 10 are positioned with respect to each other as best shown in Fig. 12. The strips are fastened, preferably by welding, to longitudinal rolled metal sections 26c, 26d, 28x, 30c, and 30d. The section 28x bridges between the metal strips 10c and 10d. While not requisite the strength of the unit is further improved by securing longitudinals 52 between the triangular areas of the strips 10c and 10d as shown in Figs. 11 and 12. The resulting interlocked compound unit constructed of the same parts as the unit of Figs. 1 to 3 is particularly adapted to function as a load-bearing partition or floor section and is advantageously used wherever additional strength is required. The unit of my copending application above referred to may also be made up to provide an interlocking unit as will be understood.

In the use of the compound units of Figs. 9 to 12 they are formed into panels in exactly the same way as the unit of Figs. 1 to 3. In addition I contemplate a composite panel constructed in part of ordinary units and in part of compound units positioned for example in a floor panel so that the weight of a wall or partition is borne by the compound unit or units.

As shown in Fig. 13, the units are particularly adapted to the construction of pointed panels to be used, for example, as walls supporting sloping roofs. The substantially right angles of the zigzags of the strips 10 specifically adapt the panels to 45 degree points but also panels having points formed on other angles can easily be made. The units in panel form are surrounded by a frame 54 as heretofore described.

In the description of my invention particular reference has been made to its use in the construction of frameless buildings. However, it should be understood that the units of my invention are adapted to use with a skeleton frame building or in similar uses if desired.

Although I have described the strips 10 as ordinarily being cut from relatively wide sheets in production operations, nevertheless I may form the strips from relatively narrow strip metal cut on an angle to form short pieces which are bent along a diagonal. The individual pieces are then welded or otherwise connected end to end along a diagonal to provide the zigzag strip described which is reinforced with the longitudinals 26, 28, and 30.

In certain instances, as for example where an extra and unfigured load is imposed, I have found it advisable to strengthen the panels of built up units either before or after they are installed in a building. In addition to the use of compound units as above described I contemplate strengthening a panel having longitudinally extending units by the use of laterally directed triangular strips of the type shown in my copending application. The strips are preferably used in the form of diamond-shaped lengths bent with triangular tabs or areas which extend down into the troughs between the longitudinal units to which they are welded or otherwise secured. The result is a two-way construction having longitudinally extending units strengthened laterally where necessary or desired with diamond-shaped squares extending into the troughs of the units and lying substantially flat with the surface of the units. Straps 40, 42, and 48 may be eliminated when lateral strengthening means of the type just described is employed.

From the foregoing description it will be seen that the objects of my invention have been achieved by the provision of improved structural units which are relatively simple to manufacture but which are light and strong. The units adapt themselves to fabrication of various kinds and particularly to frameless building structures. Once the frameless building structure is provided, the structure can be finished with brick veneer, wood-surfacing, internal plaster, or the like, in accordance with known practice.

While in compliance with the patent statutes, one specific embodiment of my invention has been illustrated and described in detail, it should be appreciated that the invention is not limited thereto or thereby, but is defined in the appended claims.

I claim:

1. A metal building unit capable of being fabricated into walls, floors, columns and similar building structures, said unit comprising a strip of sheet metal having a relatively narrow flat central portion with similarly bent but oppositely inclined edge portions, said edge portions being in the form of substantially triangular areas having the bases of the areas on one side of the central portion longitudinally intermediate of the bases of the areas on the other side of the central portion so that a continuously repeated substantially Z-shaped strip is provided, and rolled metal angles welded to the flat central portion and to the extreme lateral edges of the strip, the angle at the central portion of the strip being of greater cross-section than the edge angles.

2. A metal building unit capable of being fabricated into walls, floors, columns and similar building structures, said unit comprising a strip of sheet metal having a central portion with similarly bent but oppositely inclined edge portions, said edge portions being in the form of substantially triangular areas having the bases of the areas on one side of the central portion longitudinally intermediate of the bases of the areas on the other side of the central portion so that a zigzag-shaped strip is provided, and rolled metal angles secured to the central portion and to the lateral edges of the strip.

3. A metal building unit capable of being fabricated into walls, floors, columns and similar building structures, said unit comprising a strip of sheet metal having a relatively narrow central

portion with bent but oppositely inclined edge portions, said edge portions being in the form of substantially polygonal areas having the bases of the areas on one side of the central portion longitudinally offset of the bases of the areas on the other side of the central portion, and metal sections secured to the central portion and to the lateral edges of the strip, the metal section at the central portion of the strip being of greater cross-section than the edge metal sections.

4. A metal building unit capable of being fabricated into walls, floors, columns and similar building structures, said unit comprising a strip of sheet metal having a relatively narrow central portion with bent but oppositely inclined edge portions, said edge portions being in the form of substantially polygonal areas having the bases of the areas on one side of the central portion longitudinally offset of the bases of the areas on the other side of the central portion, and metal sections secured to the central portion and to the lateral edges of the strip.

5. A building unit comprising a metal strip having substantially triangular portions removed at spaced intervals along each side of the strip, the portions being removed on one side of the strip in longitudinally offset relation to the portions removed on the other side of the strip so as to provide a continuous Z-shaped strip in plan view, said strip being bent along its center longitudinal to form an angle of about 120 degrees, and metal-strengthening angles welded to the edges of the strip and to the center longitudinal.

6. A building unit comprising a metal strip having substantially triangular portions removed at spaced intervals along each side of the strip, the portions being removed on one side of the strip in longitudinally intermediate relation to the portions removed on the other side of the strip so as to provide a zigzag strip in plan view, said strip being bent along its center longitudinal, and metal-strengthening sections secured to the edges of the strip and to the center longitudinal.

7. A building unit comprising a metal strip having substantially polygonal portions removed at spaced intervals along each side of the strip, the portions being removed on one side of the strip in longitudinally intermediate relation to the portions removed on the other side of the strip so as to provide a zigzag strip in plan, said strip being bent substantially along its center longitudinal, and metal-strengthening sections secured to the edges of the strip and to the center longitudinal.

8. A structural unit comprising a continuously repeated zigzag strip in plan, said strip being bent along a center longitudinal to form an angle of about 120 degrees, and rolled metal sections secured to the central portion and to the edge portions of the strip.

9. A structural unit comprising a continuously repeated zigzag strip in plan, said strip being bent along a center longitudinal, and rolled metal sections secured to the central portion and to the edge portions of the strip.

10. A fabricated structural member for use as a floor, wall or ceiling in a frameless building which comprises a plurality of longitudinally extending units placed side by side and of triangular cross-sectional shape, a frame of sheet metal channels surrounding the units, tie rods extending transversely of the member at longitudinally spaced points thereon and making other than a right angle with the longitudinal units, each of said units including a zigzag sheet of strip metal bent along a central longitudinal line, and rolled metal angles welded to the central and edge portions of the sheet, said member having every alternate unit turned end for end so as to define diamond-shaped openings over the entire member.

11. A fabricated structural member for use as a floor, wall or ceiling in a frameless building which comprises a plurality of longitudinally extending units placed side by side and of triangular cross-sectional shape, a frame of sheet metal channels surrounding the units, tie rods extending transversely of the member at longitudinally spaced points thereon and making other than a right angle with the longitudinal units, each of said units including a zigzag sheet of strip metal bent along a central longitudinal line, and rolled metal sections secured to the central and edge portions of the sheet.

12. A fabricated structural member for use as a floor, wall or ceiling in a frameless building which comprises a plurality of longitudinally extending units placed side by side and of triangular cross-sectional shape, a frame of sheet metal channels surrounding the units, each of said units including a zigzag sheet of strip metal bent along a central longitudinal line, and rolled metal sections secured to the central and edge portions of the sheet, said member having every alternate unit turned end for end so as to define diamond-shaped openings over the entire member.

13. A fabricated structural member for use as a floor, wall or ceiling in a frameless building which comprises a plurality of longitudinally extending units placed side by side and of triangular cross-sectional shape, a frame of sheet metal channels surrounding the units, each of said units including a zigzag sheet of strip metal bent along a central longitudinal line, and rolled metal sections secured to the central and edge portions of the sheet.

14. A fabricated structural member for use as a floor, wall or ceiling in a frameless building which comprises a plurality of longitudinally extending units placed side by side and of triangular cross-sectional shape, a frame of sheet metal channels surrounding and secured to the units, tie rods extending transversely of the member at longitudinally spaced points thereon and secured thereto and making an angle with the longitudinal units, each of said units including a zigzag sheet of strip metal bent along a central longitudinal line, and metal sections welded to the central and edge portions of the sheet.

15. A compound unit of the character described comprising a zigzag strip of sheet metal bent on an angle along a central longitudinal, longitudinally extending strengthening means secured to the central and edge portions of the strip, and a second zigzag strip of sheet metal in overlying engagement with the first strip but longitudinally offset therefrom secured to the edge longitudinals and to the first-named strip.

16. A compound unit of the character described comprising a strip of sheet metal bent on an angle along a central longitudinal and having longitudinally repeated polygonal-shaped edge portions, longitudinally extending strengthening means secured to the central and edge portions of the strip, and a second similar strip of sheet metal in overlying engagement with the first strip but longitudinally offset therefrom secured to the edge longitudinals and to the first-named strip.

17. An interlocked compound structural unit comprising a zigzag strip of sheet metal bent on an angle along a central longitudinal, longitudinally extending strengthening means secured to the edge portions of the strip, a second similar strip of sheet metal in juxtaposition to the first-named strip and bent along a central longitudinal oppositely of the first strip, said second strip being longitudinally offset of the first strip so that the angularly inclined zigzag portions of the second strip extend between the portions of the first strip, longitudinally extending strengthening means secured to the edge portions of the second strip, and a common longitudinally extending strengthening member secured to the central portion of both the strips.

18. An interlocked compound structural unit comprising a strip of sheet metal bent on an angle along a central longitudinal and having longitudinally repeated polygonal-shaped edge portions, longitudinally extending strengthening means secured to the edge portions of the strip, a second similar strip to sheet metal in juxtaposition to the first-named strip and bent along a central longitudinal oppositely of the first strip, said second strip being longitudinally offset of the first strip so that the angularly inclined portions of the second strip extend between the portions of the first strip, longitudinally extending strengthening means secured to the edge portions of the second strip, and a common longitudinally extending strengthening member secured to the central portion of both the strips.

19. A compound structural unit comprising a pair of flat metal strips having longitudinally repeated inclined triangular areas forming the edge portions of the strip, the triangular areas of one strip extending between the triangular areas of the other strip with the planes of the areas crossing, longitudinally extending rolled metal sections secured to the lateral edges of each strip, and a metal section secured to each flat metal strip and holding the strips in spaced relation.

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