June 7, 1955 B. O'C. PARKER 2,709,975

TRUSS STRUCTURE AND SUPPORTING COLUMN

Filed April 14, 1951 2 Sheets-Sheet 1

Fig. 1.

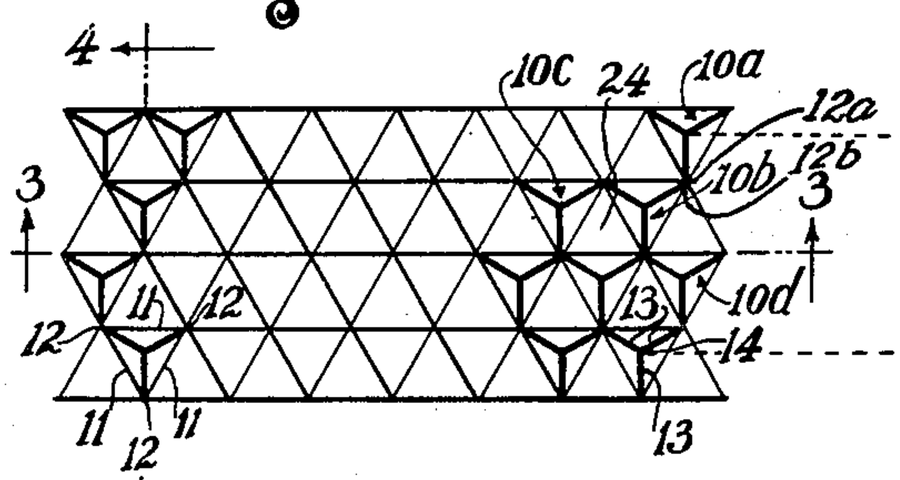


Fig. 2.

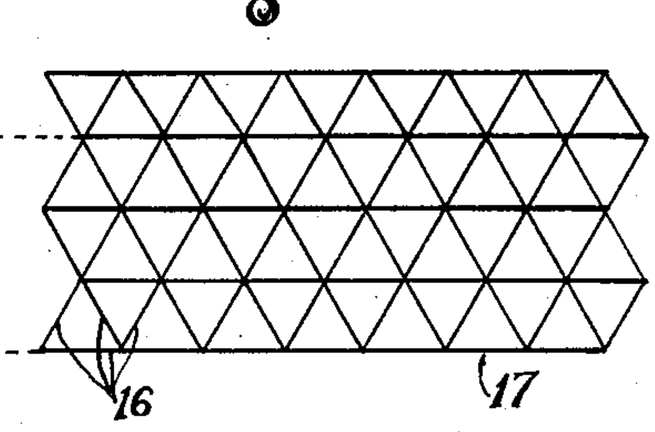
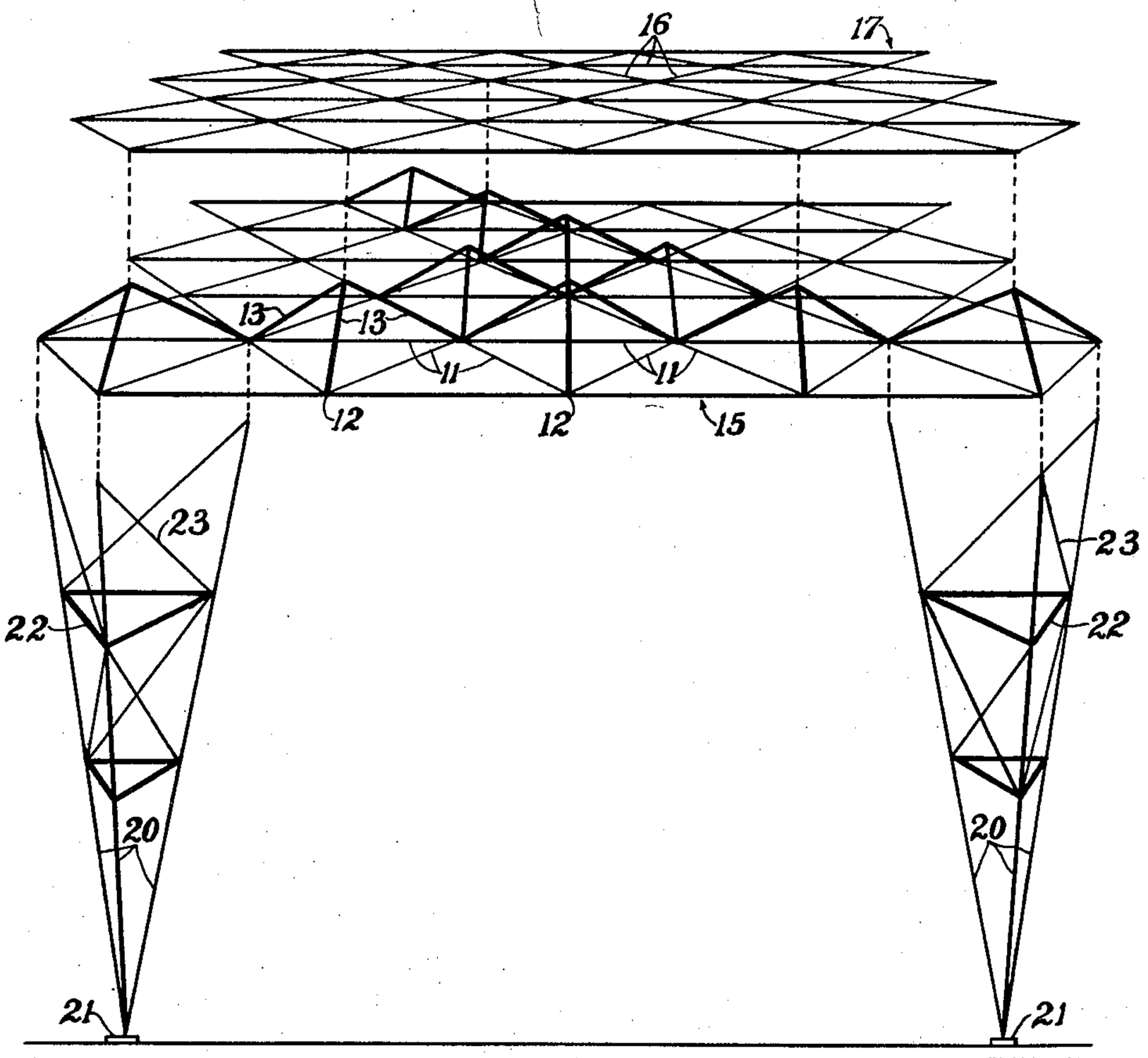


Fig. 3.

Fig. 4.

Fig. 5.



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Filed April 14, 1951 2 Sheets-Sheet 2

Fig. 6.

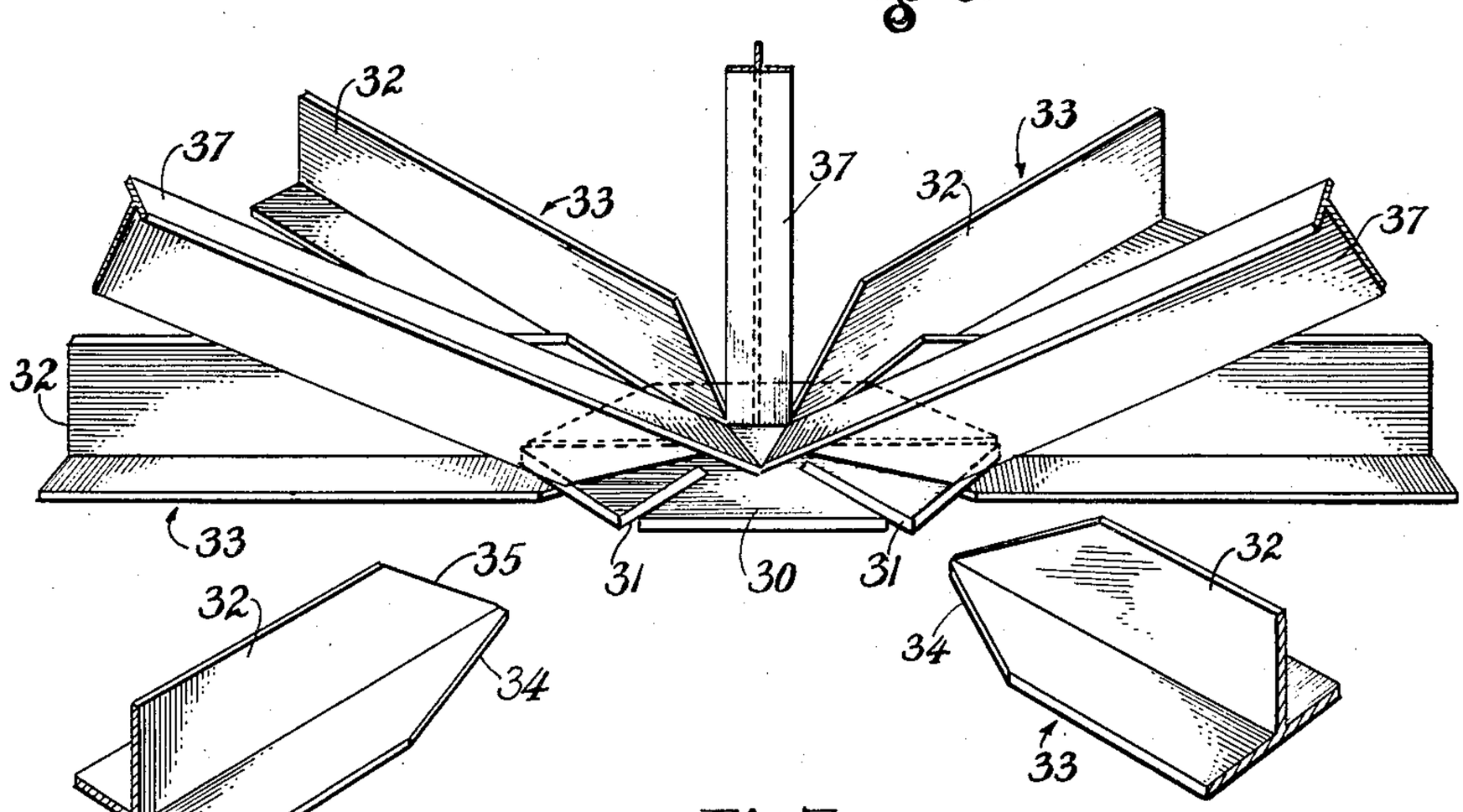


Fig. 7.

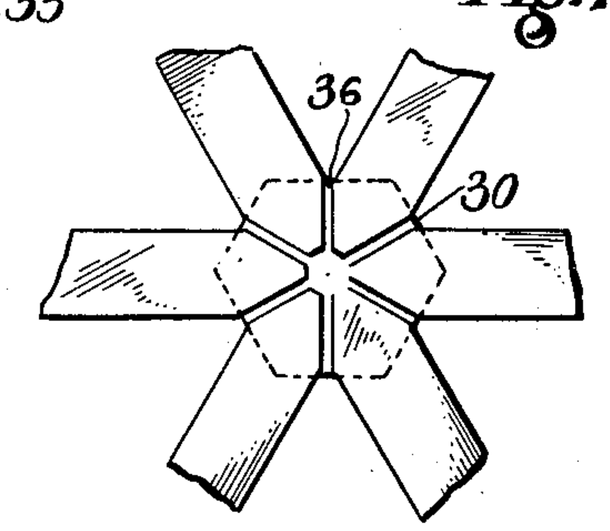


Fig. 8.

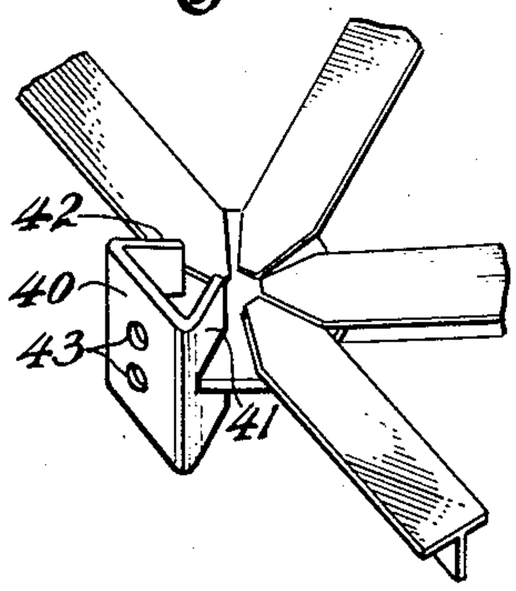
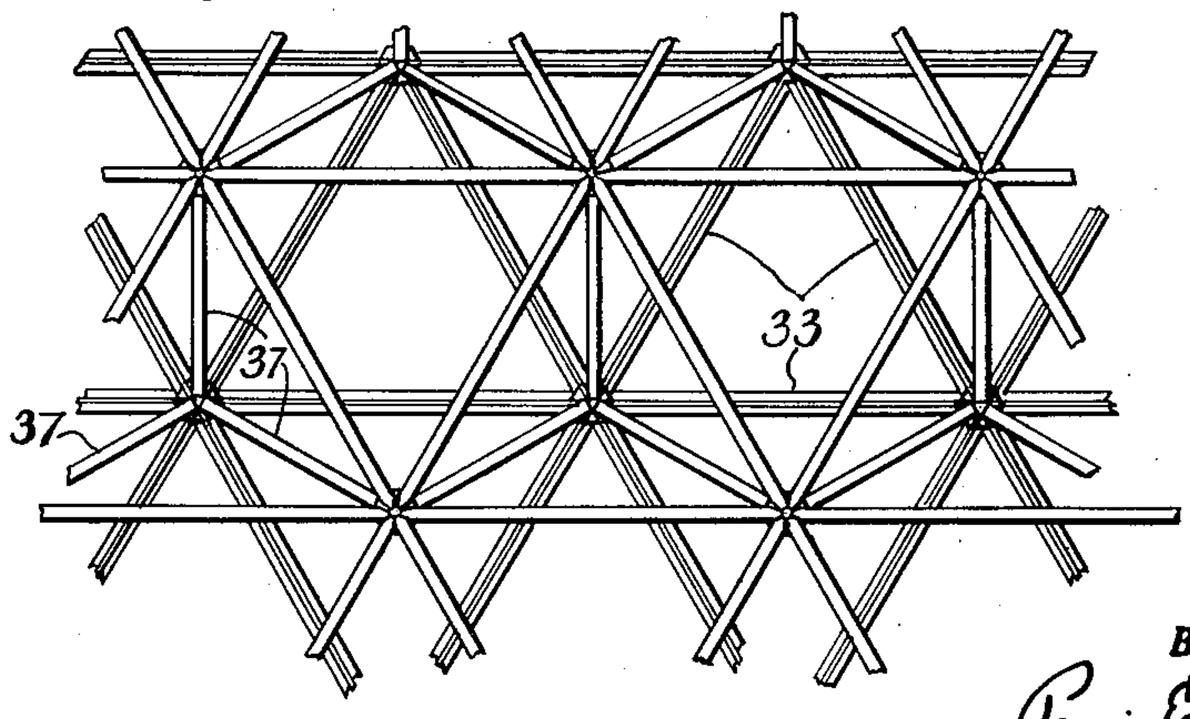


Fig. 9.



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TRUSS STRUCTURE AND SUPPORTING COLUMN

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11 Claims. (Cl. 108—23)

This invention relates to truss structures for supporting substantially uniformly distributed loads, and more particularly is directed to a truss structure made up of a plurality of triangular pyramidal units. Additionally the invention is concerned with a novel supporting column adapted to be used in combination with the aforementioned truss structure as well as with truss structures of the same general type but being made up of other than triangular pyramidal units. Furthermore, the invention includes a unique means for connecting the various members of each of the truss units to one another and for additionally connecting the units themselves to one another.

It has heretofore been proposed, as for instance in Thomas Patent 2,433,677, to construct a roof truss from a plurality of pyramidal units, the bases of which are connected together to have common sides and the apexes of which are each connected by rigid coupling members, the coupling members connecting the apex of each pyramidal unit to the apexes of the pyramidal units which surround it and have a base side in common with its base. While such a roof truss may in some instances prove satisfactory, I have found that by employing triangular pyramidal units and rearranging them, more than 15% by weight of material, from which the structure's members are formed, may be saved. Yet my lighter weight, and therefore more economical, truss will equally as satisfactorily support the same substantially uniformly distributed load as will the heavier truss of Thomas, or as will any of the other conventional roof trusses now commonly employed. At least partially responsible for this saving of material is my novel column which is designed to receive the load supported by a truss at a number of points rather than at a single point, thereby avoiding the necessity of providing relatively heavier truss members adjacent such a single point where a conventional column would engage or be connected to the truss. Yet my column does not require any more floor area than does a conventional column. Furthermore, it is more rigid in form than are conventional columns and thus lends to the truss structure which it supports greater lateral stability.

Another feature of my invention is a junction member to which various individual truss members may be connected at their points of intersection and by reason of which the truss structure of my invention may be readily assembled either into a complete truss structure or into prefabricated sections of a complete truss structure which may be fabricated in one locale and readily transported to and connected together at another locale where the structure in which the truss is to be employed is to be erected.

A further feature of my invention is the provision of edge clips for the peripheral extremity of a completed truss whereby a curtain wall may be secured to the periphery of the completed truss.

Broadly, my invention contemplates a truss structure made up of a plurality of triangular pyramidal units, each comprising a base made up of three members connected

together at their extremities to form base corners, and three web members connected to the base corners and converging to form an apex. The bases of the pyramidal units are adapted to form one truss face while the apexes thereof define a second truss face. The pyramidal units are so arranged with respect to one another that each pair of adjacent units are connected together at their bases only at one base corner of each, that is, the sole connection in the base plane between any two pyramidal units of the truss structure is the connection between one base corner of one and one base corner of another. In the plane of the apexes, however, each of the pyramidal units has its apex connected by truss members to the apexes of all the other pyramidal units which have a base corner connected to one of its base corners. More specifically, the truss structure comprises a plurality of triangular pyramidal units so connected together that each internal unit, that is, each unit of the truss, other than an edge unit, is connected at its base corners to six surrounding units and at its apex to the apexes of the same six units surrounding it.

The novel column of my invention is one which is broadly adapted to be used with any truss structure made up of pyramidal units and broadly comprises a plurality of column members, the number of which is equal to the number of apexes or base corners of the base of one pyramidal unit of the truss to be supported, each column member at one end being adapted to engage an apex or base corner of the base of a pyramidal unit of the truss and converging toward its other end to a point closely adjacent the corresponding ends of the other column members. A column, according to my invention, for use with my truss structure made up of triangular pyramidal units comprises three column members. In one instance, corresponding ends of the column members are adapted to engage the apexes or base corners of one pyramidal unit of the truss where as in another instance they are adapted to engage the apexes or base corners of three different pyramidal units. The particular advantages of either of these arrangements will be more fully pointed out below.

For a more detailed understanding of the truss and column of my invention as well as of the aforementioned junction members and edge clips adapted to be used therein, reference may be made to the accompanying drawings in which preferred forms thereof are illustrated and in which:

Fig. 1 is a diagrammatical representation of a plurality of triangular pyramidal units arranged with respect to one another in accordance with my invention;

Fig. 2 is a diagrammatic representation of what may be termed the top chord of my truss;

Figs. 3 and 4 are sectional views on lines 3—3 and 4—4, respectively, of Fig. 1;

Fig. 5 is an exploded diagrammatic view of the truss of Fig. 1 in combination with a pair of columns;

Fig. 6 is an exploded perspective view of a junction member and portions of truss members secured thereto and others adapted to be secured thereto;

Fig. 7 is a bottom view on a reduced scale of the structure illustrated in Fig. 6;

Fig. 8 is a perspective view of an edge clip secured to a portion of a truss; and

Fig. 9 is a plan view of a section of a truss in which all of the truss members are T-shaped in cross section.

By reference first to Figs. 1 through 5, the preferred form of truss and column will be described without reference to the cross sectional shapes of the various members employed and without reference to any specific manner in which the members are joined to one another. The truss structure itself is made up of a plurality of regular triangular pyramidal units 10*a*, 10*b*, 10*c*, etc.

Each of the pyramidal units is made up of three linear base members 11 which are arranged to form an equilateral triangle and are joined together at their extremities to form base corners 12. To each base corner is secured a web member 13, the three web members 13 of any unit converging away from the base to an apex 14. The triangular pyramidal units 10*a*, 10*b*, etc., are secured to one another at but one base corner 13 of each, that is, considering triangular pyramidal units 10*a* and 10*b*, these two units are secured together by connecting base corner 12*a* of triangular unit 10*a* to base corner 12*b* of triangular unit 10*b*. This is the sole connection between the bases of units 10*a* and 10*b*. It will also be noted that with units having their bases in the form of equilateral triangles as shown in the drawings, the angle between adjacent base members of two adjacent pyramidal units is 60°. Thus an internal pyramidal unit of the truss, that is, a pyramidal unit which is not an edge unit, for instance pyramidal unit 10*c*, has its base connected to six surrounding pyramidal units, one corner each of each two of which will be secured to each of its (unit 10*c*) base corners. As will also be observed from the drawings, the bases of all of the pyramidal units 10*a*, 10*b*, etc., lie in a common plane and together make up what may be termed the bottom chord 15 of the truss.

The apexes 14 of the pyramidal units are connected together by linear members 16, all of which lie in a second common plane and which together form what may be called the top chord 17 of the truss. Thus, as may be seen from Fig. 5, the apex of each triangular unit is connected by a linear member 16 of the top chord 17 to each of the apexes of the pyramidal units which have a base corner 12 secured to one of its base corners 12. Thus the apex of pyramidal unit 10*c* (an internal pyramidal unit) is connected by six linear members 16 to the apexes of the six pyramidal units which immediately surround it.

From the above description, it will be apparent that the truss comprises a bottom chord composed solely of linear members making up the bases of the various triangular pyramidal units, a top chord composed solely of linear members connecting the apexes of the various triangular pyramidal units to those of the immediately adjacent and surrounding pyramidal units, and a plurality of web members interconnecting the top and bottom chords and forming the face edges of the pyramidal units. It will also be apparent that the top and bottom chords are identical with respect to the arrangement of their linear members except that the top chord is offset from the bottom chord so that the junction points of the linear members of the top chord lie directly above the centers of the triangles formed by the linear members of the bottom chord. Therefore the truss is completely reversible, that is, it is the same even if it is inverted and chord 17 were to become the bottom chord and chord 15 the top chord. Also it will be noted that a substantially uniform load supported on the top chord of the truss will be carried through the web members and concentrated at the base corners of the triangles of the bottom chord, that is, the base corners of the pyramidal units as described.

It will be understood from the above that in designing a truss of the type disclosed for supporting a given load, the cross section of the members employed as well as the distance between the top and bottom chords, or both, may be varied within practical limits to meet given requirements of space availability and material economy, whereby the most satisfactory truss for the given load will result.

Referring now to Fig. 5, the novel column of my invention will be described. Each column comprises a plurality of column members 20, the lower ends of which are closely adjacent one another and are adapted to engage or be supported by a rigid supporting surface 21. The column members 20 diverge upwardly toward the truss and their upper ends are adapted to engage the truss at junction points of the pyramidal units comprising the truss. A plurality of horizontal bracing members 22 and a plurality of diagonal bracing members 23 may be employed to strengthen the column members and are secured to the column members 20 in any desired manner. In Fig. 5 each of the columns is illustrated as engaging the truss at the base corners of one triangular pyramidal unit and therefore each lies generally below a pyramidal unit. However, as will be explained below, a column may be so positioned that each of its column members 20 engages the truss at the base corner of a different pyramidal unit and therefore does not lie below a pyramidal unit.

Use of my column rather than a conventional column of constant section results in a number of advantages. The amount of material employed in my column is substantially less than that employed in a conventional column of constant section adapted to support an equal load. Furthermore, by reason of the fact that my column engages and is connected to the truss at a number of points and over a greater area than would be a conventional column of constant section, the weight of material necessarily employed in the truss structure is substantially reduced. Additionally, by reason of the greater rigidity of my column and the rigid coupling between it and the truss, it will be understood that a lateral stability is obtained in my combined column and truss structure which is not so obtained where a conventional column of constant section is employed.

When a column member is located beneath a pyramidal unit of the truss as illustrated, the load area of the top chord which is directly supported by the column through direct connection therewith by web members is greater than the load area of the top chord directly supported by a column which is not located directly below a pyramidal unit. The explanation for this is relatively simple and may be explained by considering a column located beneath pyramidal unit 10*c* of Fig. 1. In this instance the load area of the top chord supported directly through web members by the column may be defined by a line joining the apexes of the six triangular pyramidal units surrounding unit 10*c*. This line will describe a hexagon, the area of which is equal to six times the area of one of the triangles of the top chord. If, however, the column is not located beneath a pyramidal unit but rather beneath an area of the bottom chord such as area 24 (Fig. 1), the load area of the top chord directly supported by the column will be defined by a line through the apexes of the pyramidal units surrounding this area, namely, the pyramidal units which have a base member defining one side of this triangular area 24 and the pyramidal units having a base corner located at a corner of area 24. This line defines a triangle, the area of which is but four times the area of a triangle of the top chord.

As set forth earlier in the specification, a truss may be prefabricated into panels or units which may be readily handled and transported to the location at which a complete truss structure is to be erected. At that location the panels may be connected to one another and the complete truss structure erected. With a view to minimizing the labor involved in erection, I have devised a plan therefor which I will now describe.

According to this plan, the panels which are to be connected together to make up the completed truss structure may be connected together upon the ground and the columns may be erected while the truss is still on the ground by having their lower ends extended through the truss at spaces between the pyramidal units thereof and secured to the rigid supporting members 21. The upper bracing members of the columns may then be removed if the columns are erected with these bracing members in place, or columns may be provided in which the upper bracing members have not yet been incorporated. The completed truss structure is then raised around the col-

umns, the upper ends of column members 20 being sprung inwardly to permit their passage through the limited open area of the truss structure. When the truss is at the desired height and above the columns, column members 20 spring outwardly and their upper ends may be secured to the lower chord of the truss. In this system of truss erection, the upper ends of the column members of the column will probably not, although they may be, secured to the base corners of a single pyramidal unit and therefore lie therebelow, but rather the column will lie beneath an area of the truss, such as area 24 of Fig. 1 and the upper ends of the column members will be secured to base corners of three adjacent pyramidal units. The upper brace members may then be connected to the column members 20. If, however, the panels of the truss are connected together on the ground and then the truss structure raised to its proper height and the columns then placed therebeneath, or if the complete truss structure is constructed at its proper height, the column members will preferably be secured to the truss structure so that they will be located below pyramidal units, thereby obtaining the benefit of the fact that they directly support a greater load area of the top chord as described above.

It might be well to mention here that, when a complete truss structure is formed from a series of prefabricated panels, some of the panels may be constructed of truss members of one cross sectional size where others may be formed of members of another cross sectional size. The reason for this is that the truss members directly above or adjacent the columns are called upon to withstand greater stresses than are those at a distance from the columns. Thus panels of lighter weight truss members may be employed at points throughout the truss structure remote from the columns and panels of heavier members employed in the truss structure adjacent the columns. In other words, where the moments are least, that is, at points remote from the columns, lighter truss members may be employed than where the moments are greater.

In the general description of a truss and its supporting columns according to my invention, as set forth above, the cross sectional shapes of the various members are not referred to, although it is contemplated that the column members 20 will be made up of pipe sections or the like. However, one form of truss member which is particularly well adapted for use in my truss structure is a T-shaped member. For use in a truss structure having chord members of T-shaped cross section, I have developed a unique junction member. Its employment in construction of my truss, while requiring that the chord members be T-shaped or right angular in cross section or at least have flat ends, does not require any specific cross sectional shape of the web members.

This junction member is illustrated in Figs. 6 through 9 and comprises a hexagonal plate 30 provided with a plurality of radially extending slots 31. Slots 31 are adapted to receive the stems 32 of chord members 33, the ends of chord members 33 being preferably coped as at 34 and the stems being likewise coped at their ends as at 35. For a truss structure made up of triangular pyramidal units, the junction member 30 is provided with six equally spaced radially extending slots and is therefore capable of receiving the stems of six chord members. The chord members may be readily secured to the junction member by being welded thereto. In this respect, it will be noted that the provision of coped ends 34 for chord members 33 results in a decrease in the number of welds required by reason of the fact that these beveled ends form channels 36 whereby the adjacent beveled edges of two chord members which form the channel 36 may be welded to the junction member 30 in one operation.

As illustrated, the web members 37 are also T-shaped in cross section and the ends of their stems coped at an angle which is dependent upon the elevation which they are to assume in any truss.

It will be clear that the use of my junction members 30 removes completely the necessity of locating the chord members with respect to one another, by measurement, when constructing a truss because their spacing with respect to one another is determined completely by the position or relation of slots 31 with respect to one another in the junction members. This, of course, results in a considerable saving in the time which is required to construct a truss and consequently results in considerable economy.

Another important feature of the above junction members is that when a truss structure is to be formed of prefabricated panels, these panels may be readily secured to one another to form the completed truss because the periphery of each panel will be composed either of a number of junction members having a number of unfilled slots 31 or the free ends of chord and web members (these being temporarily secured together if desired for stability in shipment). To join the panels together, therefore, the free terminal ends of the chord members of one panel need merely be brought up to the adjacent peripheral junction member of another panel and their stems be inserted in the unfilled slots in the junction members and welded thereto.

As will be understood from the above description, the outer edge of a complete truss structure which embodies my invention will not be a right edge and therefore the top and bottom chords thereof will not terminate in a common vertical plane whereby the truss can be readily secured to a vertical wall. To provide a ready means for securing the truss to a vertical wall, or vice versa, that is, hanging a wall from the truss, I have devised what may be termed an edge clip which is illustrated in Fig. 8. The edge clip comprises a back section 40 and two wing sections 41 and 42 integral with the back section and extending therefrom at an angle of 60° with respect to one another (the latter angle, of course, being dependent upon the nature of the pyramidal units which are employed to form the truss structure). The rear section 40 of the clip is provided with at least one hole 43 extending therethrough which is adapted to receive a bolt or other securing member. The edge clips are readily securable to a peripheral junction member of the truss and may be so secured thereto by insertion of their wing sections into a pair of unfilled slots 31 of the junction member, the wing sections then being welded in place.

Among the numerous advantages of my invention are the following: It is suitable for mass production since it consists of a few identical elements which recur many times in the entire structure; the erection process is relatively simple compared to that of comparable long span constructions; and what is perhaps the most important feature is that the weight of material required to construct my truss structure and the supporting columns to carry a given substantially uniformly distributed load is more than 15% less than that required in conventional comparable structures adapted to support an equal load.

It will of course be understood that various changes and modifications may be made in the design of the structures of my invention without departing from the scope of the invention and therefore the invention should not be limited except to the extent set forth in the appended claims.

I claim:

1. A truss structure for supporting substantially uniformly distributed loads comprising a plurality of triangular pyramidal units each comprising a base made up of three base members connected together at their extremities to form base corners and three web members connected to the base corners and converging to form an apex, the bases of the pyramidal units forming a base truss face and the apexes partially defining a top truss face, each pair of adjacent pyramidal units having one base corner of the base of one unit of the pair connected to one base corner of the base of the other unit of the pair, this connection being the sole connection between

the bases of said pair of adjacent units, and a plurality of top face members connecting the apex of each unit to the apexes of all the units which have a base corner connected to one of its base corners, the base members making up the bases of the pyramidal units and the top face members connecting the apexes of the pyramidal units each having a stem section and at least one flange section integral therewith and substantially coextensive in length.

2. A truss structure according to claim 1 in which the base members making up the bases of the pyramidal units are all equal in length and in which the web members are all equal in length.

3. A truss structure according to claim 1 in which the stems of the base and top face members are directed inwardly toward the interior of the truss.

4. A truss structure for supporting substantially uniformly distributed loads comprising a bottom chord, a top chord, and a plurality of web members interconnecting the bottom chord and the top chord, said bottom chord comprising a plurality of linear members connected together at their extremities to form a plurality of equilateral triangles, each pair of adjacent triangles of said bottom chord having a common side and therefore a pair of common apexes, said top chord comprising a plurality of linear members equal in length to the linear members of the bottom chord and connected together at their extremities to form a plurality of equilateral triangles of the same dimensions as those of the bottom chord, each pair of adjacent triangles of said top chord having a common side and therefore a pair of common apexes, the top chord being parallel to but offset from the bottom chord so that the apexes of the triangles of the top chord lie above the centers of the triangles of the bottom chord, and the web members being of equal length and each extending from the apex of a triangle of the bottom chord to the apex of one of said triangles of the top chord, a maximum of three web members extending from any common apex each of which web members extends at an angle of 120° with respect to each of the other two web members, the linear members of both chords each having a stem section and at least one flange section integral therewith and substantially coextensive in length.

5. In combination with a truss structure as set forth in claim 1, a supporting column for said truss which comprises three column members, each of said column members engaging said truss at a base corner of a pyramidal unit and all of said column members converging in a direction away from said truss with their outer ends in close proximity.

6. The combination set forth in claim 5 in which the end of each column member adjacent the truss engages the truss at one base corner of a single pyramidal unit.

7. The combination set forth in claim 5 in which all column members are of equal length.

8. A truss structure for supporting substantially uniformly distributed loads comprising a plurality of triangular pyramidal units, a plurality of junction members, the base of each pyramidal unit being made up of three members arranged to form a triangle, each pair of adjacent ends of said three members being connected to a junction member, the faces of each pyramidal unit being defined by three web members each secured at one end to a junction member of the base and converging at its other end to a junction member to which it is secured and which forms the apex of the pyramidal unit, each pair of adjacent pyramidal units having one base junction member in common, this connection being the sole connection between the bases of said pair of adjacent pyramidal units, and a plurality of members connecting the apex junction member of each pyramidal unit to the apex junction members of all the pyramidal units which have a base junction member in common with its base.

9. A truss structure according to claim 8 in which the members forming the bases of the pyramidal units and the members connecting the apexes of the pyramidal units each have a stem section and at least one flange section integral therewith and substantially coextensive in length, and in which each junction member comprises a flat plate hexagonal in shape and provided with six radially extending slots.

10. A truss structure according to claim 9 in which the stems of the base members and of the apex-connecting members are received in the slots of the junction members.

11. A truss structure according to claim 10 which includes a plurality of edge clips for securing the truss to a wall, each of said edge clips being connected to a junction member located at the periphery of the truss, and each comprising a back section containing at least one hole and wing sections integral with the back section and extending therefrom in a converging direction at an angle of substantially 60° with respect to one another, said wing sections being received in a pair of adjacent slots in the junction member.

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