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Du Chateau

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[54] **METAL STRUCTURE AND SECTIONS**

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[51] **Int. Cl.** **E04h 12/08**
[58] **Field of Search** 29/428, 455, 282, 29/200; 46/23, 24, 25, 26; 272/2, 3, 4; 52/650, 81, 648

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Assistant Examiner—D. C. Crane
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[57] **ABSTRACT**

The method of assemblying pyramid elements in order to obtain a metallic space structure consists in joining the truncated corners of the basic frames of the pyramid elements, these frames being regular polygones, each joint being effected by means of one single bolt.

2 Claims, 7 Drawing Figures

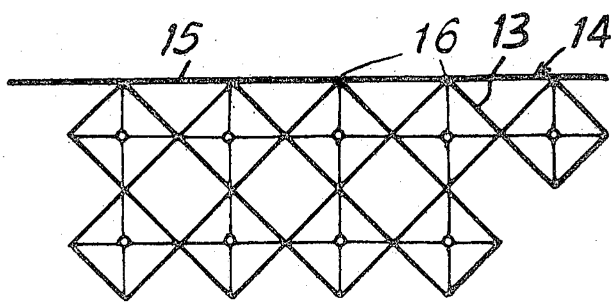


Fig:1

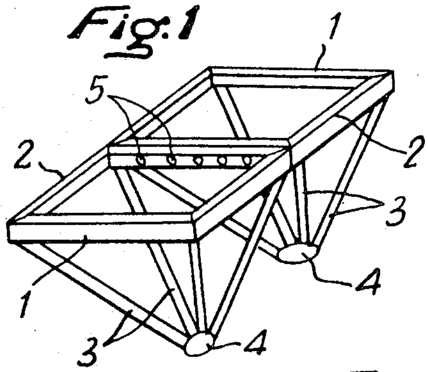


Fig:3

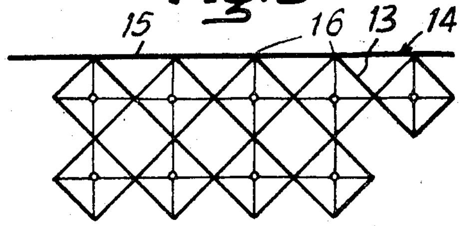


Fig:2

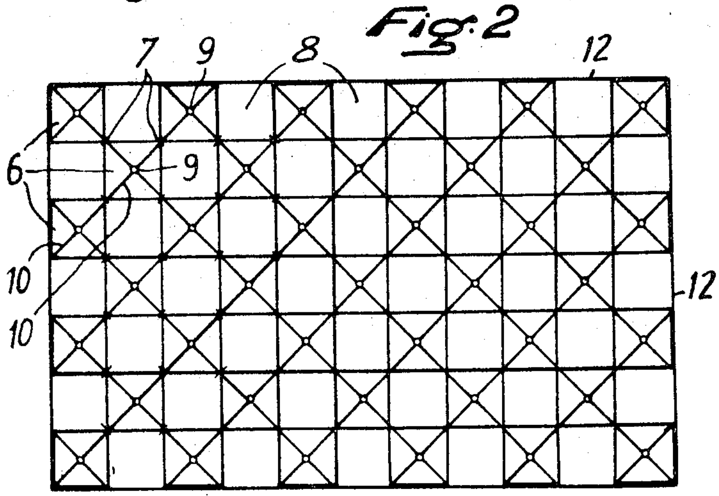


Fig:4

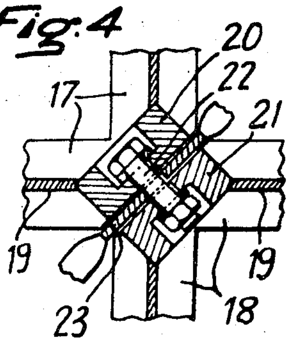


Fig:5

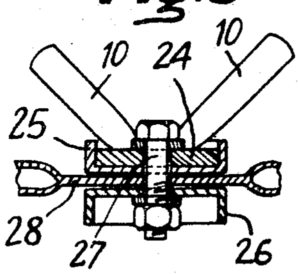


Fig 6

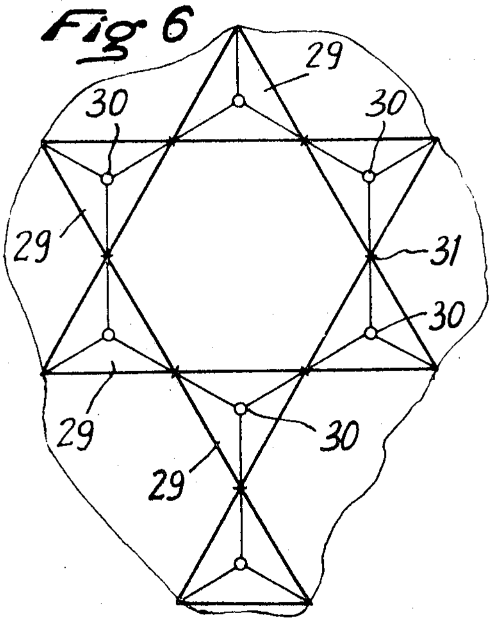
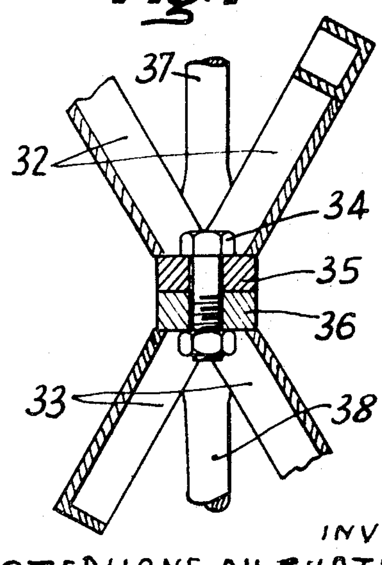


Fig:7



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METAL STRUCTURE AND SECTIONS

Many structures and metal constructions are known which consist of an assembly of sections in the form of pyramids with a regular polygonal base. These structures differ from one another by the manner in which these sections are assembled and by the position these sections occupy in space.

At present the assembly of different sections consists in bolting the base of a pyramidal section from one side to the side adjacent to the base of the next section. In a popular method of assembly the sides of the base of the pyramidal sections consist of angle irons and when bolted together they form an outer plane of T-sections composed of two members. This method of assembly which is undoubtedly efficient suffers, however, from the drawback that twice the number of bolts is required — at least seven to nine bolts per section. Finally the maintenance and the corrosion protection of bolted connections of angle irons present certain difficulties.

The present structure avoids the above drawbacks and recommends a new method of assembly for pyramidal sections for metal constructions, where the number of sections used is halved and the number of bolts are cut to a minimum. The method consists in joining pyramidal sections at their corners which had previously been prepared. The assembly of two pyramidal sections therefore requires only one bolt.

The frames of pyramidal sections can consist of bars, open sections and closed (tubular) sections. Adjusting and customary compensating plates can be introduced into the bolt assembly for domed constructions and supplementary pieces such as diagonals and stiffeners.

The lower plane of the metal construction is fixed to the vertex of each pyramidal member by a fixing device requiring a single perpendicular bolt or any other device for transmitting stresses in the opposite direction to the frame of the pyramid. In its present state of development the assembly of metal structures with square-based pyramidal sections requires only three bolts per pyramidal section, i.e., 1.5 bolts per square unit of constructed surface.

In this system of metal construction the lower plane is at 45° to its upper plane and the length of the members of the lower plane is equal to the diagonal of the pyramidal base frame. It represents an extremely economical construction, since it halves the number of the required pyramidal sections, since half of the squares of the checker-pattern of the upper plane is empty. Like all orthogonal grids the structure built solely from pyramidal sections is not rigid. It is rendered stable through the introduction of diagonals into the design of the plane, through rigid fillings of the frames (flooring and flagging) or through its external frame work by means of a member joining the corners of the frames.

In order to clarify the nature of the structure the assembly of sections, preferably pyramidal, has been described below with reference to the attached sheet of drawings in which:

FIG. 1 shows a perspective view of the conventional method of assembly employed for two pyramidal sections;

FIG. 2 represents a plan view of a structure with square-based pyramidal sections using the present technique;

FIG. 3 represents a part view of the plan of a structure where the sides of the pyramidal base are at 45° to the edges of the structure which is assumed to be rectangular;

FIG. 4 is a plan view showing the assembly between two pyramidal sections using the present method;

FIG. 5 is a side view of the method of connecting the lower plane to the vertex of a pyramidal section;

FIG. 6 is a plan view of a structure using triangular pyramids and forming a hexagonal mesh;

FIG. 7 is a horizontal sectional view showing the junction between two tetrahedrals from FIG. 6.

The pyramidal sections in FIG. 1 have a square base 1, the sides of which are angle sections 2. The bracings of the pyramid are formed by side members 3, one end of which is integral with base 1 at one of its corners and the other end is an integral part of a fixing device 4. In the customary process the sections are assembled by joining them with bolts 5 at the adjacent sides of two frames 1. In order to construct a metal structure each side of frame 1 is connected to the side of the corresponding adjoining frame 1 which demands a large number of bolts 5.

A metal construction composed of square-based pyramidal sections similar to that of FIG. 1 but based on the present process has been represented in FIG. 2. Each pyramidal section-base frame 6 made to this design is connected at one of its corners 7 to the corresponding corner of the adjacent base frame 6. This assembly, as will be shown in more detail in FIG. 3, uses only a single bolt for each corner connection which reduces the number of bolts required to a minimum. Furthermore, it is evident in FIG. 2 that every other square is empty (indicated by 8) which constitutes a large saving and uses only half of the number of pyramidal sections in this checker pattern.

The fixing device 9 at the ends of the bracings 10 of each pyramidal section serves for fixing the lower plane of the structure. This lower plane consists of tubes which are orientated along the diagonals of each frame 6 (their projections in FIG. 2 are superimposed on those of bracings 10). The means of stabilizing such a structure has not been represented in detail, but it should be understood that this stabilization can for instance be achieved by the surrounding framework 12.

The optimum application of the inverted structure (i.e. with all members turned through an angle in the horizontal plane) occurs when the members in the top plane 13 (FIG. 3) are at an angle to the edge beams 14 such that the edge beams 15 connected at corners 16 of the pyramidal bases represent a peripheral triangle.

The assembly of frame 17–18 of two pyramidal sections at their corners has been represented in detail in FIG. 4. Each frame is made of T-shaped bars 19 whose webs are cut off at each corner to facilitate attachement by welding of an assembly unit of block members as indicated by 20 and 21 for frames 17–18 in the diagonal axis of the frame and each block member contains a hole for the bolt 22. When the two frames 17–18 are connected by two block members 20–21 a supplementary device, such as 23 for fixing the diagonals, can be inserted between these block members 20–21.

FIG. 5 shows that the arrangement for fixing the vertex of the pyramidal section to the lower plane of the structure consists of a plate 24 upon which the ends of the tubular bracings **10** of the pyramidal section have been welded. Plate **24** is rigidly fixed to the intersecting lower members **25** and **26** of U or other cross section by a bolt **27** passing through the assembled members. The flat part **28** of a diagonal can be introduced between members **25** and **26**.

A three-directional or hexagonal structure of the type shown in FIGS. **6** and **7** as examples can be constructed from regular-base tetrahedral pyramids using this system of assembly.

FIG. **6** shows the plan of a structure of tetrahedrals **29**, the bases of which belong to the top plane while their vertices **30**, belonging to a lower plane, are distributed at the nodes of a hexagonal network. The triangular bases have been joined at their opposing corners **31**, as shown in FIG. **7**, which represents a horizontal view showing the junction at the corner between two members (L or U) of the triangular base of a pyramid **32** with two corresponding members of the adjacent pyramid **33**. This joint is made by bolt **34** which passes through pieces **35–36** welded to the corners to be assembled. Bracing members **37–38** are shown going from the corners to the vertices of these two pyramids.

It is obvious that the above description is not restricted to the example given and that the structure allows for additions and modifications without going outside its scope and must therefore be considered from a wider aspect.

What I claim is:

1. A frame structure comprising fixing devices, a plurality of pyramidal frame units each having a base of pyramidal shape provides by base members rigidly connected together at their ends providing corners thereof and side members each attached at one of its ends to a corner of said base and at its other end to a respective cooperating one of said fixing devices, said frame units being positioned with each base having a corner only thereof adjacent a corner only of a second one of said bases and each said corner having a lateral cut, connecting members each consisting of a block member attached to one of said base corners at the corner cut thereof and having an axial bore, said block members of adjacent base corners facing one another, and assembly bolt means extending through the axial bores of facing block members joining said block members and thereby the adjacent base corners together.

2. A frame structure as claimed in claim **1** wherein said frame units are further positioned with certain of said bases each having at least two of their corners only thereof adjacent to corners only of further of said bases, additional ones of said connecting members are connected to said further base corners and additional ones of said assembly bolt means bolt said additional adjacent connecting members together.

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