Jan. 23, 1968 R. J. POLO 3,364,633

SPACE FRAME STRUCTURE

Filed May 7, 1964 3 Sheets-Sheet 1

Fig. 1

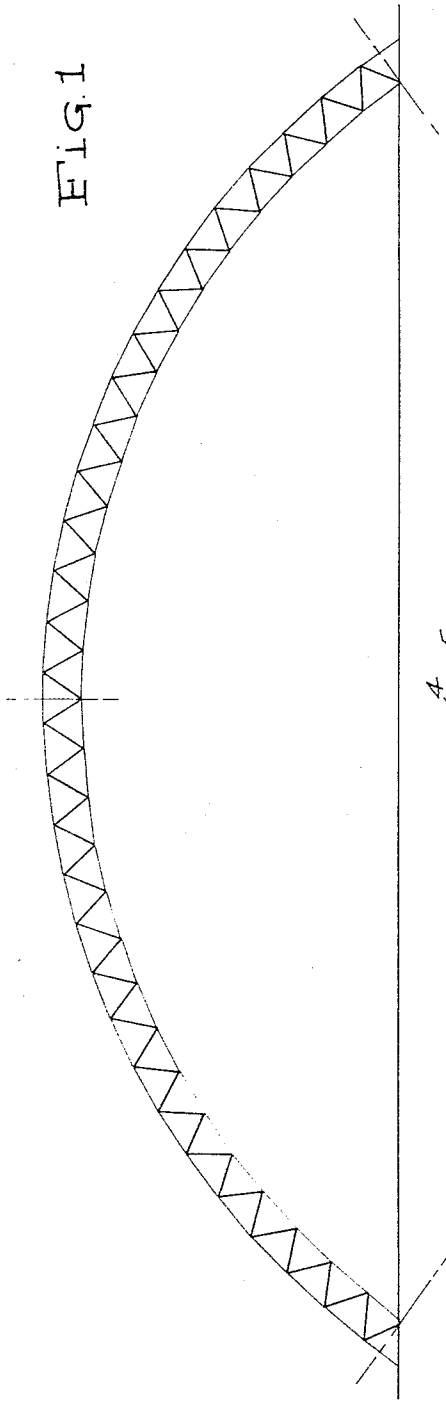


Fig. 2

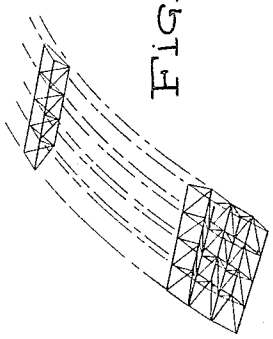
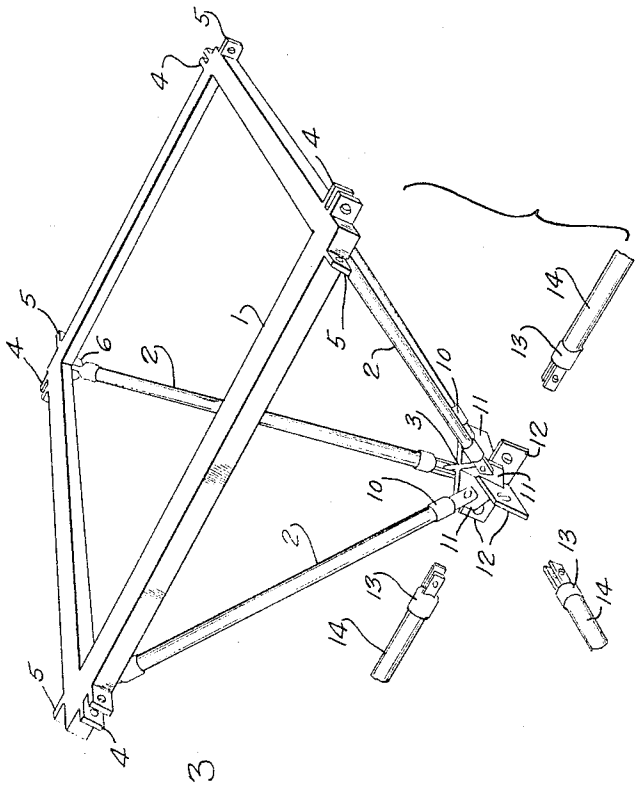


Fig. 3



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SPACE FRAME STRUCTURE

Filed May 7, 1964 3 Sheets-Sheet 2

Fig. 7

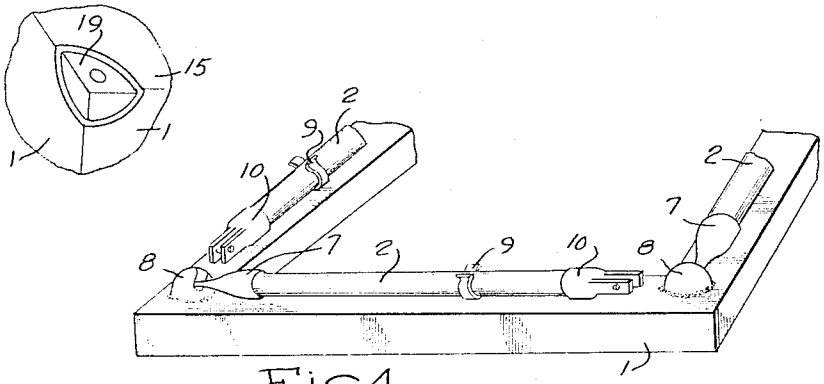


Fig. 4

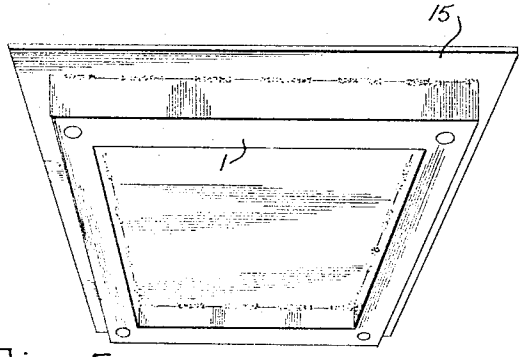
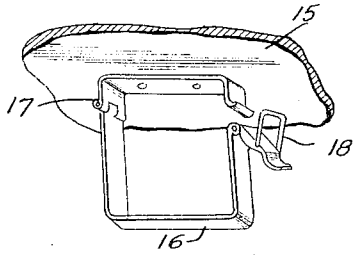


Fig. 5

Fig. 8



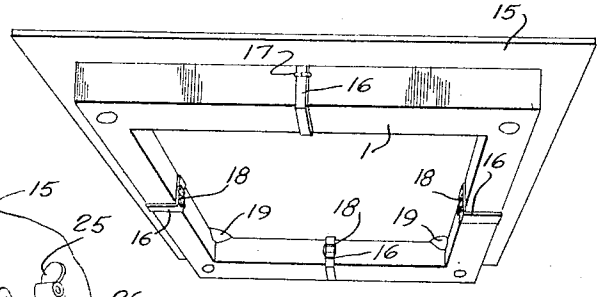
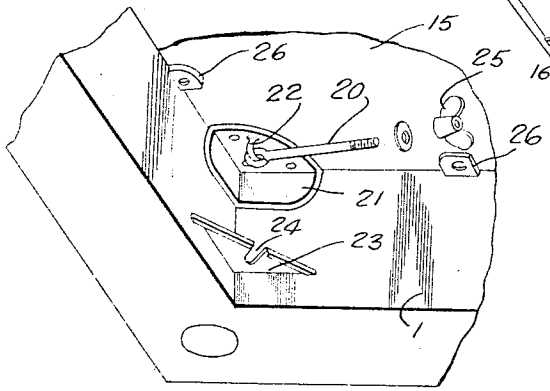


Fig. 6

Fig. 9



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Jan. 23, 1968 R. J. POLO 3,364,633

SPACE FRAME STRUCTURE

Filed May 7, 1964 3 Sheets-Sheet 3

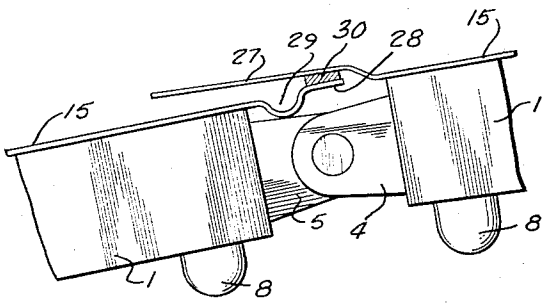


FIG. 10

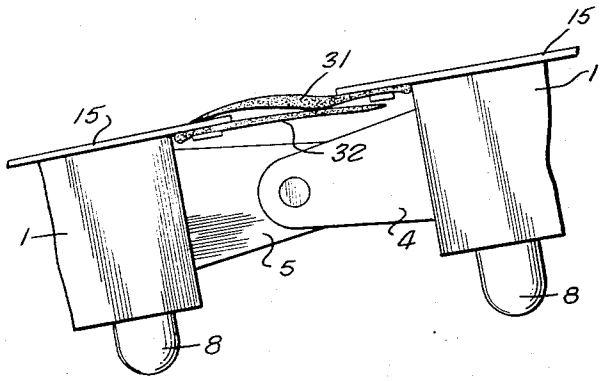


FIG. 11

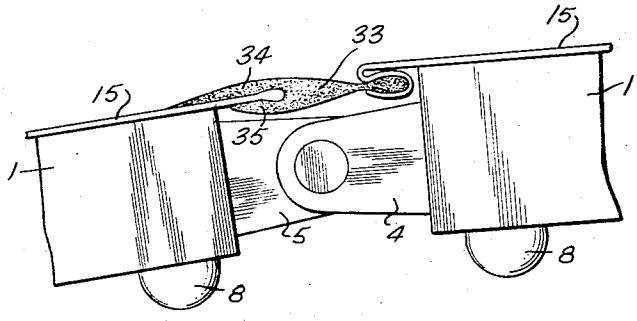


FIG. 12

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SPACE FRAME STRUCTURE

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Filed May 7, 1964, Ser. No. 365,845
1 Claim. (Cl. 52—86)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to an arched space frame structure and more particularly to the module forming the basic building unit for the space frame structure.

An object of the invention is to provide a simply designed, low cost, mass produced structure which is constructed by assembling many repetitions of one basic module.

Another object of the invention is to provide a structure that can be rapidly erected or disassembled using little heavy equipment and whose span, height, and length can be varied by varying the size or number of the basic modules.

Another object of the invention is to provide a basic building module which folds into a compact unit and which is composed of standard, interchangeable structural members.

Another object of the invention is to provide a separately integral module, no member of which is common to any adjacent module.

Another object of the invention is to provide a basic building module in which the roof section is a part of the module so that no separate roofing operation is required.

Another object of the invention is to provide a basic building module complete with roof section and weatherproofing roof joint means.

The structural features of the invention are illustrated in the accompanying drawings in which:

FIG. 1 is a schematic cross-sectional view of the space frame structure;

FIG. 2 is a schematic drawing of a portion of the structure showing the interrelationship of the space frame modules;

FIG. 3 is a perspective view of the space frame module without the roof section;

FIG. 4 is a perspective view of a portion of the module base frame showing the web members in folded position;

FIG. 5 is a perspective view of the underside of the module base frame with roof section attached;

FIG. 6 is a perspective view of the underside of the module base frame showing the roof section strapped onto the base frame;

FIG. 7 is a detailed perspective view of a roof section positioning cleat;

FIG. 8 is a detail perspective view of the roof section strap means shown in FIG. 6;

FIG. 9 is a perspective view from the underside of one corner of the module base frame showing alternative means for fastening the roof section to the module base frame;

FIG. 10 is an elevation view of the joint between two modules showing the joint weatherproofing means;

FIG. 11 is an elevation view showing alternative joint weatherproofing means; and

FIG. 12 is an elevation view showing additional alternate joint weatherproofing means.

Referring to the drawings, FIG. 1 illustrates the type of structure in which the module of this invention can be best used. FIG. 2 illustrates the interrelation of the modules within the structure shown in FIG. 1.

FIG. 3 shows the basic space frame module of this invention, with the roof section removed. The module is

pyramidal in form and comprises an integral base frame 1, tubular web members 2, and a connecting member 3 at the apex of the pyramid of the module. Base frame 1 is preferably made up of four integrally connected tubular members and is in the form of a square, although other base frame forms are within the scope of this invention. Each base frame member has a protruding yoke member 4 and a tongue member 5, each perforated to allow passage of a connecting pin, not shown. The placement of the yoke and tongue members of opposite members of frame 1 is reversed so that when the modules are joined together a tongue member of one module fits into a yoke member of the adjacent module. The web members 2 are pivotally connected to each corner of the base frame 1, preferably by a ball and socket hinge 6. The base frame end of each web member 2 is fitted with a ball coupling assembly 7, shown in FIG. 4. Each socket member 8 is slotted to alow each web member 2 to be folded flat against the base frame 1 for convenient storage and transportation of the module. Retainer clips 9 are riveted to base frame 1 to hold web members 2 in folded position. The apex end of each web member 2 is fitted with a yoke coupling assembly 10. Each yoke of assembly 10 fits over a tongue member 11 of apex connector 3. Yoke 10 and tongue 11 are perforated to allow passage of a connecting pin, not shown. Apex connector 3 also has perforated tongue members 12. Perforated yoke coupling members 13 of chord members 14 fit over tongues 12 and are preferably connected with pins, not shown. Tubular chord members 14 connect each module apex with the apex of each adjacent module. In the transverse direction, chord members 14 are shorter than the transverse members of base frame 1 to provide for the arch of the space frame structure.

The complete module has a roof section 15 attached to base frame 1. FIG. 5 shows a metal plate roof section 15 attached to base frame 1 by fillet welds. FIG. 6 shows roof section 15 releasably fastened to base frame 1. The fastening means, shown in detail in FIG. 8, comprise strap 16 which is riveted to roof section 15. If strap 16 is metal, the base frame-surrounding portion is connected to the roof section portion by hinge 17. Buckle 18 secures the strap 16 around each base frame 1 member. It is to be understood that roof section 15 need not be metal but could be of wood, cloth, plastic or other suitable material. Strap 16 likewise may be of a material other than metal. Roof section cleat 19, shown in detail in FIG. 7 is riveted to roof section 15 to insure proper positioning on base frame 1.

FIG. 9 shows alternative means for releasably fastening roof section 15 to base frame 1. One such means comprises a bolt 20 pivotally connected to plate 21 by hinge 22. Plate 21 also serves as the positioning cleat shown in FIG. 7. Hooking plate 23 having slot 24 is fastened to each inside corner of base frame 1. Wing nut 25 is tightened to bolt 20 after bolt 20 has been inserted in slot 24. When nut 25 is tightened, roof section 15 is drawn to base frame 1 in secure fashion. Another means for fastening roof section 15 to base frame 1 is shown in FIG. 9 as protruding, perforated tab 26. These tabs 26, protruding from the corners of each base frame member, provide the receiving member whereby roof section 15 can be bolted or screwed to base frame 1.

FIG. 10 shows one means of weatherproofing the joint between the roof sections of two adjacent modules. Considering the module frame shown in FIG. 3, roof section 15 is extended to overlap base frame 1 on all four sides. On two adjacent sides, for example the north and west sides, the overlapping extension consists of a portion of the roof section 15 which is bent so as to be parallel with but slightly higher than the plane of the section 15. This extension is shown as 27 in FIG. 10. The other two sides

of roof section 15 have overlapping extensions 28 in which a gutter 29 is impressed. When assembled, the raised overlapping extension 27 of one roof section 15 extends over the overlapping extension 28 and gutter 29 of the adjacent roof section. Gasket 30 may be inserted between overlapping plates 27 and 28 as shown in FIG. 10. The resulting joint prevents any water from entering the building. Gutters 29 carry away water which may be blown under extension 27. If desired, a gasket, not shown, may be crimped into extension 28 to form the weatherproof seal.

FIG. 11 shows alternative means for weatherproofing the joint between the roof sections of two adjacent modules. This means consists of overlapping flexible flaps 31 and 32 attached to the underside of each edge of roof section 15. Each flap is of sufficient dimension to extend from one roof section 15 to the roof section of the adjacent module. Flaps 31 and 32 may be attached to roof sections 15 by any suitable means such as by rivets or by crimping the roof section over the flap.

FIG. 12 shows still another means of weatherproofing the joint between the roof sections of two adjacent modules. This means consists of a flexible gasket 33 which is attached to one overlapping edge of roof section 15 by crimping or riveting. Gasket 33 has resilient gripping means on its distal end consisting of upper 34 and lower 35 flap portions of the gasket 33. Flap portions 34 and 35 are dimensioned so as to extend from one roof section 15 to grip the overlapping roof section 15 of the adjacent module, thereby forming a weatherproofing seal.

In constructing the space frame structure using the module just described, the module base frames are connected together to form an arch the width of one base frame. The arch is formed by using pinned module connections and having the transverse apex-connecting chord members shorter than the transverse base frame members. It is assumed that the pyramidal modules are inverted, with the apexes facing the inside of the structure. The space frame thus constructed generates a circular structural shell, the length of which can be varied by adding or substracting module-wide arches.

The structure formed by the modules of this invention is highly efficient since each module member reaches approximately the same maximum stress under loading conditions most likely to occur. Such modular design permits economy of material and the use of only a few types of standard structural members. Moreover, the integral roof sections and weatherproof joints of the modules of this invention eliminate a separate roofing operation and allow

use of expedient roof materials such as wood, cloth or plastic as well as metal. Another important feature of this invention is that the modules can be folded flat for storage and transportation and that each module is complete in itself with no common interconnecting members. This integrity of modules permits easier and faster assembly and disassembly and more efficient storage and transportation.

I claim:

1. A space frame structure comprising a plurality of interconnected pyramidal modules, each module having a separately integral base frame, said frame carrying alternating, protruding yoke and tongue lugs disposed at the corners thereof and extending normal to the sides of said frame, web members pivotally connected to and extending from the corners of said base frame, and a connecting member at the apex of the module, said connecting member including a first series of protruding tongue lugs vertically disposed and forming a cruciform configuration, each of said tongue lugs supporting the distal end of one of said web members, a second series of tongue lugs forming a cruciform configuration vertically and angularly displaced relative to and secured to said first cruciform configuration with the inner edges of said second series of tongue lugs protruding from the common intersection of the tongue lugs of said first series of tongue lugs, the integral base frames of said modules being fastened together by inserting a protruding tongue lug of one module base frame into the yoke lug of an adjacent module base frame and passing a pin through the tongue and yoke joint, and the apexes of said modules being connected by chord members, said chord members terminating in yoke lugs for receiving one of said second series of tongue lugs and pins to form a yoke and tongue joint.

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