

[54] ROOF CONSTRUCTION

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[51] Int. Cl.E04b 7/14

[58] Field of Search52/83, 63, 222

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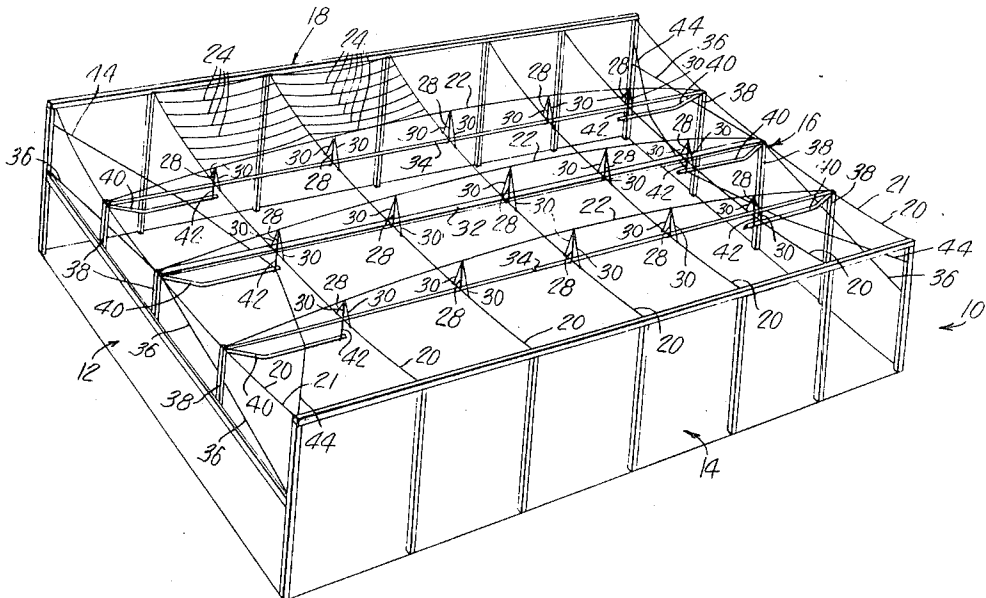
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[57]

ABSTRACT

A flexible roof structure supported by tension members extending in a catenary between the walls of the structure and a second set of tension members interconnected to the first set of tension members through a hold, the tension members of the first set in position and preventing undue flexing of the roof.

8 Claims, 6 Drawing Figures



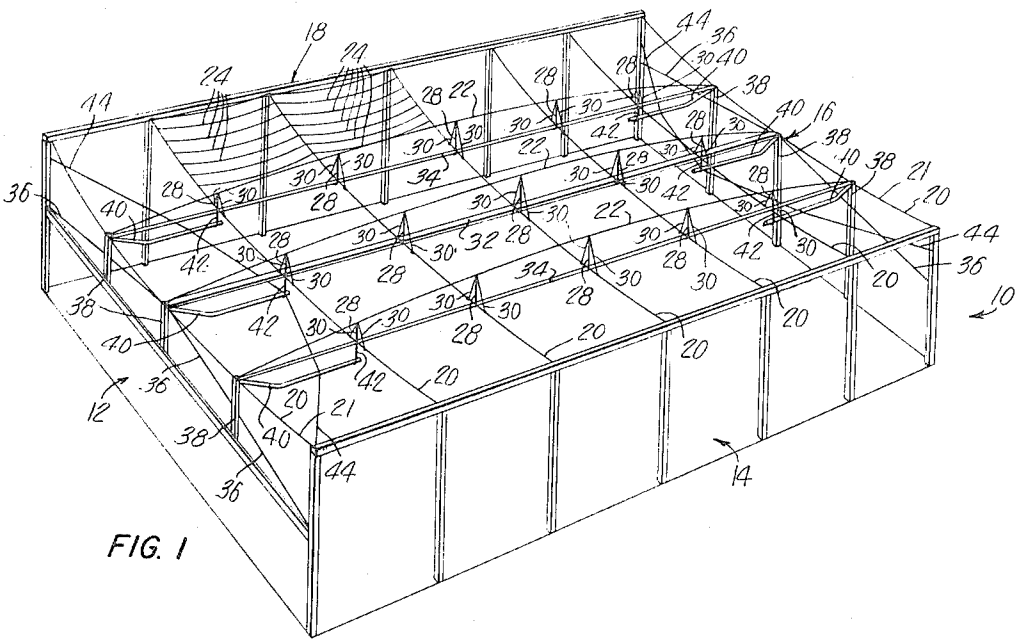


FIG. 1

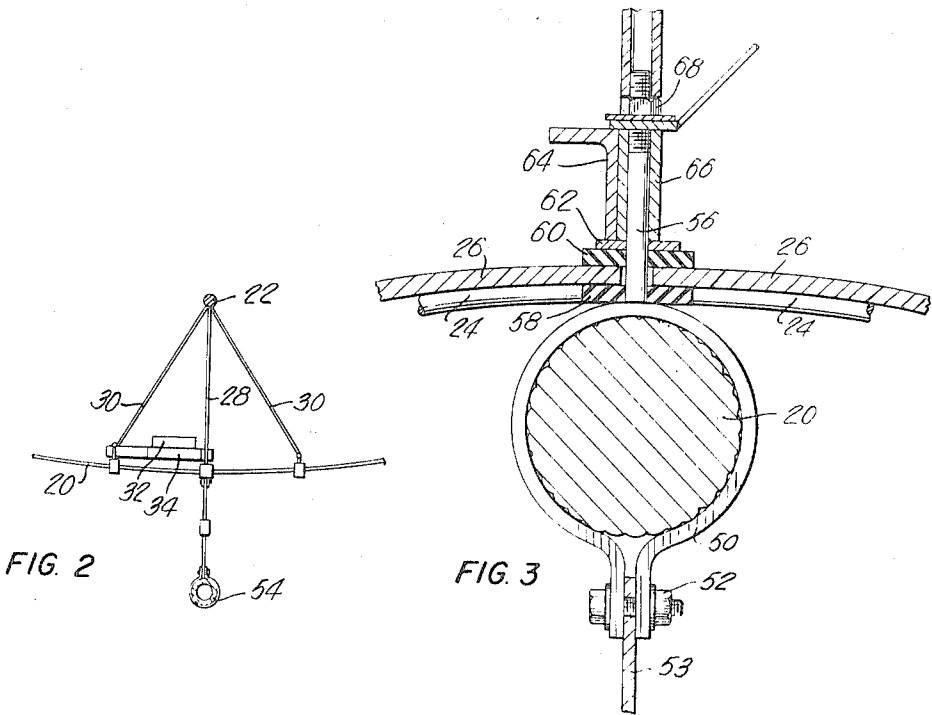
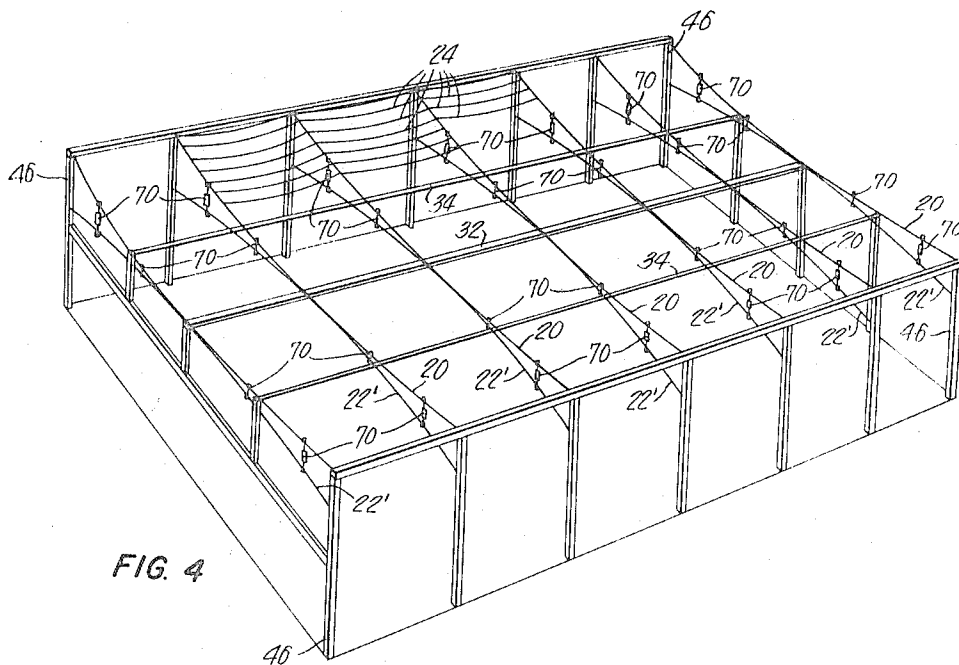
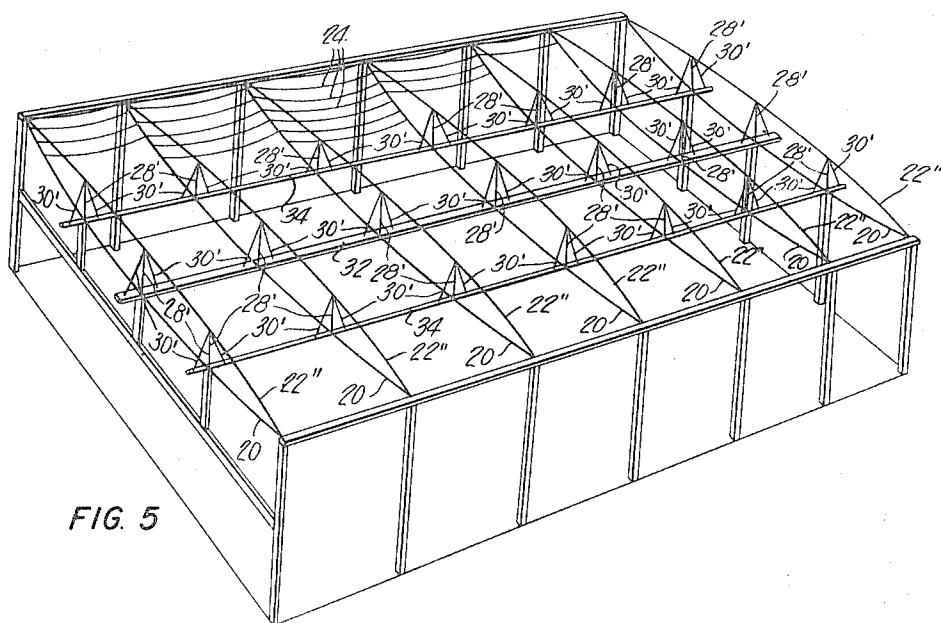


FIG. 2

FIG. 3

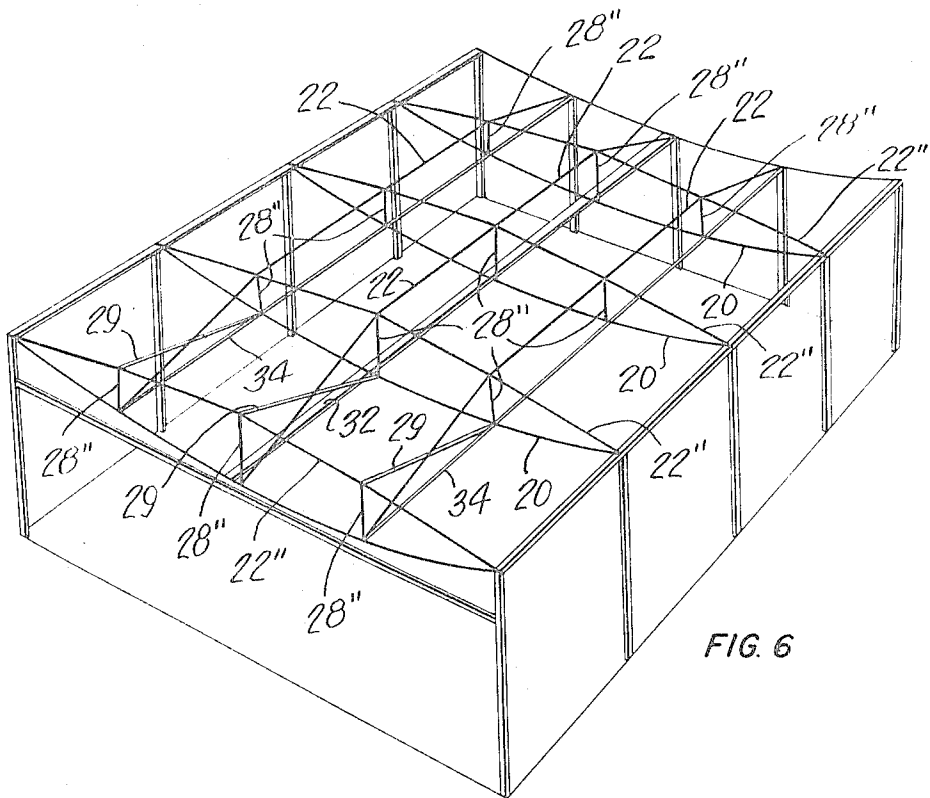
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ROOF CONSTRUCTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to roofs. More specifically, the present invention relates to roof structures employing flexible roof skins and suitable for buildings having relatively long unsupported spans of square or rectangular roof areas.

2. Description of the Prior Art

It is a practice in the construction industry to build roofs for large buildings using rigid or semirigid roof decking supported on substantially rigid purlins which, in turn, are supported on trusses that may consist of top and bottom chords, struts, diagonals, etc. Such roofs are relatively expensive.

Roofs employing flexible skins have found only very limited use and have generally been reserved for relatively small structures or very unusual structures. For a roof of any reasonable size to be made using flexible skins, i.e., on tents or the like, it is a practice to stretch the flexible skin under tension and provide an abrupt change in direction for a slope in the roof to improve the rigidity of the structure and reduce the tendency for it to flutter in the wind.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a relatively inexpensive roof structure for covering large unsupported spans.

A further object of the present invention is to provide a suspended roof structure specially adapted for large unsupported spans and utilizing flexible roofing skins.

Broadly, the present invention comprises means defining a roof opening, a first set consisting of a plurality of spaced, substantially parallel, elongated flexible tension members spanning the roof opening, flexible roofing skins, means connecting said flexible roofing skins to said first set of flexible tension members, a second set consisting of a plurality of spaced, substantially parallel tension members, spacing members extending transversely of said first set of tension members for maintaining said tension members in spaced-apart relationship, a plurality of spaced force-transmitting means connecting said tension members of said first set with said tension members of said second set, said tension members of said first set applying a force to said force-transmitting means in one direction while said tension members of said second set apply a force in substantially the opposite direction, whereby movement of said tension members of said first set is resisted by said tension members of said second set.

BRIEF DESCRIPTION OF THE INVENTION

Further features, objects and advantages will be evident from the following detailed description of a preferred embodiment of the present invention taken in conjunction with the accompanying drawings in which:

FIG. 1 is an isometric schematic view illustrating a preferred form of the present invention;

FIG. 2 is a schematic view of a detail of FIG. 1;

FIG. 3 is a section of one form of connector for mounting the skin and catwalk on the roof structure;

FIGS. 4, 5 and 6 are isometric views similar to FIG. 1 but illustrating modifications of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the structure 10 is composed of four vertical walls 12, 14, 16 and 18 with conventional vertical columns which may, if desired, be stayed in position by fixing, bracing or guying them to the foundations.

In the illustrated arrangement, a first set of cables or the like tension members 20 are anchored to the opposite columns of walls 14 and 18 of the structure 10 and extend in a catenary therebetween. A second set of cables or tension members 22 are anchored in a manner to be described hereinbelow to the opposite walls 12 and 16 and extend in overlying relationship

to the members 20. Between the members 20 are supporting members in the form of cables or the like 24 extending as a catenary between adjacent members 20 and functioning to support the flexible roof skins 26 (see FIG. 3).

As indicated above, the second set of cables 22 extends over the cables 20. Spaced-apart secondary compression members 28 arranged in rows in alignment with the second set of tension members or cables 22 project up from each of the tension members 20 and connect the members 20 and 22 and function to transfer forces between the tension members 20 and 22. These compression members 28 are held in substantially vertical position by means of tie or tension wires 30 connected to the members 20. In the illustrated embodiment, a substantially rigid catwalk 32 is connected to the tension members 20 adjacent the center of the roof span or catenary formed by the members 20. The specific mounting means for the catwalk 32 and for the compression members 28 and how they are connected to the member 20 will be described in more detail with reference to FIGS. 2 and 3. A rigid spacer 34 extends between the compression members 28 in each row of compression members 28 located on opposite sides of the centerline of the roof. The catwalk 32 and spacing members 34 function to maintain the lateral spacing of the members 28 and thus of the tension members 20.

The ends of the second set of tension members 22 are connected to the walls 12 and 16 in a specific manner. As shown, the end cables indicated at 21 of the first set of tension members 20 are anchored at opposite ends to the walls 14 and 18. Also anchored to the walls 14 and 18 beneath the top thereof is a secondary tension member 36. This member 36 is connected to structural members 38 forming part of the wall 12. To each of the members 38 is connected the end of a tension member 22 of the second set of tension members and projecting downwardly and inwardly from each of the members 38 is a compression member 40. The opposite ends of the compression members 40 are supported from a tension member 20 by a suitable cable or the like 42. A cable or supporting tension member 44 is anchored to the cornerposts of the structure 10 and is connected to the compression members 40. The support members 40 extend to a point below catenaries 20 and are attached thereto by a vertical tension member 42. The horizontal inward component of a force coming from cable polygons 22 or catwalk 32 or spacers 34 or catenary 20 is transmitted via the compression members 40 to tension member 44 and to the cornerposts of the structure 10.

Referring to FIGS. 2 and 3, as can be seen, each compression member 28 is clamped to and projects upwardly from the cables 20 and is supported in a vertical position by means of the tension wires 30 which are connected to the cables 20 by suitable clamps. Each of the clamps for holding the catwalk 32, compression members 28 or tension wires 30 is formed by a steel strap or the like 50 which encircles the cable 20 and is clamped thereto by a bolt 52 (see FIG. 3) which bolt 52 also functions to support a hanger 53 for a drainpipe 54 (see FIG. 2). The drainpipe 54 is connected by a standpipe to the lowest part of the roof and functions to drain the water that tends to accumulate here. A stud 56 is welded or otherwise secured to the clamp strap 50 and projects upwardly therefrom. The stud 56 receives a rubber washer 58, flexible roof skin 26, a second rubber washer 60 and a rigid washer 62 or the like. If the clamp is not to support the catwalk 32, then the skin 26 may simply be clamped between the two washers 58 and 60 by means of a suitable bolt and if a tie 30 is to be connected at the clamp, it may be connected to the stud 56 above the above-mentioned clamping bolt.

When the clamp is to support the catwalk 32, the stud 56 is preferably extended as shown in FIG. 3 and a horizontal frame member 64 having a pair of spaced hollow elements or pipes 66 is positioned so that each pipe 66 receives a stud 56 projecting from a pair of spaced clamps and is bolted into position by suitable bolts 68 (only one shown). Tightening of the bolts 68 moves the frame member 64 and pipe 66 down against the washer 62 to clamp the skin 26 between the rubber washers 58

and 60. The catwalk 32 may be secured to the structural member 64 in any suitable manner. As above indicated, the catwalk is a substantially rigid structure that maintains the spacing between the tension members 20.

The compression members 28 may take the form of simple standpipes that telescope over the ends of the stud 56, thereby mounting the compression members 28 in position.

In operation, the tension members 20 are held in position by the combined action of the spacer 34 and catwalk 32 maintaining the spacing of the members 20 and the tension members 22 which extend in the form of a polygon and force the members 20 downwardly through pressure applied between the members 20 and 22 by the compression members 28. Thus, if the wind tends to cause ripples or waves in the flexible skin 26, i.e., to lift the skin 26 and thus the whole roof, the tension members 22 acting through compression members 28 prevent the roof from lifting.

The tension members 36 and the members 38 combine with the cables 44 and secondary compression members 40 to maintain the tension members 22 in proper position and resist the stresses applied to the end wall 12 by the members 22. This structure employing the tension members 36 and 44 reduces the structural rigidity required in the walls 12 and 16 to support the cables 22. The walls 12 and 16 may be made sufficiently rigid to support the cables; however, since these cables 22 may extend for an even longer span than the cables 20, the walls 12 and 18 if conventionally constructed would have to be exceptionally heavy.

In the arrangement shown in FIG. 4, the second set of cables 22 has been replaced by another set of cables 22' which extend between the walls 14 and 18 and are anchored thereto at a position directly below each of the cables 20. The tension members or cables 22' are connected at spaced locations to the cables 20 immediately thereabove by suitable tension members 70 which may, for convenience, include turnbuckles to adjust the length and to ensure that the cables 20 and 22' are tightly secured together. In this arrangement, the catwalk 32 and spacers 36 for the cables 20 are retained. However, obviously, the compression members 28 and their ties 30 may be dispensed with.

In the operation of the FIG. 4 embodiment, movement of the cables 20 and 22' is mutually restricted by each pair of cables 20 and 22' pulling against the other through the tension members 70.

In the arrangement of FIG. 5, the second set of cables 22 has been replaced by a set of cables 22'' which extend substantially parallel to the cables 20 but instead of being below the cables 20 as were the cables 22', the cables 22'' are above. The cables 22'' are connected to the cables 20 by suitable compression members 28' that are guyed by guy wires 30' to the spacer members 34 and catwalk 32 rather than to the cables 20 as were the compression members 28 of the FIG. 1 embodiments.

In the operation of the FIG. 5 arrangement, the cables 22'' hold the cables 20 down much in the manner the cables 22 operate in the FIG. 1 embodiment.

Modifications may be made to the invention as disclosed and combinations of the various arrangements of cables may be used, i.e., the cables 22 may be used together with the cables 22' or cables 22'' to hold down the cables 20 or both cables 22' and 22'' may be used with cables 20 or some of each may be used.

One arrangement incorporating cables similar to cables 22' and 22 is illustrated in FIG. 6. Compression members 28' space the cables 22, 22' from the cables 20 but do not require guy wires to hold them in place, since they are automatically held in place by the crossing arrangement of the cables 22 and 22''. The cables 22'' and the compression members 28' at the ends of the structure are held in position by means of rigid members 29 which extend from the compression members 28'' to the catwalk 32 or spacers 34. In the illustrated arrange-

ment, these members 29 extend to the adjacent compression members 29''.

In operation, the compression members, as indicated, are maintained in vertical position by the crossing arrangement of the cables 22'' and 22 and the end compression members 28'' are held in vertical position by the rigid members 29. The cables 22, 22' function in the manner described above to hold the cables 20 in position.

Modifications may be made without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A roof structure comprising:
 - a first set of spaced, substantially parallel tension members for supporting vertical downward loads,
 - a second set of spaced, substantially parallel tension members disposed above and transverse to said first set for supporting vertical upward windloads,
 - flexible roofing skins supported by said first set of tension members,
 - spacing means traversing said first set of tension members to maintain said tension members of said first set at laterally spaced relationship,
 - a plurality of spaced force-transmitting compression members arranged in rows substantially in alignment with said tension members of said second set, and
 - said force-transmitting compression members interconnecting said tension members of said first and said second sets at spaced locations.
2. A roof structure as defined in claim 1, wherein said tension members of said first set extend substantially perpendicular to said tension members of said second set.
3. A roof structure as defined in claim 2, further comprising:
 - a secondary tension member,
 - structural members,
 - said secondary tension member interconnecting said structural members,
 - said tension members of said second set being connected to said structural members,
 - compression support members connected at one end to a respective one of said structural members and being supported at its other end by a supporting tension member secured to a tension member of said first set, and supporting tension members anchored to corner structural members and to said compression members and supported below the plane of said first set of tension members.
4. A roof structure as defined in claim 3, wherein said spacing means includes a catwalk.
5. A roof structure as defined in claim 1, wherein said tension members of said first set extend in substantially the same direction as the tension members of said second set.
6. A roof structure as defined in claim 5, further comprising:
 - a secondary tension member,
 - structural members,
 - said secondary tension member interconnecting said structural members,
 - said tension members of said second set being connected to said structural members,
 - a supporting tension member, and
 - compression members interconnecting said supporting tension member and said structural members.
7. A roof structure as defined in claim 6, wherein said spacing means includes a catwalk.
8. A roof structure as defined in claim 1 wherein said second set of tension members extends across opposed structural walls of said roof structure and are held above and transverse to said first set of tension members at each intersection with a tension member of said first set, said tension members of said second set being held transverse to said first set of tension members a predetermined distance above each tension member of said first set and disposed substantially in the form of a polygon.

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