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Snibbe

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[54] **SUSPENDED STRUCTURE**

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[52] **U.S. Cl.** **52/73,** 52/83

[51] **Int. Cl.** **E04b 7/14**

[58] **Field of Search** 52/73, 83, 148, 23; 182/82

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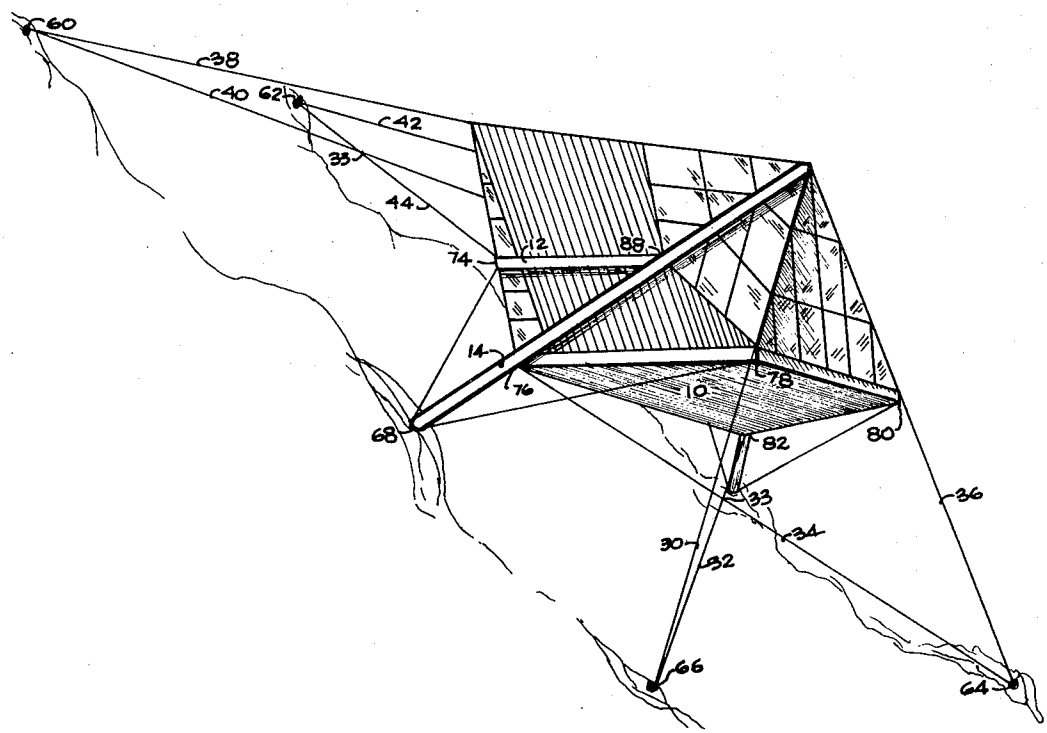
Assistant Examiner—H. E. Raduazo
Attorney, Agent, or Firm—Burgess, Dinklage & Sprung

[57] **ABSTRACT**

A suspended structure is disclosed and includes an elevated platform attached to a compression frame and tension cable means anchored at points above and below the structure inclining the compression frame at an acute angle from the vertical and suspending the platform in a horizontal position. The structure can have one or more horizontally suspended platforms and can be enclosed for residential, commercial and industrial uses.

7 Claims, 5 Drawing Figures



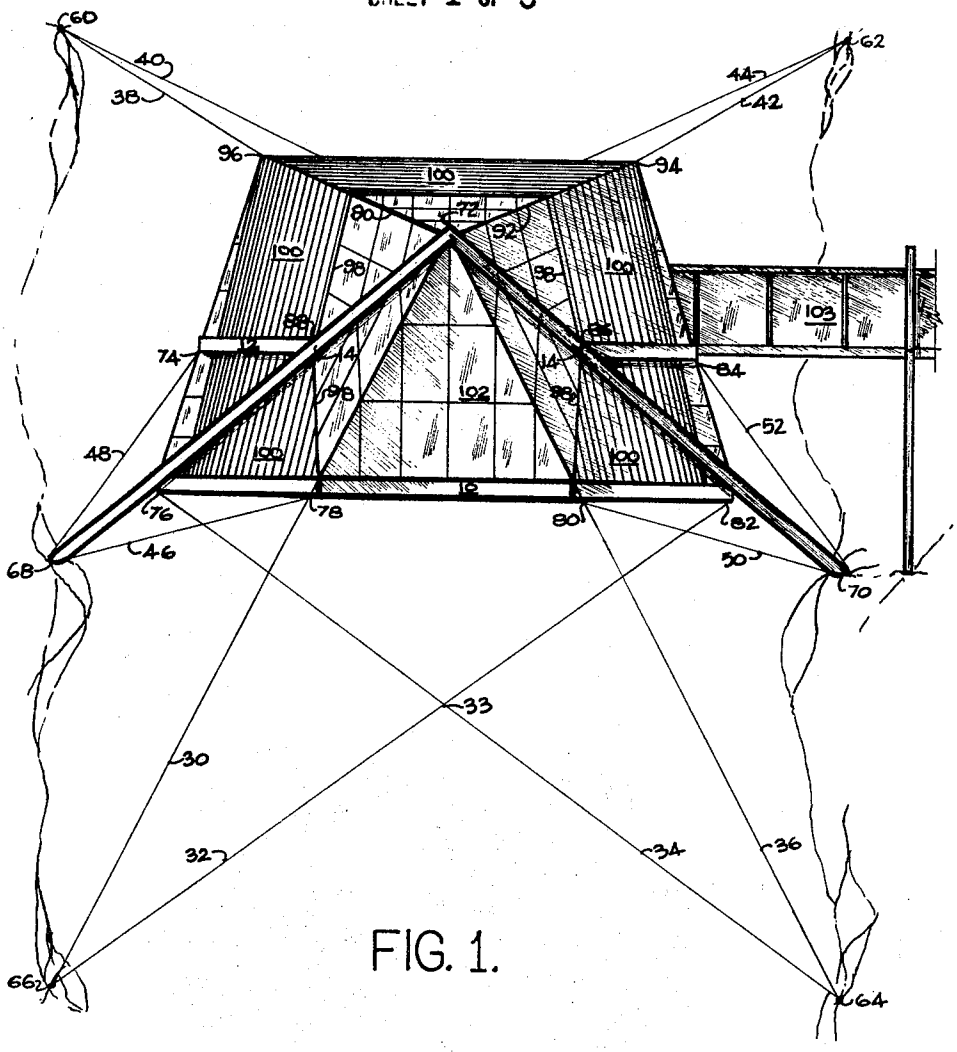

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FIG. 1.

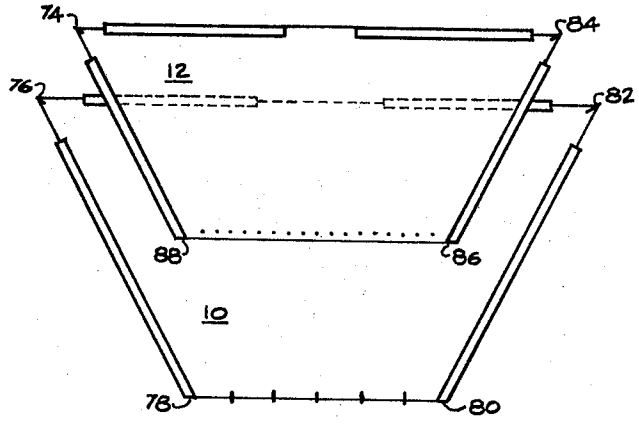
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FIG. 2.

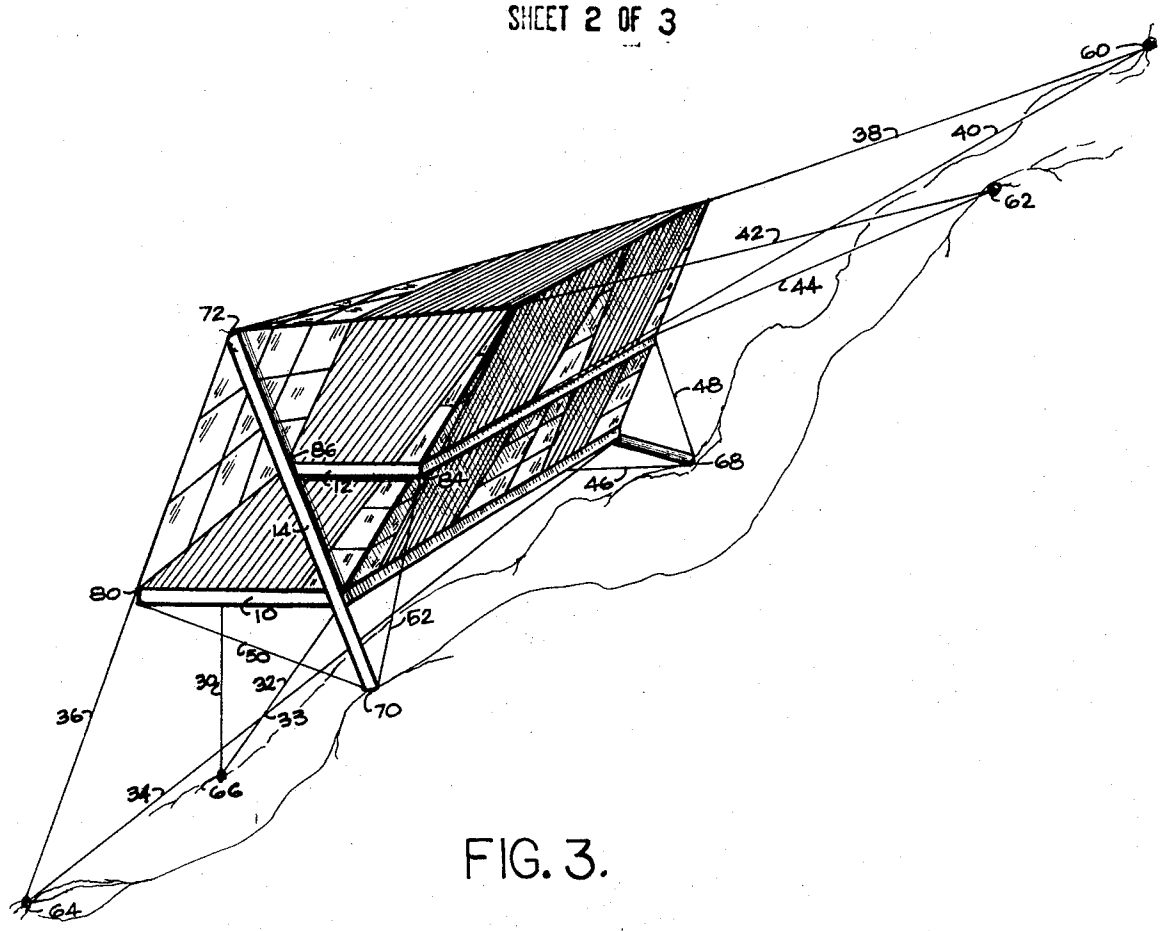
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FIG. 3.

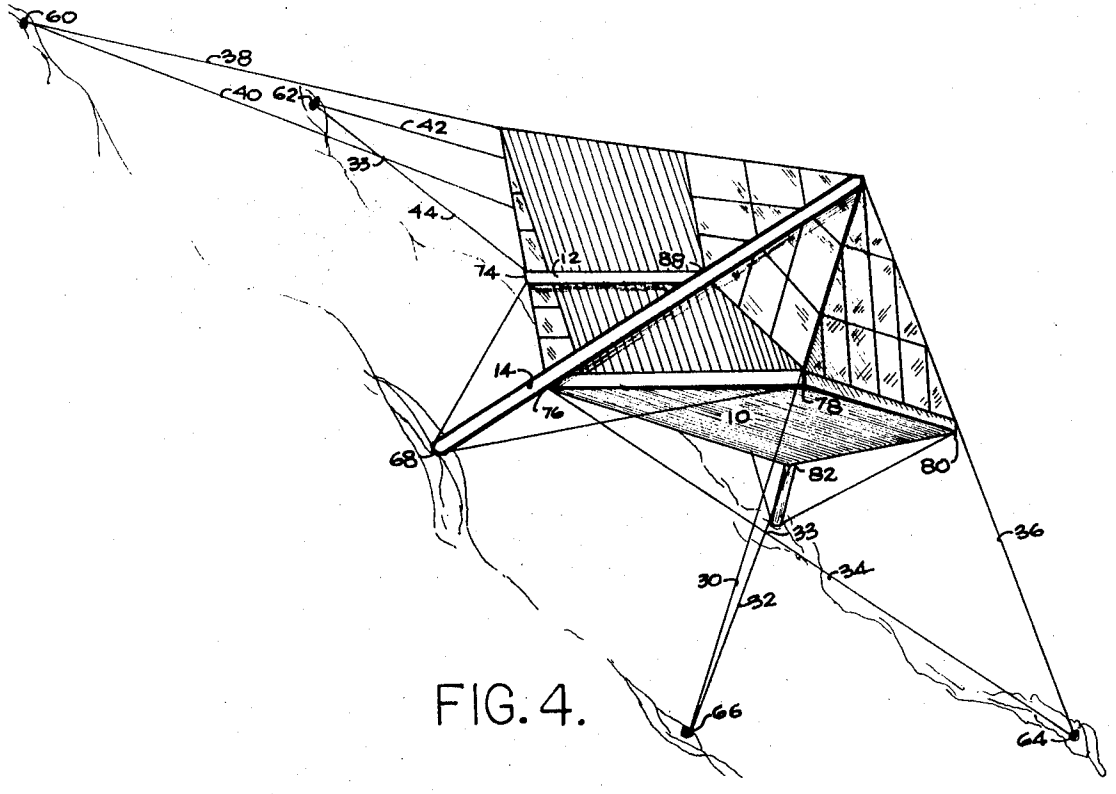
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FIG. 4.

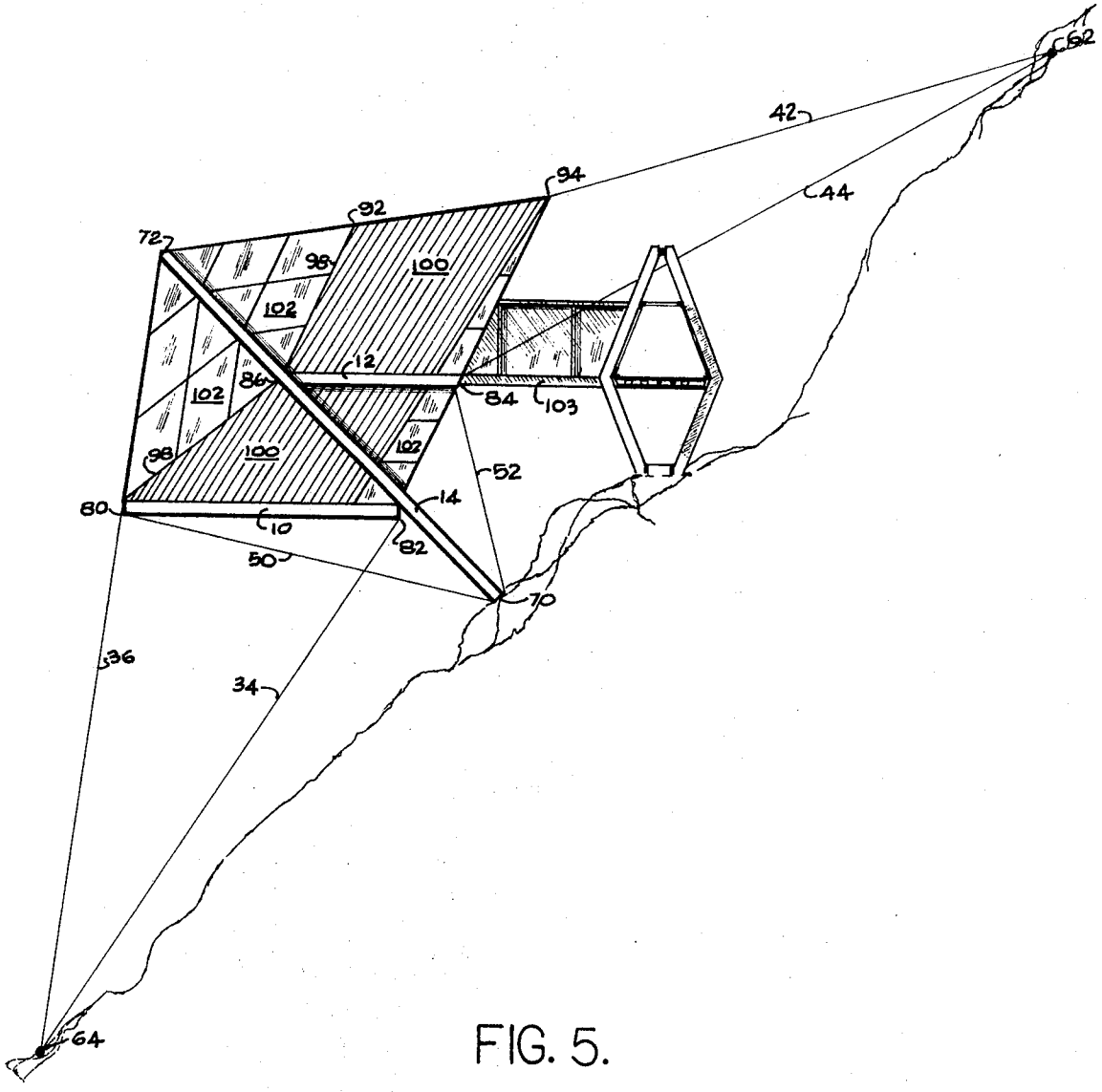
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FIG. 5.

SUSPENDED STRUCTURE

BACKGROUND

This invention relates to a suspended structure. More particularly, this invention relates to a suspended structure which can be made and erected using a simple frame member or members and one or more horizontally suspended platforms.

There is an ever pressing need for residential and commercial structures that can be erected economically preferably using prefabricated modules without sacrificing aesthetic and quality standards. The present invention provides such a structure.

SUMMARY

In its broadest aspect, the suspended structure of the invention comprises elevated platform means attached to compression frame means and tension cable means anchored at points above and below said structure inclining the compression frame means at an acute angle from the vertical and suspending the platform means in a horizontal position. The tension cable means anchored at points above and below the structure run to the apex of the compression frame means. Where the compression frame means is attached to the rearward portion of the platform means, the platform means is horizontally suspended by the tension cables running from below the structure to the apex of the compression frame means. In this embodiment additional cable means anchored at points below the structure cross and are attached to rearward portions of the platform means, preferably at the points of attachment with the compression frame means to minimize stresses.

Where the compression frame means is attached to the forward portions of the platform means, the platform means is horizontally suspended by crossing tension cable means anchored at points above the structure and running to opposite points of attachment with the rearward portions of the platform means.

In a preferred embodiment upper and lower platform means, preferably trapezoidal in shape, are provided attached at respective forward and rearward portions thereof to the compression frame means, each horizontally suspended as described above. Additional bracing cable means running approximately from the base of the compression frame means can also be utilized as described herein in greater detail.

In a preferred embodiment of the invention the suspended structure comprises upper and lower platform means, A-frame means inclined at an acute angle from the vertical attached to the forward portion of the upper platform means and the rearward portion of the lower platform means, upper and lower spaced apart anchoring means, upper tension cable means attached to the upper anchoring means in pairs, one member of each pair being attached approximate the apex of the A-frame means, the other members crossing and being attached to opposite rearward portions of the upper platform means and lower tension cable means attached to the lower anchoring means in pairs, one member of each pair being attached to the apex of the A-frame means and the forward portion of the lower platform means, the other members crossing and being attached to opposite rearward portions of the lower platform means.

DESCRIPTION OF THE DRAWING

The present invention will be more fully understood from the following description taken in conjunction with the accompanying drawing wherein:

FIG. **1** is a front view in elevation of a preferred suspended structure according to the present invention;

FIG. **2** is a top plan view showing the relationship between the upper and lower platforms of the preferred suspended structure of FIG. **1.**

FIG. **3** is an upper rear and side view taken in perspective of the preferred suspended structure of FIG. **1**;

FIG. **4** is a lower side and front view taken in perspective showing the preferred suspended structure of FIG. **1**; and

FIG. **5** is a side view in elevation of the preferred suspended structure of FIG. **1.**

DESCRIPTION

Turning now to the preferred suspended structure illustrated in the drawing, the suspended structure of the invention is shown to include an upper platform **12** and a lower platform **10.** As shown in FIG. **2,** the platforms **10** and **12** are preferably trapezoidal in shape and are positioned such that the upper platform is offset to the rear of platform **10.** This is an inherent characteristic of the suspended structure wherein upper and lower platforms are provided and attached to the A-frame as shown in the drawing. Again with reference to FIG. **2,** the corners **76, 78, 80** and **82** of the preferred trapezoidal shaped lower platform **10** form preferred points of attachment with the A-frame and cable members described in greater detail below. The upper platform **12** has similar points of attachment **74, 84, 86** and **88** at the corners thereof.

A-frame **14** is inclined at an acute angle from the vertical (FIG. **5**). The bases of the A-frame **14, 68** and **70,** rest on and are preferably firmly attached to a supporting foundation which can be natural or man-made.

The A-frame **14** is attached to the forward portion of the upper platform **12** at points **88** and **86** and is attached to the rearward portion of the lower platform **10** at points **82** and **76.**

Anchoring devices are positioned at spaced apart points **60** and **62** above the suspended structure and at points **64** and **66** below the structure.

Upper cable members are attached to the upper anchoring devices **60** and **62** in pairs. One member of each pair, **38** and **42** in the drawing, is attached approximate the apex **72** of the A-frame **14.** As shown in the drawing, the two upper cable members **38** and **42** are somewhat bowed or sagged. This is an intentional preferred feature induced during erection which enables the suspended structure to more efficiently absorb externally applied stresses thereby remaining rigid. The most commonly encountered stresses are due to the force of wind and roof loads such as snow.

The other members of the upper cable members **40** and **44** extend from the anchoring points or devices **60** and **62** and cross and are attached to opposite rearward portions of the upper platform **10.** In the preferred embodiment the cables **40** and **44** cross and are attached to opposite corners **74** and **84** of the upper platform **12.** The cables **40** and **44** can be attached at their crossover point **33,** if desired.

Lower cable members are attached to the lower anchoring points or devices **64** and **66** in pairs. One member of each pair, cables **30** and **36** are attached approximate the apex **72** of the A-frame **14** and are attached to the forward portion of the lower platform **10,** for example at points or corners **78** and **80.** The other cable members **32** and **34** attached to the lower anchoring points or devices **64** and **66** cross each other and are attached to opposite rearward portions of the lower platform **10,** for example the points or corners **76** and **82** of the lower platform **10.** Again, the cables **32** and **34** can be attached at their point of intersection **33,** if practical and/or desired.

The crossing cable members **32** and **34** are preferably attached to the lower platform **10** at the points of attachment **76** and **82** with the A-frame **14.** This is a preferred manner of attachment which minimizes stresses. However, it should be understood that the crossing cables **32** and **34** can be attached adjacent or within the general region of the points **82** and **76** without impairing the structural integrity of the structure of the invention.

In addition to the upper and lower cable members strung from the upper and lower anchoring points or devices, it is preferred to use additional bracing cables attached to the bases **68** and **70** of the A-frame **14.** One set of such bracing cables are cables **46** and **50** attached to the bases **68** and **70** of the A-frame **14** and the forward portions of the lower platform **10** preferably at points of attachment **78** and **80** which are common with the points of attachment between lower cables **30** and **36** and the lower platform **10.**

Another set of bracing cables are cables **48** and **52** which extend from the bases **68** and **70** of the A-frame **14** to the rearward portions of the upper platform **12.** Cables **48** and **52** are preferably attached to upper platform **12** at points **74** and **84** which are common with the points of attachment between upper cable members **40** and **44** and upper platform **12.**

It is preferred for economy in design and construction and to minimize stresses that the points of attachment between the platforms, the A-frame and the various cables, be as common as is practically possible. In other words, the points of attachment are confined to a small area or a single point but can be adjacent to one another or in the same general area. Conventional means for attaching the A-frame, the upper and lower platforms and the various cables to one another can be employed. For example, any type of bolted or clamped device can be used to securely fasten the component parts of the suspended structure at their respective points of attachment.

The upper and lower anchoring points **60, 62, 64** and **66** can utilize conventional anchoring devices such as pin, pipe, or bar members and the like with hook, eye or clamping means. Such members or similar devices can be driven into holes drilled into the supporting terrain utilizing the holding power of the terrain itself in the case of rock or additional supporting sub-structures can be used for the anchoring devices such as poured concrete foundations at the respective anchoring points.

As shown in FIG. **1,** the upper and lower anchoring points are preferably vertically aligned with the bases of the A-frame **14.** However, the spacing and positioning of the upper and lower anchoring points can be altered to meet varying terrain contours and conditions.

With reference to FIG. **5,** the A-frame **14** is preferably inclined at an acute angle from the vertical such that the A-frame **14** is perpendicular to a line drawn between upper and lower anchoring points **62** and **64** respectively. However, the angle of inclination of the A-frame **14** can vary to meet or accommodate terrain contours and/or design features vis-a-vis the enclosure for the suspended structure.

The essential components of the suspended structure of the invention, namely the frame, the platform or platforms and the various cables, can be made from conventional materials of construction. For example, the A-frame **14** can be suitably made from steel pipe, 12 inches in diameter and the various cable members can be made from steel cable 1 inch and 1 ½ inches in diameter. The A-frame can be made from other conventional materials such as laminated wood members or structural steel members. The various cable members can also be replaced partly or completely by metal rod members. For example, the bracing cables extending from the bases of the A-frame could be made of rigid metal rods or bars while the upper and lower suspending and supporting cable members can be made of strand steel cable. It should be understood that the term cable as used herein is intended to generically define any linear supporting and suspending member such as cables, rods and bars.

The frame **14** can also be made of prefabricated steel reinforced concrete members. The platforms **10** and **12** can also be made of steel reinforced concrete slabs prefabricated in the desired shape. Other known materials of construction such as laminated, composite or honey comb structures can be used to prefabricate slabs for the upper and lower platforms. The platforms themselves as indicated herein are preferably trapezoidal in shape. However, other shapes such as round and/or polygonal shapes can also be utilized. It should be understood that the respective platform members **10** and **12** can extend beyond the configuration shown in the drawing such that the A-frame **14** and the various cable members pass through and are attached to adjacent inboard portions of the respective platforms **10** and **12.** Various extensions of the upper and/or lower platform members can be utilized to provide exterior deck space for the suspended structure or additional interior space.

As pointed out previously, the suspended structure of the invention can be erected with platform **10** in which case cables **40** and **44** could be eliminated or attached to points **76** and **82.** The structure can also be erected with a single platform such as upper platform **12** attached at its forward portion to the A-frame **14.** It is also possible to use a single platform wherein the A-frame **14** passes through the central portion of the sides thereof and the forward and rearward portions of the platform are suspended horizontally via the cable members described herein for suspending the upper and lower platform members **12** and **10,** respectively. More than two platforms can also be incorporated into the suspended structure of the invention to provide for a multilevel structure. For example, in FIG. **5** an additional platform or platforms could be attached and suspended in the same manner as the lower platform **10** above or below same. The same is true for additional platforms attached and suspended in the same manner as upper platform **12.**

The suspended structure of the invention is ideally erected on a steeply sloped rocky terrain. Where the terrain is less steeply sloped, the upper anchoring points **60** and **62** can be built-up to the desired height from which the upper cable members are to be suspended. Thus, towers or similar such structures can be utilized to hang or suspend the upper cable members from the upper anchoring points **60** and **62.**

The suspended structure of the invention can be enclosed in a number of ways to suit the use intended for the suspended structure. The enclosure for the suspended structure of the invention shown in the drawing is by way of example only and is not intended to limit the invention in any way. In the drawing a suitable enclosure for using the suspended structure as a residence is illustrated and includes appropriately located mullions **98** defining a portion of the structure enclosed by glass panels **102.** Surrounding the glass enclosed portion is a solid panel enclosure utilizing panel member **100** as illustrated. As shown in FIGS. **3, 4** and **5,** rearward portions of the structure can also be enclosed in glass. An enclosure can be suspended from upper cables **38** and **42** at points **90, 92, 94** and **96** and points intermediate thereof. The mullions **98** defining the glass enclosed portion can also be replaced by a continuous cable member which runs from point **78** on the lower platform **10** to point **88** on upper platform **12** and then to point **90,** point **92** back down to point **86** on the upper platform **12** and finally ending at point **80** on lower platform **10.** The enclosure for the suspended structure can be suspended from and attached to the various parts thereof using conventional attaching devices such as bolts, rivets, clamps and the like.

Entry ways for ingress and egress can be located at any desired site. For example a tower containing a spiral staircase or elevator can extend from below the lower platform **10** and extend upward therethrough. Access can also be had by means of a tunnel-shaped structure extending through the rear of the enclosure to the space above the upper platform **12.** Such a structure is indicated in FIGS. **1** and **2** by reference numeral **103** and is suitably supported by being suspended from the upper cable members, or platform of the structure, or from the ground.

Utility lines and waste removal conduits can be suitably located in the base or floor of the tunnel structure **103,** in the interior of the legs of the A-frame member **14** or in the tower structure extending through the lower platform **10** as described previously.

The suspended structure of the invention also makes it possible to erect a multi-level structure involving a series of vertically aligned A-frames with platforms and supporting cables as described herein, said structures being interconnected by suitable tower, elevator and tunnel structures. It is thus possible to construct an entire community having suspended structures suited for all aspects of public and private life, said structures being constructed from inclined frame members, horizontal platforms supported and suspended by a system of cables as described herein and interconnected by suitable elevators, towers, tunnels, tramways, cable cars and the like.

In such structures, relatively simple and/or complex compression frame means can be employed for single or multi-level suspended structures having platform means with the same, varying or different shapes. Suitable frame means can be terrain supported and/or radiate from one or more vertical towers or poles and can be H, I, M, T, U, V, W, X or Y-shaped as well as other symmetrical, simple and multi-sided shapes.

What is claimed is:

1. Suspended structure comprising:

a. upper and lower platform means each having forward and rearward portions;

b. compression frame means inclined at an acute angle from the vertical attached to forward portion of the upper platform means and the rearward portion of the lower platform means;

c. upper and lower spaced apart anchoring means;

d. upper tension cable means attached to the upper anchoring means in pairs, one member of each pair being attached approximate the apex of the compression frame means the other members crossing each other and being attached to opposite rearward portions of the upper platform means; and

e. lower tension cable means attached to the lower anchoring means in pairs, one member of each pair being attached to the apex of the compression frame means and the forward portion of the lower platform means, the other members crossing and being attached to opposite rearward portions of the lower platform means.

2. Suspended structure of claim **1** wherein the crossing members of the lower tension cable means are attached to the lower platform means at the points of attachment with the compression frame means.

3. Suspended structure of claim **1** wherein cable means are attached approximately at the bases of the compression frame means and forward portions of the lower platform means.

4. Suspended structure of claim **3** wherein the tension cable means are attached to the lower platform means at the points of attachment with the lower tension cable members attached to the apex of the compression frame means.

5. Suspended structure of claim **1** wherein tension cable means are attached approximate the bases of the compression frame means and rearward portions of the upper platform means.

6. Suspended structure of claim **5** wherein the tension cable means are attached to the upper platform means at the points of attachment with the crossing members at the upper tension cable means.

7. Suspended structure of claim **1** wherein the upper and lower platform means are trapezoidal in shape, the corners thereof being the respective points of attachment with the compression frame means and the upper and lower tension cable means.

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