April 14, 1970 J. L. FONTAINE 3,506,746

STRUCTURAL FORM AND METHOD FOR MAKING ARCHITECTURAL STRUCTURES

Filed Dec. 18, 1967 2 Sheets-Sheet 1

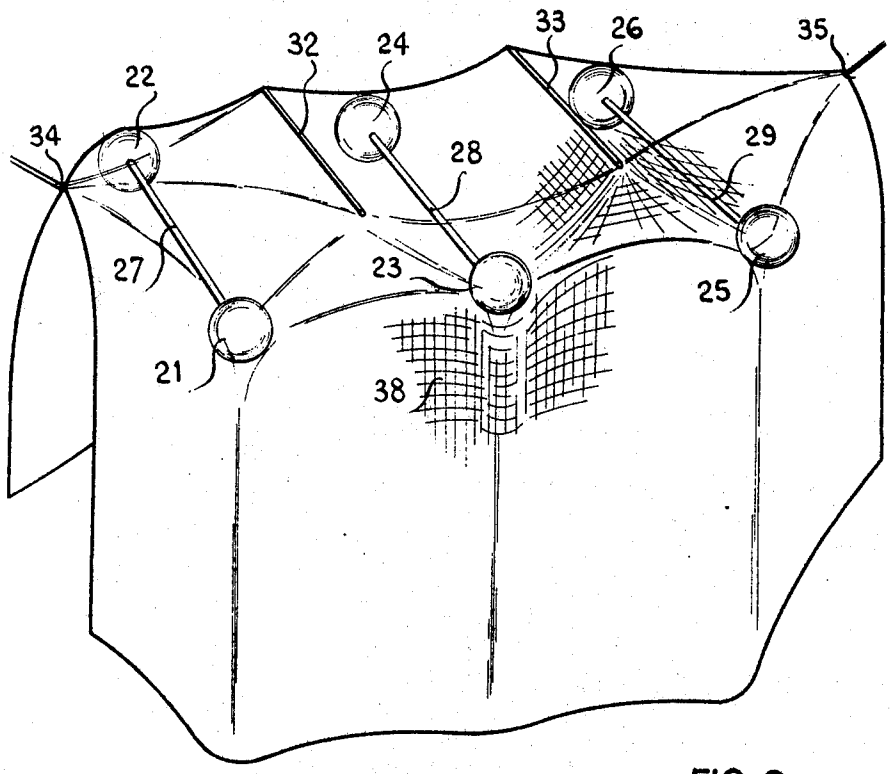


FIG. 2

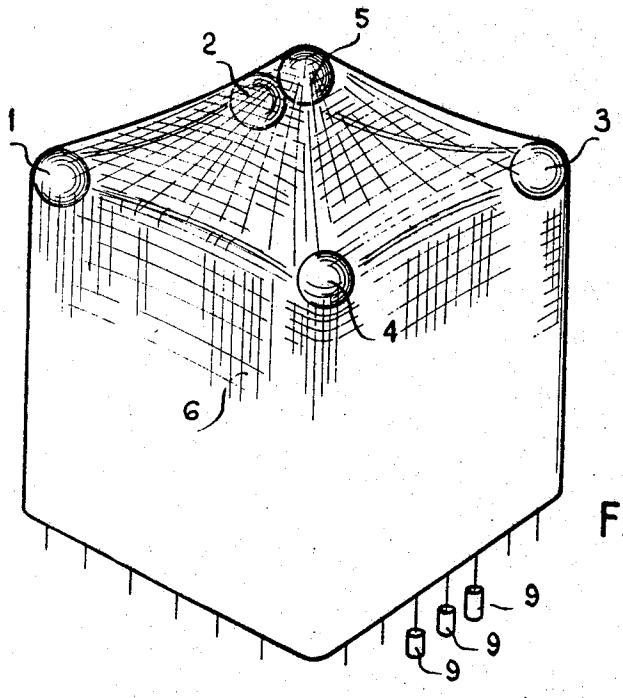


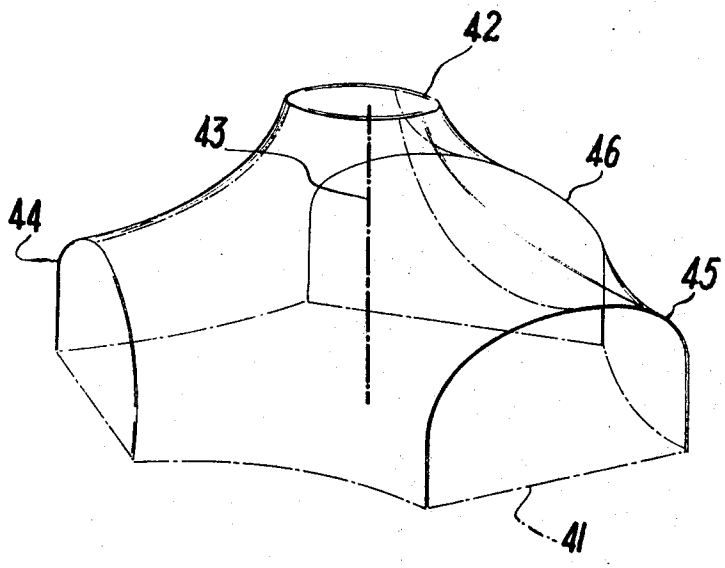
FIG. 1

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STRUCTURAL FORM AND METHOD FOR MAKING ARCHITECTURAL STRUCTURES

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FIG. 3



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STRUCTURAL FORM AND METHOD FOR MAKING ARCHITECTURAL STRUCTURES

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U.S. Cl. 264—32 3 Claims

ABSTRACT OF THE DISCLOSURE

A method of forming an architectural structure and a form upon which an architectural structure may be made. One or more elevated supporting elements are positioned at the roof level, a deformable mesh element is draped thereover with the central region suspended from the supporting elements, the lower peripheral region being tensioned downwardly. The intermediate regions hang freely downwardly in unsupported fashion to define the contour and texture of the side walls.

The present invention relates to a novel method for manufacturing rapidly and economically architectural structures, which comprises the steps of providing supporting elements conveniently fixed in locations corresponding to the projecting points of the roof of the structure to be constructed, suspending the central portion of a net having deformable meshes on said supporting elements while allowing the remainder of said net to hang downwardly so as to constitute the basic texture element of the walls, stretching said net from its lower edge, applying upon the stretched net a layer of filling material such as plaster or a convenient plastic material so as to form a shell, and removing said supporting elements and their fixing means after solidification of said shell.

It will be easily understood that when the net is stretched from its lower edge, it will take a general configuration constituted by surfaces presenting regular natural curvatures wherein the tension of the various strands of the net shows a trend to become uniform due to the deformation of the meshes; thus after solidification of the filling material and removal of the supporting elements the resulting structure constitutes a large shell submitted to compression stresses with a comparatively uniform fatigue rate which corresponds up to a certain point to the tensional fatigue of the various strands of the net.

When the filling material has solidified to a satisfactory degree any desirable apertures may be cut out in the shell, said apertures corresponding to any doors, windows, etc., to be provided in the final structure.

The supporting elements are preferably constituted by elements having a convex surface such as portions of spheres, or cylindrical surfaces. In an advantageous embodiment of the instant method inflatable balloons are used as supporting elements, whereby the transportation, positioning and removal of said supporting elements are facilitated.

The stretching or tensioning of the net may be effected by attaching a plurality of weights distributed over the length of the lower net's edge. This results in a construction having vertical walls. If on the other hand the stretching or tensioning of the net is effected by applying to its lower edge obliquely directed forces the resulting structure will comprise inclined curved walls.

In one embodiment of the present method, which relates, more particularly, to comparatively large constructions a layer of cement or concrete is applied upon the resulting structure after solidification of the above mentioned filling material; said cement or concrete layer may be reinforced by a metallic grid or a similar reinforcement element.

In another embodiment of the instant method a high resistance supporting net having deformable meshes is suspended on the supporting elements and stretched or tensioned as indicated hereinabove, whereafter an intermediate light-weight web constituted, for instance, by a foil of plastic material or of another convenient separating material is applied upon the stretched net; a second net being then placed upon said intermediate web, whereafter the filling material is applied on said second net. The high resistance supporting net functions as a re-usable molding or shuttering element. Its lower edge may be provided with a frame to which the tensioning forces may be applied, for instance by means of weights suspended on said frame. The intermediate web of plastic material or the like which separates the two nets prevents the filling material from penetrating the meshes of the inner or lower supporting net, thus allowing the latter to be subsequently removed and re-used. Furthermore, the intermediate web facilitates the formation of a smooth interior shell surface, thus reducing the finishing operation to be subsequently effected on the latter. The intermediate web may comprise folds or be constituted by a plurality of partially overlapping web portions so as to adapt the web configuration to the general configuration of the structure to be achieved.

Generally speaking the novel method allows for manufacturing architectural structures without resorting to templets and without using scaffolding structures which are of considerable high cost and the construction of which is a time-consuming operation.

The present invention also covers architectural structures produced by the above-mentioned method.

Further features and advantages of the invention will become apparent from the description hereinafter which refers to the appended drawings; the latter show several embodiments of architectural structures produced by the method according to the invention. In the drawings:

FIG. 1 is a schematic perspective view of a structure having a rectangular base and a roof with four slopes.

FIGS. 2 and 3 show two other embodiments of a structure, respectively.

FIG. 1 illustrates schematically the way of carrying out the method of the present invention with a view to produce an architectural structure having a rectangular base and a roof with four slopes.

To this end supporting elements **1**, **2**, **3**, **4**, **5** having a convex surface are conveniently arranged by means of a convenient scaffolding structure and of convenient attaching elements such as cables; in the example shown the supporting elements are advantageously constituted by inflatable balloons. Four of said balloons i.e. balloons **1**, **2**, **3**, **4** are disposed in respective locations corresponding to the four corners of a theoretical rectangle having the same size as that of the basis of the structure to be achieved. The fifth balloon **5** is disposed in a location corresponding to the gable of the roof. Broadly speaking, the balloons thus are arranged in respective locations which correspond to the projecting points of the finished structure.

Mat **6** constituted by a net having deformable meshes (i.e. meshes having more than 3 edges, such as square meshes) is disposed upon the above-mentioned five supporting elements. The central portion of the net will thus rest upon the five above-mentioned balloons whereas the remainder of the net will naturally hang down in a vertical position on the sides of the assembly so as to con-

stitute the basic texture element for the walls of the structure to be produced.

The net is then stretched or tensioned, for instance by attaching weights such as **9** along its lower edge. The entire net will then automatically assume a harmonious configuration constituted by curved surfaces wherein the tensional stresses acting on the various strands of the net tend to equalize to a certain degree. When the net is thus stretched, or tensioned, a filling material such as plaster or a convenient plastic material is projected upon the net. When the solidification of this filling material has reached a satisfactory degree the supporting elements may be removed and the structure be allowed to rest on the floor while being supported by its lower edge. Any apertures necessary for forming the doors, windows, etc. of the final structure may then be cut out.

In a modified embodiment the net instead of being stretched by means of weights **9** may be tensioned in an oblique direction by means of cables or the like, one end of which is attached at a plurality of points distributed over the length of the lower net edge, the other end of said cables being provided with a tensioning weight, and said cable passing over one or several pulleys arranged to determine the direction of the tensional force exerted on the net. In this manner the final structure will be provided with oblique side walls having a very harmonious curved configuration.

FIG. 2 illustrates another embodiment wherein the supporting elements **21–22**, **23–24**, **25–26** are constituted by three pairs of spheres disposed, respectively, at the two ends of straight lines **27**, **28**, **29** which may be materialized by rods or bars. The supporting points also comprise two horizontal bars **32**, **33** parallel to the rods **27**, **28**, **29** and located at a level higher than that of the latter and above two spaces respectively limited, on the one hand by rods **27**, **28** and, on the other hand, by rods **28** and **29**. Two other supporting elements are constituted by two hooks or similar elements respectively disposed in two locations **34**, **35** comprised in the vertical median plane perpendicular to the center of the bars of the above-mentioned rods. When a deformable mesh net **38** is then placed over the above-described supporting points, said net will assume substantially a configuration illustrated in the drawing; practically all the surfaces defined by the net will be curved in accordance with natural curvatures.

The filling material is then applied as described hereinabove whereafter the necessary apertures are cut out in the desired locations.

By varying the number, the nature, the shape, and the locations of the supporting points of the central net portion, the user may vary infinitely the configuration of the architectural structure to be achieved.

In the preceding examples it has been shown that the supporting elements may be constituted by elements having a convex surface, such as elements in the form of portions of spheres or cylinders.

Different and more economical supporting elements can also be used; for instance, at least some of the elements used for a given structure may be constituted by simple arcs preferably disposed in vertical planes.

Such arcs may advantageously be used in combination with other supporting elements, preferably disposed on elements higher than the respective apexes of said arcs. The said other supporting elements may comprise, for instance, portions of spherical surfaces or simple rings which are preferably horizontally disposed.

Considering now the example illustrated in FIG. 3, the structure to be realized is a building having a hexagonal base **41** constituted, for instance, by a regular hexagon.

The uppermost or top supporting element is constituted by a horizontal ring **42**; three other supporting elements used in combination with said ring are constituted by arcs **44**, **45**, and **46** the base points of which coincide with the corner of hexagon **41**; arcs **44**, **45**, and **46** are placed along every second side of said hexagon. Each arc comprises, for instance, a lower portion formed by two vertical straight foot portions the top ends of which are connected by an appropriately curved line. The top ring **42** is in a central location with respect to the base **41**, i.e. the centre of said ring is located on the vertical axis **43** which passes or extends through the centre of the hexagonal base **41**.

With a view to carrying out the instant method the ring and supporting arcs are arranged in their respective appropriate positions by means of a convenient scaffolding structure and convenient attaching elements such as cables. The above-mentioned supporting elements are thus disposed in locations which correspond to the projecting points of the roof of the finished structure.

As explained hereinabove with reference to FIGS. 1 and 2 a mat constituted by a net having deformable meshes is disposed upon the above-described supporting elements in such a way that the central portion of the net rests on said elements, whereas the remainder of the mat hangs freely in a vertical position on all sides of the supporting elements so as to constitute the vertical basic texture for the walls of the structure to be produced. The net is then stretched, or tensioned, and a filter material is projected thereupon. Upon solidification of the filler material the supporting elements may be withdrawn and the resulting structure be allowed to rest with its lower edge upon the floor, or ground.

The horizontal top ring **42** may be replaced by a convex supporting surface constituted, for instance, by a portion of a spherical surface.

In the example shown the base of the building to be constructed is constituted by a regular hexagon; it will be easily understood that the base could have any other desired shape such as any polygonal shape other than hexagonal, or a circular or oval shape, or any other desired configuration, even an irregular one.

In a specific case the building, or structure, may have, for instance, an elongated rectangular configuration on the small side edges of which two arcs may be disposed, respectively, so as to produce a building presenting the form of a tunnel.

While several particular embodiments of the invention have been shown and described herein it should be understood that various changes in the practical execution of the instant method, and in structure and arrangements of the various elements may be made.

What is claimed is:

1. A method of making ground supported architectural structures and the like comprising the steps of: positioning at least one supporting element above and spaced from ground level and at the roof of an architectural structure to be formed, suspending a deformable mesh element in its central region by placing its central region on said supporting elements whereby the lower peripheral portion of said deformable mesh element is positioned adjacent ground level and the portion of said deformable mesh element intermediate the central region and lower peripheral portion is unsupported and hangs freely to provide the basic texture of the side wall of said architectural structure, tensioning said lower peripheral portion downwardly to tension said mesh element, disposing a flexible web over said deformable mesh element, disposing a second deformable mesh element over said web, and applying a layer of solidifiable filling material to said second mesh element to form a structural shell, then, after said layer of solidifiable filling material has solidified, removing said supporting elements and said first deformable mesh element.

2. A structural form for an architectural structure to be erected and adapted to be covered with a solidifiably formed wall, at least one supporting element spaced from and above ground level, a deformable mesh element, said deformable mesh element having a central region, a lower peripheral region and an intermediate region therebetween, said central region being suspended upon said sup-

porting element, said lower peripheral region being disposed adjacent ground level, said intermediate region being unsupported and freely hanging from said suspended central region whereby said intermediate region defines the basic contour of the said walls of said architectural structure to be erected, means connected to said lower peripheral region for tensioning said deformable mesh element downwardly between said supporting element and ground level, and further comprising a flexible web overlying said deformable mesh element and a deformable second mesh element over-lying said flexible web.

3. A structural form for an architectural structure to be erected and adapted to be covered with a solidifiably formed wall, at least one supporting element spaced from and above ground level, a deformable mesh element, said deformable mesh element having a central region, a lower peripheral region and an intermediate region therebetween, said central region being suspended upon said supporting element, said lower peripheral region being disposed adjacent ground level, said intermediate region being unsupported and freely hanging from said suspended

central region whereby said intermediate region defines the basic contour of the said walls of said architectural structure to be erected, means connected to said lower peripheral region for tensioning said deformable mesh element downwardly between said supporting element and ground level, and wherein a solidified shell conforming to the contour of said deformable mesh element is provided on said deformable mesh element.

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