Feb. 1, 1966 S. W. WIDMER 3,232,806

STRUCTURAL BUILDING COMPONENT AND METHOD OF MAKING THE SAME

Filed May 19, 1961 2 Sheets-Sheet 1

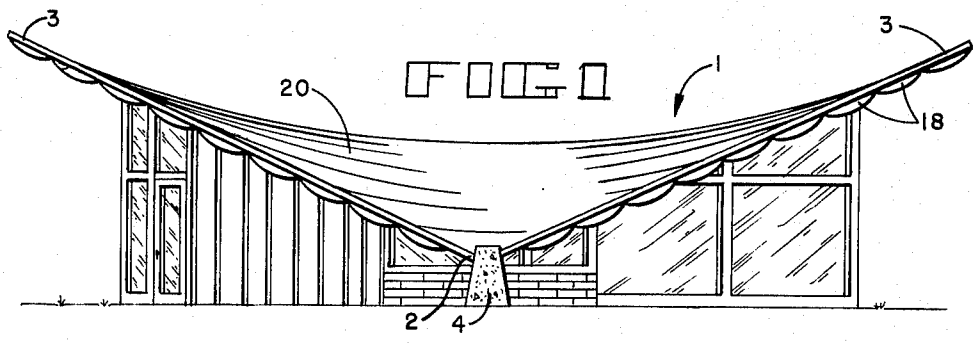

FIG 1

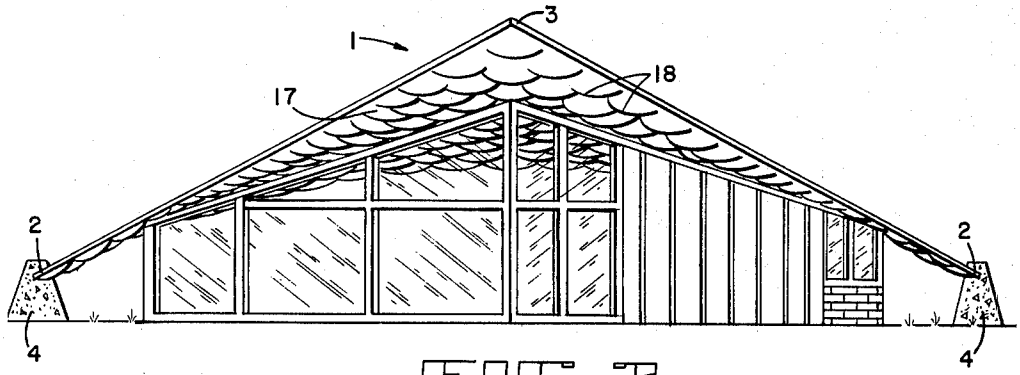

FIG 2

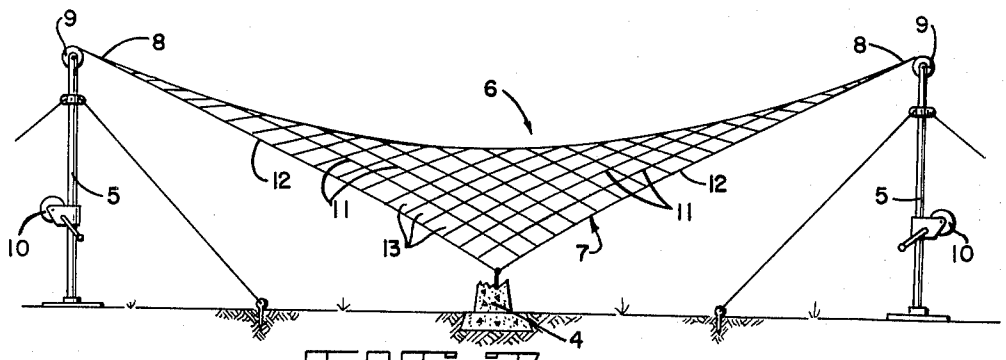

FIG 3

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Feb. 1, 1966 S. W. WIDMER 3,232,806

STRUCTURAL BUILDING COMPONENT AND METHOD OF MAKING THE SAME

Filed May 19, 1961 2 Sheets-Sheet 2

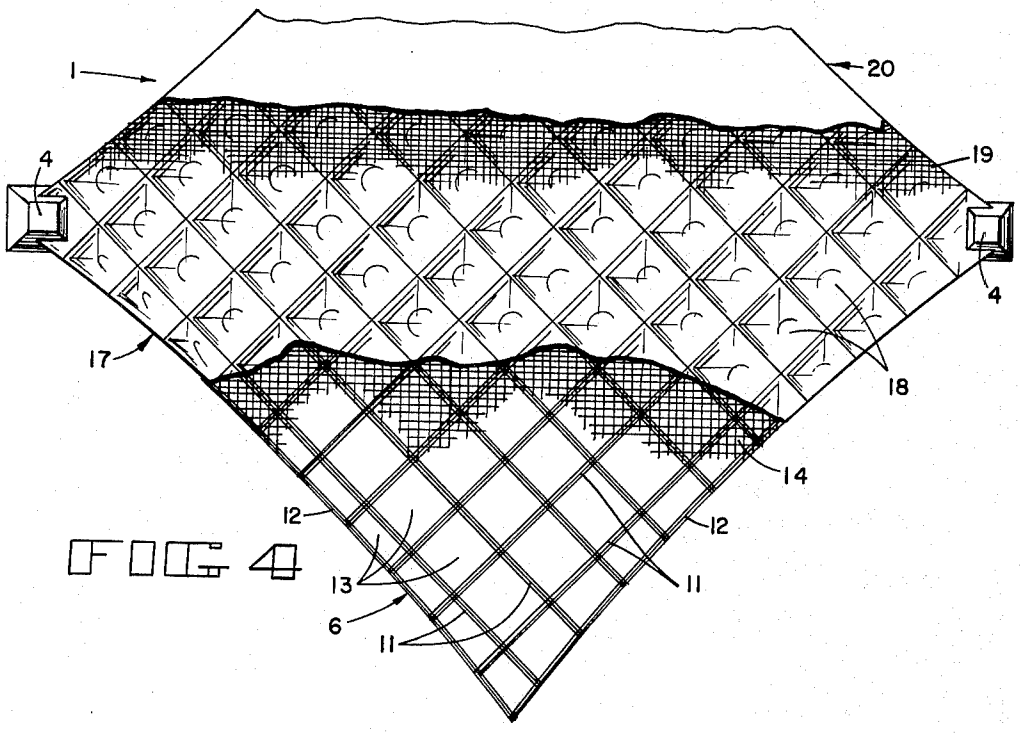

FIG 4

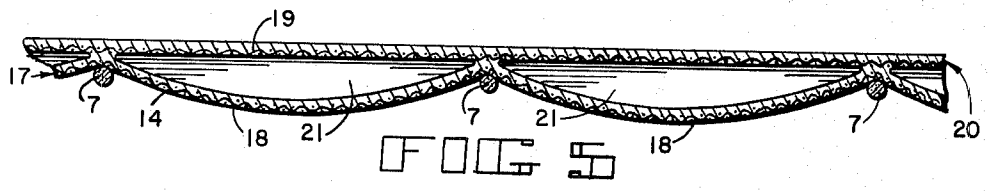

FIG 5

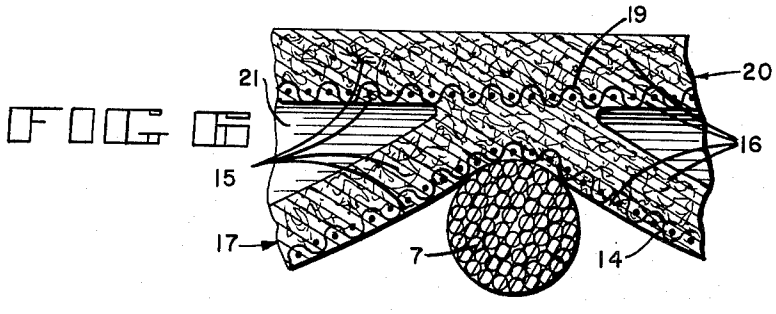

FIG 6

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STRUCTURAL BUILDING COMPONENT AND METHOD OF MAKING THE SAME

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4 Claims. (Cl. 156—212)

This invention relates to a structural building component such as a roof or a wall and the method of making the same.

Numerous methods have been devised for fabricating structural building components. These methods generally require complicated support scaffolding and/or forms adding greatly to the cost of construction and time fabrication and erection. It is generally an object of this invention to provide a structural building component and method of making the same which eliminates the need for usual types of supporting forms and/or scaffolding and thus achieves a lower cost for such structures.

According to the invention a removable support netting having relatively large mesh openings is disposed between suitable support structures and tensioned to assume the general contour of the finished building component. A netting of relatively small mesh is disposed over the support netting and is permitted to sag within the mesh openings of the support netting to a generally uniform depth to present a scalloped appearance. A layer of fibrous material is placed on the scalloped netting and is impregnated wtih a binding material to bind the small mesh netting and fibrous material into a scalloped layer. Thereafter, a second small mesh netting is stretched tightly over the scalloped layer engaging only the high portions or ridges between the scallops to present a generally smooth appearance. A layer of fibrous material is then placed on the second small mesh netting and is impregnated with a binding material to bind the netting and fibrous material into a generally smooth layer and fuse the second layer to the high portions or ridges of the scalloped layer. The large mesh support netting is thereupon removed to complete the fabrication of the building component. In the resultant double layer building component the scallops form a plurality of pockets of trapped air which serves as an insulation barrier.

The drawings furnished herewith illustrate the best mode for carrying out the invention as presently contemplated and set forth hereinafter.

In the drawings:

FIG. 1 is a side elevation of a building having a hyperbolic paraboloid, self-supporting roof structure made in accordance with this invention;

FIG. 2 is an end elevation of the building structure of FIG. 1;

FIG. 3 is a side elevation during an early stage of construction of the roof structure of FIG. 1;

FIG. 4 is a top plan view of the self-supporting roof structure of FIG. 1 with parts broken away to better explain the progressive stages of the method of erection;

FIG. 5 is an enlarged partial sectional view through the roof structure; and

FIG. 6 is an enlarged partial sectional view and shows a juncture location between the roof layers.

The method for the fabrication of a structural building component in accordance with this invention is shown in the drawings and hereinafter described in connection with a self-supporting, hyperbolic paraboloid or saddle type roof structure 1 which is fabricated in situ. The roof structure 1 is shown to have a pair of spaced low points 2 from which the roof structure is supported and a pair of spaced high points 3 on a line normal to the vertical plane through the low points. As shown in the drawings, a pair of permanent support buttreses 4 of concrete or other suitable material are provided at predetermined spaced locations for the roof structure 1 for receiving the low points 2 of the roof structure. A pair of temporary or removable supports 5 are disposed in position to receive the high points of the roof structure and are located in a vertical plane normal to the vertical plane through the permanent buttresses 4 and generally equidistantly therefrom.

After the permanent and temporary supports 4 and 5 have been built and located in position, respectively, a relatively large mesh netting 6 of steel wire or cable 7 is placed therebetween with the corners of the netting adjacent the respective supports. The corners of the netting 6 adjacent to the permanent supports 4 are securely and removably fastened thereto. A suitable wire or cable 8 is secured to the corners of netting 6 adjacent to the temporary supports 5 and extends over the corresponding pulleys 9 carried at the upper ends of supports 5 and is adapted to be wound onto winches 10 carried by the supports. Through the operation of winches 10 the netting 6 is stretched to the desired tension to provide the desired roof configuration.

In the fabrication of netting 6 for a hyperbolic paraboloid roof structure, the respective strands 11 intermediate the outer strands 12 are cut to their calculated length and secured to the curved or bowed outer strands so that upon stretching the netting to the desired roof configuration, a generally uniform stress is carried by the respective strands. While the interlaced and criss-crossing strands 11 may be spaced to provide mesh openings 13 of any given size, it is generally preferred that the mesh openings measure approximately two feet on a side for the roof structure 1.

After the netting 6 has been secured to the respective supports and stretched to produce the desired roof configuration, the strands 11 and 12 of the netting are coated with a suitable releasing agent to prevent adherence thereto by the resin binder employed in the subsequent steps of fabrication.

Thereafter, a netting 14 preferably of cord material and of relatively small mesh as shown most clearly in FIG. 4, is draped over the steel netting 6 and is permitted to sag into the mesh openings 13 of the steel netting to a given depth to define a generally uniformly scalloped surface as shown in the drawings. To prevent movements of netting 14 relative to the steel netting 6 during the next subsequent steps in the fabrication of the roof structure, the netting 14 is secured at spaced intervals by ties, not shown, to the steel netting. Since the ties are subjected to little stress, they can be made with an easily severable cord material which is readily assimilated into the finished roof structure. As a possible alternative to the spaced ties or in addition thereto, a resin coating such as an epoxy resin or the like may be applied to the cord netting 14 which upon setting provides a degree of rigidity to substantially prevent movement of the netting during subsequent steps in the fabrication of the roof structure.

With the cord netting 14 in place, a layer of loose fibrous material 15, such as short glass fibers, is blown or otherwise spread over the scalloped surface of the cord netting 14 to a given thickness. A binding material 16, such as an epoxy resin, is sprayed over the layer of fibrous material 15 and impregnates the fibrous material and cord netting 14. Upon curing, the binder material 16 together with the fibrous material 15 and the cord netting 14 form a lower roof layer 17 having a plurality of scallops 18. While a single application of fibrous material 15 and binder material 16, respectively, are generally preferred, roof

layer 17 may, if desired, be built up by a plurality of alternations of these materials to the required thickness. Or, if desired, the roof layer 17 may be built up with fibrous material 15, which is pre-impregnated with the binding material 16 either at the time of application or prior thereto so that the materials are simultaneously applied onto netting 14.

After the scalloped roof layer 17 is completed, a second cord netting 19 is disposed over the completed layer. The netting 19 is stretched tightly over roof layer 17 and secured relative thereto so as to engage only the high portions or ridges intermediate the respective scallops 18 and present a relatively smooth surface. Thereafter, a layer of loose fibrous material 15 of given thickness is blown or otherwise spread over netting 19 or is placed thereon in mat form. A binding material 16 is then sprayed over the layer of fibrous material 15 and impregnates the fibrous material 15 together with the netting 19 to form a relatively smooth upper roof layer 20 which upon curing fuses to the high portions or ridges intermediate the respective scallops 18 of lower layer 17 leaving a space or pocket 21 of trapped air in each scallop. Here again, while a single application of fibrous material 15 and binder material 16 respectively are generally preferred, roof layer 20 may be built up by a plurality of alternations of these materials to the required thickness or with fibrous material which is pre-impregnated with the binding material.

Upon completion of roof structure 1, the large mesh steel netting 6 is released from the several supports 5 and 5 and removed from the structure, and the temporary support structures 5 are likewise removed leaving the finished roof structure supported only by the permanent supports 4.

The several layers 17 and 20 form a structurally sound roof structure. The dead air trapped in pockets 21 formed between the scallops 18 of lower roof layer 17 and the upper smooth roof layer 20 serves as an insulation barrier against temperature extremes in the weather.

While the method of fabricating structural building components was hereinbefore described in connection with the fabrication of a hyperbolic paraboloid type roof structure 1 in situ, the method is applicable to other types of roof structures as well. The method may also be employed for the prefabrication of building components either in whole units or in sectional panels for erection subsequently on the building site.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In a method of fabricating a structural building component, the steps of stretching and supporting a relatively large mesh support netting in a given position to provide the general contour desired for the structural component, placing a relatively small mesh netting over the support netting and permitting the small mesh netting to sag within the mesh openings of the support netting a given amount to define a scalloped surface, applying a layer of resin impregnated fibrous material of given thickness on the small mesh netting, said layer having a plurality of scallops and ridges between the scallops as defined by said small mesh netting, placing a second relatively small mesh netting over the first layer and stretching same to a taut condition to define a generally smooth surface wherein the second netting contacts only the ridges of the first layer, applying a second layer of resin impregnated fibrous material of given thickness on the second small mesh netting, said second layer being generally smooth as defined by said second small mesh netting and being in binding engagement with the ridges of the first layer to form pockets of trapped air between the scallops and the second layer whereby to provide an insulation barrier between the layers, and separating the double layer structural component from the support netting.

2. In a method of fabricating a structural building component, the steps of stretching and supporting a relatively large mesh support netting in a given position to provide the general contour desired for the structural component, placing a relatively small mesh netting over the support netting and permitting the small mesh netting to sag within the mesh openings of the support netting a given amount to define a scalloped surface, placing a layer of fibrous material to a given thickness on the small mesh netting, impregnating the fibrous material with binding material to bind the small mesh netting and fibrous material into a first layer having a plurality of scallops and ridges between the scallops, placing a second relatively small mesh netting over the first layer and stretching same to a taut condition to define a generally smooth surface wherein the second netting contacts the ridges of the first layer, placing a layer of fibrous material to a given thickness on the second small mesh netting, impregnating the fibrous material on said second small mesh netting with a binding material to bind the netting and fibrous material supported thereby into a generally smooth second layer and bind the second layer to the ridges of the first layer to form pockets of trapped air between the scallops and the second layer whereby to provide an insulation barrier between the layers, and separating the double layer structural component from the support netting.

3. A method of fabricating a roof structure in situ, the steps comprising providing permanent support means for receiving and supporting the low portions of the roof structure, providing temporary support means for supporting the high portions of the roof structure, removably securing a relatively large mesh support netting between said support means and tensioning said netting into a position assuming the general contour of the roof structure, applying a releasing agent to the large mesh netting, placing a relatively small mesh netting over the support netting and permitting the small mesh netting to sag within the mesh openings of the support netting a given amount to define a generally uniformly scalloped surface, releasably securing the small mesh netting against movement relative to the large mesh support netting, placing a layer of fibrous material to a given thickness on the small mesh netting, impregnating the fibrous material with binding material to bind the small mesh netting and fibrous material into a scalloped lower roof layer, placing a second small mesh netting material over the lower roof layer and stretching same to a taut condition to define a generally smooth surface wherein said netting contacts the high portions of the lower roof layer intermediate the scallops, placing a layer of fibrous material to a given thickness on the second small mesh netting, impregnating the fibrous material on said second small mesh netting with a binding material to bind the second small mesh netting and fibrous material supported thereby into a generally smooth upper roof layer and bind the upper roof layer to the high portions of the lower roof layer to form a plurality of pockets of trapped air between the respective scallops of the lower roof layer and the smooth upper layer and thereby provide an insulation barrier between said layers, and removing the relatively large mesh support netting and the temporary support means from the roof structure.

4. In a method of fabricating a structural building component, the steps of stretching and supporting a relatively large mesh support netting in a given position to provide the general contour desired for the structural component, placing a relatively small mesh netting over the support netting and permitting the small mesh netting to sag within the mesh openings of the support netting a given amount to define a scalloped surface, placing a layer of fibrous material to a given thickness on the small mesh netting, impregnating the fibrous material with bind-

ing material to bind the small mesh netting and fibrous material into a first layer having a plurality of scallops and ridges between the scallops, placing a second relatively small mesh netting over the first layer and stretching same to a taut condition to define a generally smooth surface wherein the second netting contacts the ridges of the first layer, placing a layer of fibrous material to a given thickness on the second small mesh netting, and impregnating the fibrous material on said second small mesh netting with a binding material to bind the netting and fibrous material supported thereby into a generally smooth second layer and bind the second layer to the ridges of the first layer to form pockets of trapped air between the scallops and the second layer whereby to provide an insulation barrier between the layers.

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HENRY SUTHERLAND, *Examiner.*