United States Patent

Perry

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[54] **ROOF STRUCTURE WITH STATIONARY AND MOVEABLE SHEATHED SECTIONS**

[72] Inventor: **Elmer W. Perry**, 31 Fawn Lane, Watchung, N.J. 07060

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[52] **U.S. Cl.** **52/71**, 52/641, 52/643

[51] **Int. Cl.** **E04b 7/16**

[58] **Field of Search**.....52/71, 639–643, 52/127, 64, 745

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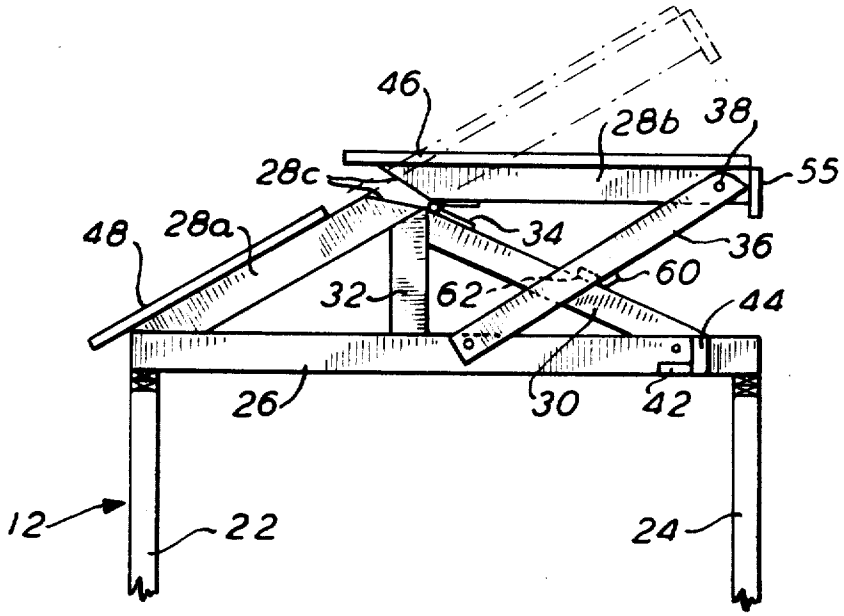
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Primary Examiner—Frank L. Abbott
Assistant Examiner—Leslie A. Braun
Attorney—Melford F. Tietze

[57] **ABSTRACT**

A truss supported roof structure in substantially completed form in which a portion of the upper end thereof is hinged and provided with adjustable supporting means whereby said hinged portion may be adjusted to a lowered position for shipment and raised to final position at the erection site.

6 Claims, 9 Drawing Figures



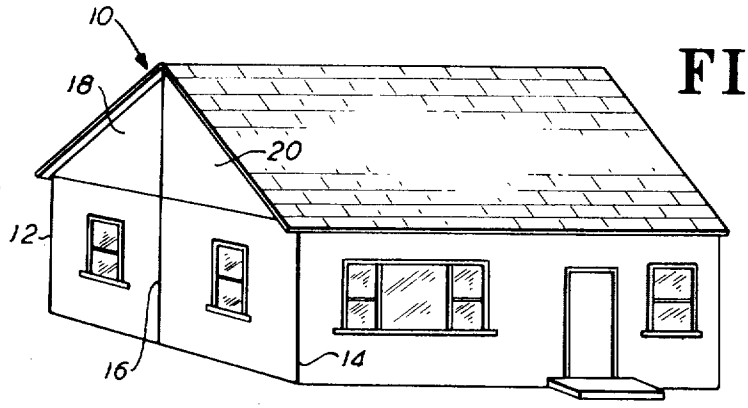


FIG. 1

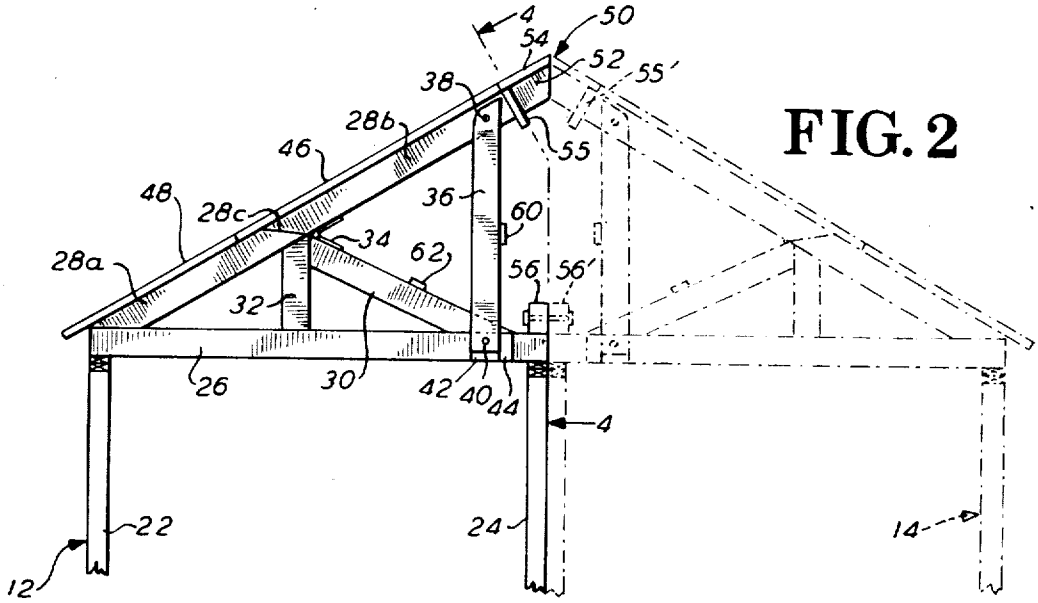


FIG. 2

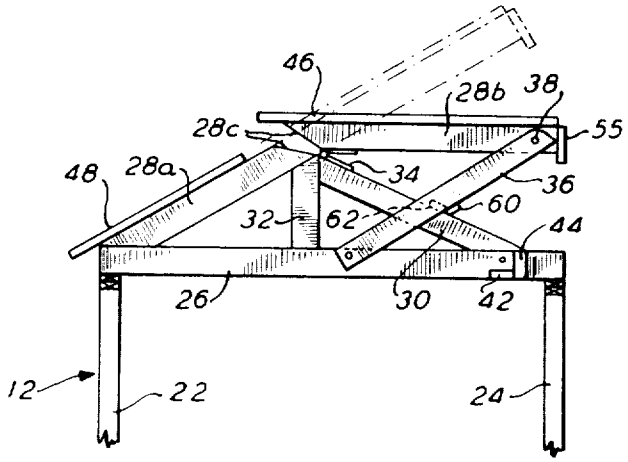


FIG. 3

INVENTOR
ELMER W. PERRY
BY
Hilford & Tietz
ATTORNEY

FIG. 4

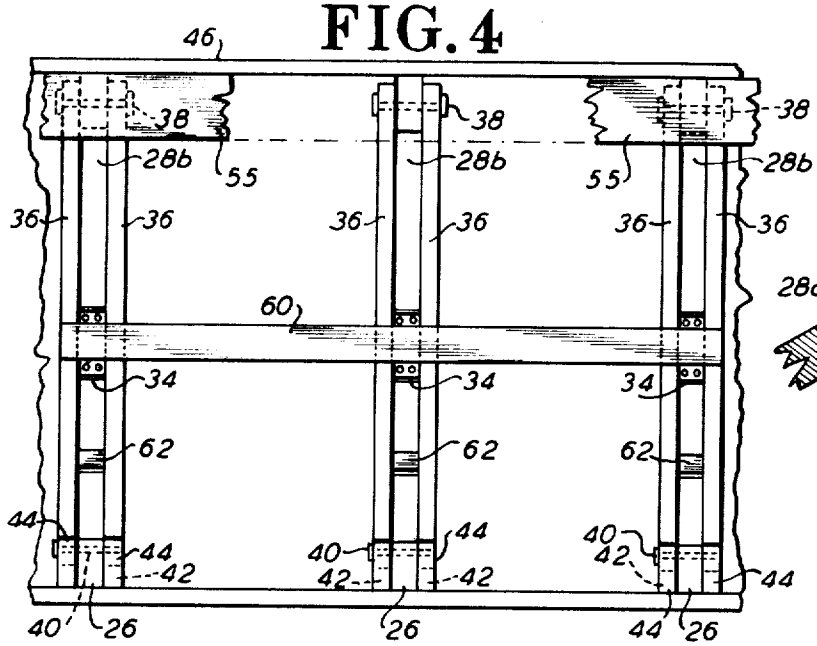


FIG. 6

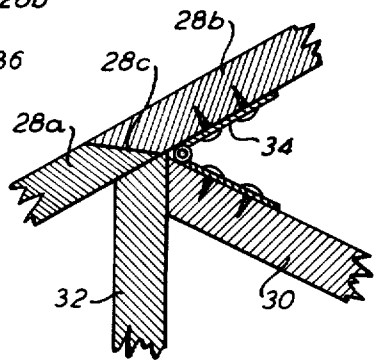


FIG. 5

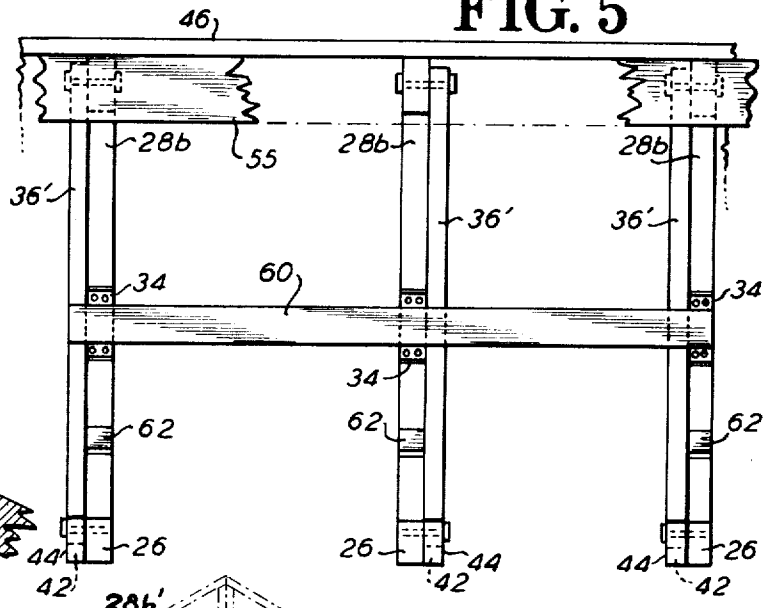
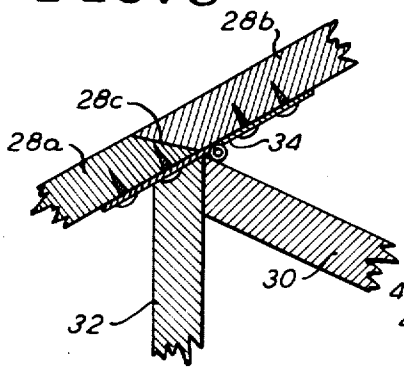


FIG. 8



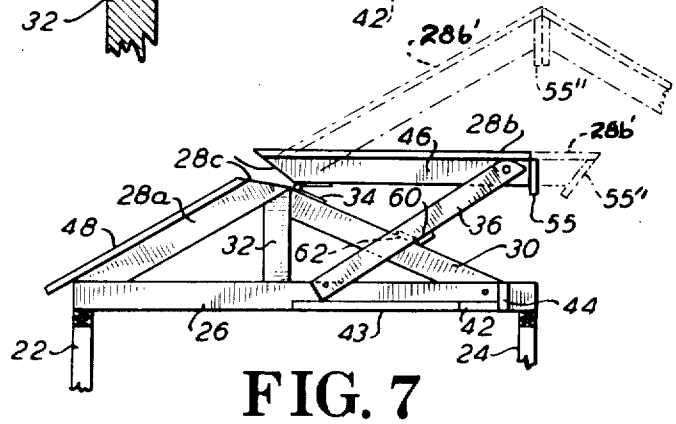
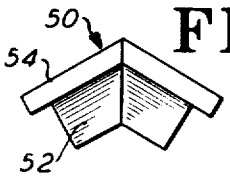


FIG. 7

FIG. 9



INVENTOR
ELMER W. PERRY

BY
Melford L. Siegel
ATTORNEY

ROOF STRUCTURE WITH STATIONARY AND MOVEABLE SHEATHED SECTIONS

The invention is particularly related to manufactured structures of modular design which are transported from the place of manufacture to the erection site. Generally two or more modular units are joined to form the finished structure. With the drastic rises in cost of material and labor such methods of construction are of increasing importance and rapidly becoming widespread. Accompanying this growth has been a demand for greater flexiblity in the design and arrangement of the fabricated units so as to afford as nearly as possible the advantages of custom on-site construction. Accordingly many of the fabricated units heretofore available are not satisfactory in design or construction to meet these new and increasing needs.

Examples of limitations that have heretofore inhibited the acceptance of fabricated modular construction are the restrictions as to width and height of shippable units. Regulations and ordinances governing transport via overland routes impose dimensional limitations. Thus for example the roof pitch of typical units has generally been characteristically substantially lower than the more asthetic steeper pitch of a conventional custom built structure, or employed lower interior ceiling heights and/or narrower units in order to stay within height restrictions. Some designs have responded to the drawback by the use of roof sections that may be lowered during transport and raised at the erection site. But such designs themselves have frequently incurred other disadvantages. For example typical roof structures of this kind cannot be substantially completely sheathed or shingled prior to shipment due to the adjustable construction; nor do they provide any such adjustable roof section in a true truss structure which will afford substantial savings of material without detracting from structural strength.

In a truss construction a bottom chord constituting a main tension member extends between the bearing points on either side of the span to be covered and top chords, constituting main compression members, extend diagonally inwardly from either end of the bottom chords are connected by one or more web members that form a triangular pattern with the top and bottom chords that produce the so called truss action. Such triangular pattern may be repeated using an appropriate number of vertically extending webs depending upon the length of the span. An inherent advantage in such roof construction is that the diagonal top truss chords may be of substantially smaller cross-section than a comparable rafter and under most structural codes, spaced at greater intervals. Substantial savings of material can thus be realized. Truss spans also afford greater flexibility in interior design by warrant of their inherent freedom from the requirement for intermediate load bearing walls and the like. Thus interior partitions may be designed and arranged at the will of the architect rather than to provide needed structural support. However, by warrant of the fixed nature of truss elements it has not been possible heretofore to provide a truss support for roofs with vertical adjustability and which therefore has the capability for raising or lowering for shipment without the drawbacks heretofore described.

An object of this invention is to provide a truss type roof for fabricated structures in which a portion of the roof is vertically adjustable relative to a fixed portion thereof.

Another object of the invention is to provide such a roof construction for modular units to be transported to erection sites in which the sheathing and shingles may be substantially completely applied prior to transport.

A further object of the invention is to provide such a roof construction in which the lower portion is fixedly supported by spaced truss frames and in which the upper portion is supported on rafters hinged at the peaks of the truss frames to permit the adjustable portion alternatively to be lowered to or below the level of the peaks of the trusses or raised into alignment with the lower roof portion.

A still further object of the invention is to provide such a construction where support means connected with the adjustable portion of the roof is retractable in one position to allow said roof portion to be lowered and is engageable in a second position with positioning means to support said roof portion in its extended final position.

A still further object of the invention is to provide a pivoted member for each of said support means and means extending transversely of and connecting said support members to render them operable in unison.

A still further object of the invention is to provide means engageable with said pivot support means in the lowered position of said adjustable roof portion to support said roof portion in substantially horizontal position.

Other objects and features of the invention will become apparent from the following description of an advantageous embodiment taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view showing a structure having two joined modular units and illustrating the manner in which they would be arranged;

FIG. 2 is an end elevation view showing the upper portion of a modular structure unit having a truss roof construction according to the present invention and showing in dotted lines the assembly of a second similar modular unit assembled therewith;

FIG. 3 is a partial elevation of the structure in FIG. 2 showing the adjustable roof portion in a lowered position;

FIG. 4 is a partial side view of the roof construction of FIG. 2 substantially along the line 4—4 in FIG. 2;

FIG. 5 is a partial side view showing a modified version of the construction seen in FIG. 4;

FIG. 6 is an enlarged sectional view of the hinge construction of the adjustable roof portion;

FIG. 7 is a partial side elevation of an alternate form of the construction seen in FIG. 3 in which the roof sheathing abuts but does not overlay the joint between the fixed and adjustable roof portions;

FIG. 8 illustrates an alternate arrangement of the hinge member; and

FIG. 9 is an enlarged sectional view of the peak member used to join the abutting roof portions of adjacent nodular units.

Referring now to the drawings in FIG. 1, the numeral 10 designates a prefab building consisting of two modu-

lar units **12** and **14**. In practice the units are fabricated at a manufacturing plant and shipped to the construction site where they are joined along their abutting sides **16**. Various well known means may be employed to secure the units in assembled position. Additional units may be assembled endwise. The gable end closures **18** and **20** are inserted at the time of erection and generally used only to enclose the roof openings at the ends of the terminal units that are assembled. The roof formed by the assembled units **12** and **14** has a pitch preferable in the order of 3.5 to 12 or greater which is normally desired to permit standard roof shingle application and standard appearance. In conjunction with the maximum permissible modular widths however that are normally permissible for overland shipment (in the order of 12 feet in most states and 14 feet in some); and with a standard ceiling height of about 8 feet, the overall height of the units exceeds the limit normally permitted for shipment. According to the present invention the roof structure of the modular units is adjustable to permit a portion of the roof to be lowered during shipment.

Referring to FIGS, **2–4** of the drawing, the vertical side walls of unit **12** are shown at **22** and **24**, the horizontal ceiling joists are shown at **26**. The roof structure comprises a series of spaced truss frames in which the joists **26** comprise the bottom chords. Members **28*a*** comprise top chords which join at the peak with chords **30** and vertically extending web struts **32**. Rafter elements **28*b*** are hinged at the peaks of the trusses as by the hinges **34** which may be fastened on the confronting faces of the rafter **28*b*** and chord **30**.

Alternative hinge arrangements for the rafters **28*b*** may be employed. For example, the hinges **34** may be disposed as shown in FIG. **8** with the leaves of the hinge being fixed respectively to the truss chords **28*a*** and the rafters **28*b***. Generally speaking, the abutting faces **28*c*** are advantageously at or closely approximating the horizontal plane to enhance the load bearing quality of these faces.

It will be understood that the term "hinge" as herein employed need not necessarily be limited exclusively to the conventional hinge device having a pair of hinge plates rotatable about a pin axis as shown in the drawings. Rather the term "hinge" may include any form of angularly adjustable connection between the rotatable members which will hold them in desired alignment while permitting angular rotation. Thus for example, a flexible plate whose opposite end portions are secured to the respective members **28*a*** and **28*b*** may be employed in place of the hinge device shown in FIG. **8**. In this instance the flexible plate can be made to allow sufficient rotation and will serve satisfactorily since the hinge connection need operate to permit rotation only a relatively few times.

Supporting means, such as a pair of struts **36** (see FIG. **4**), are hingedly secured by a pin **38** to the upper ends of the rafters **28*b***. The lower ends of the struts **36** are fastened in place by a removable bolt **40** and rest on pillow blocks **42** and against positioning block **44** on either side of the horizontal joints **26** which insure that the rafters **28*b*** are in alignment with the truss members **28*a*** when the struts are seated thereagainst.

In this construction the roof sheathing may be completely applied prior to shipment. As seen in FIG. **2** sheathing **46** is secured to the upper adjustable rafters **28*b***. Preferably the sheathing **46** extends downwardly past the abutting interface **28*c*** of the rafter members **28*b*** and the truss member **28*a***. The overlapped portion may be nailed to the truss members when the unit is to be erected to thereby afford increased strength. However, the sheathing can if desired extend only to the line of the joint as shown in FIG. **7**. Sheathing **48** is secured to the fixed rafter-truss elements **28*a***. In addition roof shingling may be substantially completely applied over the sheathing. However to accommodate the displacement of the sheathing **46** one or two courses of the shingling adjacent the line of abutment of the sheathing **46** and **48** are omitted and applied at the time of erection.

It is normally desirable to have the side walls **22** and **24** spaced the maximum distance allowed for transportation. Accordingly, the ends of the rafters **28*b*** may not project beyond the wall **24**. Therefore the upward angular rotation of the rafter elements **28*b*** will result in their ends being laterally displaced slightly inward from the center line of the assembled units. To fill the gap thus left at the peak of the assembled roof and to join the roof portions of the adjacent units a removable peak section **50** is provided. The peak section may comprise cross-pieces **52** covered with sheathing **54** as seen in FIG. **9**. The sheathing **54** projects outwardly beyond the cross-pieces and seats along the edges of frame members **55** which extend transversely of the rafter members and are secured to the ends of the rafters **28*b***. By warrant of the truss type of construction the roof structure of each modular unit is self sufficient and the rigidity and strength of the assembled roof is not dependent upon the peak segment between the adjacent units. The peak segment **50** may be fastened to the respective roof structures in any suitable fashion. For example the projecting edges of sheathing **54** may simply be nailed to the frame members **55** on which they lie. Bolts or other means through the adjacent beams **56** may be used to secure the adjacent modular units in assembled ration.

Where it may not be required to have the side walls **22** and **24** spaced the maximum distance allowable, the rafters **28*b*** may project beyond the side wall **24**. This is illustrated in the dotted line extension **28*b'*** in FIG. **7**. In such an arrangement the ends of the rafters **28*b*** are preferably chamfered so that cross frame member **55** will be on an angle such as shown at **55''** in FIG. **7**. When the rafters **28*b*** are rotated to the elevated position as shown by the dotted line position of the rafters **28*b'*** the end piece **55''** will be substantially in a vertical plane so as to be placed flush against the corresponding member **55''** of the adjacent module. In such arrangement of course the adjacent roof sections join directly at the peak of the assembled structure and it is not necessary to provide a removable peak such as **50**.

The pivoted construction of the rafter members **28*b*** may best be seen in FIGS. **3**, **4** and **7**. To rotate the upper portion of the roof downwardly about the hinges **34**, the pins **40** of the vertical struts **36** are withdrawn and the lower ends of the struts rotated inwardly about their upper pins **38**. In the structure of FIG. **4** a cross-piece **60** extends between the struts and is adapted to bear against a stop block **62** when the rafter **28*b*** has been lowered substantially to its horizontal position.

This is a shipping position of the unit. It may be noted for example that with the sheathing extending across the joint **28c** any further lowering of the rafters **28b** below the horizontal would rotate the overlapping end of sheath **46** to increase rather than decrease the vertical dimension. Thus in such construction the horizontal position of the roof portion **28b** represents the minimum height for shipment.

The hinged roof section if desired, may be shipped in other then the horizontal position. For example it may be completely lowered until the frame members **46** or other part of the hinged portion comes to rest on the fixed portion. Alternatively, the stop block **62** may be positioned relative to the cross-piece **60** to limit rotation of the hinged section to any desired amount. The hinged rafter elements **28b** are in the plane of the truss members **28a**, **30** and **26**. The struts **36** lie adjacent the plane of the truss so as to be rotatable without interference with the truss frame. Preferably the struts **36** are slidably engaged with the sides of the truss frames so that the cooperative engagement provides a guiding restraint on the hinged roof section.

The permanent attachment of the vertical struts **36** as part of the hinged rafter assembly is important. The abutting faces **28c** of the rafters **28b** and the lower truss members although accurately chamfered can not be relied upon to achieve a true linear alignment of the roof sections. Slight deviations in alignment will be readily detected by the eye and detract from the appearance of the structure. Accordingly the vertical struts **36** together with fixed pivots **38** and the removable anchoring pins **40** make it possible to precisely set the alignment at the factory and to assure exact realignment on the erection site. The lower ends of the struts **36** may be fastened by means other than the pins **40**. In fact for most applications it will normally be more expedient and equally satisfactory merely to nail the struts to the frame chords **26** when the unit is being finally erected. The lower ends of the struts **36** will be accurately positioned by the blocks **42** and **44** and the attachment completed when the struts have been properly seated.

The struts **36** may be provided as only a single strut for each truss frame. In such arrangement the struts of adjacent truss sections preferably are alternately on opposite sides of the frames so that when connected by cross-member **60** they will be guided by the truss frames as seen in FIG. **5** which shows strut members **36'** alternately on opposite sides of the truss frames.

The extent of interior wall and ceiling finishing completed at the plant prior to shipment of the modular units may vary according to particular circumstances. For example it is customary to have the interior covering applied to the side-walls of the modules. It may also be desired to apply ceiling covering to the bottoms of the truss frames at the plant. In such event provision is advantageously incorporated to prevent the ends of the struts **36** from striking the ceiling panels or breaking through them. This may be accomplished by guide strips such as shown at **43** in FIG. **7** which are fastened on the sides of the truss chords **26**. The strip **43** are arranged to extend from the blocks **42** toward the center of the truss span so as to slidably receive the lower ends of the struts and prevent them from extending below the guide strips. The struts, however, are free to move laterally to accommodate rotation of the hinged roof section.

It will be apparent from the foregoing description of the illustrated embodiments of the invention that there is provided by virtue of the hinged rafters **28b** and transverse frame member **55** a unitary frame structure that is rotatable about said hinge fixtures. Although the unitary framework referred to includes the transverse piece **55** acting to secure the ends of the rafter **28b** it will be understood that the sheathing **46** itself serves to interconnect the rafters **28b** to form therewith a unitary structure. The sheathing of course extends over several of the rafters each of which is fastened at intervals along its length thereto. The combination of such sheathing and rafters therefore may be relied upon to provide the unitary roof section without the necessity of the end piece **55**. Of course in the embodiment of FIG. **2** the end piece **55** also serves as a support for the peak section **50**. Generally the inclusion of the cross member **55** will enhance the structural rigidity and is preferred. However for the sake of reducing the required materials to a minimum it will be appreciated that the sheathing and rafters attached thereto effectively form a rotatable frame structure even without the member **55**.

The fact that the rotatable and fixed roof sections may be substantially completely sheathed and shingled at the plant is highly important. The elimination of any interference between the supporting struts **36**, the truss frames and the adjustable roof frame formed by the rafters **28b** and the sheathing **46**, is significant in enabling this objective to be accomplished. The struts are pivoted at their upper ends and have no arcuate displacement that would require their upper ends to extend beyond the plane of the sheathing. The struts also are disposed between and alongside the truss frames thus moving parallel to and without obstruction with them. Also the struts may be retracted and the roof lowered without requiring the struts to project below the level of the truss frames. Additionally the rafters **28b** are mounted for rotation in the planes of the truss frames. The sheathing carried thereon consequently has no interfering position with the truss frames in any angular adjustments. In combination the upper adjustable roof section, in substantially completely finished form, may be raised or lowered between its upper, coplanar aligned position and any desired lower shipping position without interference or without requiring such roof section being folded in reverse direction or displaced beyond its desired limits of movement in order to accommodate the movement of interfering members. Accordingly the present invention affords a highly advantageous truss type roof construction having vertical adjustability to permit reduction of height for shipment while permitting such roof to be shipped in substantially finished form.

Various modifications and embodiments may be made without departing from the scope of my invention as set forth in the following claims.

I claim:

1. A roof assembly for a fabricated structure comprising paralled spaced truss frames extending across the top of said structure, said truss frames each including a lower substantially horizontal chord member and an upper inclined chord member extending from an

end of said lower chord member to a peak, and an oppositely inclined frame member extending from the other end of the horizontal chord member to said peak, a sheathed, fixed roof section carried by the inclined chord members of said truss frames on one side of said peak, and terminating in spaced relation thereto, a sheathed moveable roof section adapted in conjunction with said sheathed fixed roof section to form a sheathed roof for said structure, and an angularly adjustable framework for carrying said sheathed moveable roof section comprising rafter members coplanar with and hingedly secured at one end to each of said oppositely inclined frame members at the peaks thereof, adapted to be pivoted upwardly for positioning in axial alignment with said roof carrying inclined chord members, the secured end of said rafter members being adapted to engage flush against said truss frame at said axially aligned position and restrained by such engagement against further upward adjustment, and said sheath on the moveable roof section extending beyond the ends of said rafter member to overlie said first inclined chord member, adjustable vertically extending support members pivotally connected at their upper ends with said rafter members means for positioning said support members whereby said moveable roof section may be secured in elevated position in coplanar alignment with said fixed roof section and stop means on an inclined truss frame member engagable with said support means when said support means is pivoted away from said positioning means so as to support said moveable roof section alternatively in a lower position.

2. A roof assembly according to claim 1 wherein said support means comprise pivoted strut members each arranged for angular displacement in planes parallel to said truss frames and adjacent thereto.

3. A roof assembly according to claim 2 wherein transverse frame means connect each said strut members whereby said strut members are adjustable in unison.

4. A roof assembly according to claim 3 wherein said strut members include a strut slidably in contact with each truss frame, at least two of which are disposed on respectively opposite sides of said frames whereby said strut members coact to guide the angular displacement of said moveable roof section.

5. A roof assembly according to claim 2 wherein a pair of pivoted strut members straddles each of said truss frames.

6. A roof assembly according to claim 2 wherein stop means are engageable with said strut members to limit the displacement thereof corresponding to a predetermined angular adjustment of said moveable roof section.

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