

Dec. 10, 1968

M. K. SNYDER ET AL

3,415,027

TRUSS OF SPACED PYRAMIDAL UNITS

Filed July 30, 1965

5 Sheets-Sheet 1

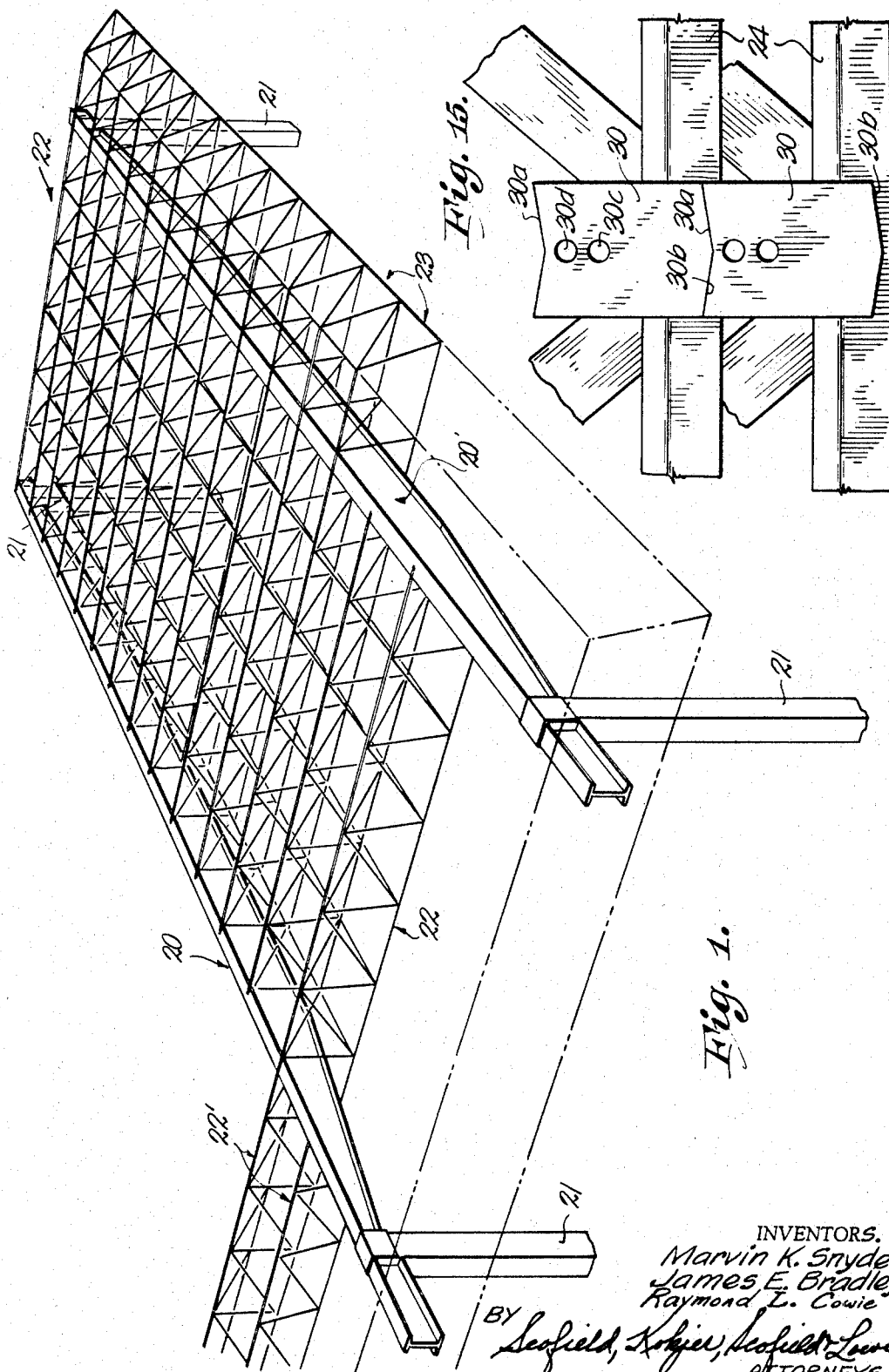


Fig. 1.

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5 Sheets-Sheet 2

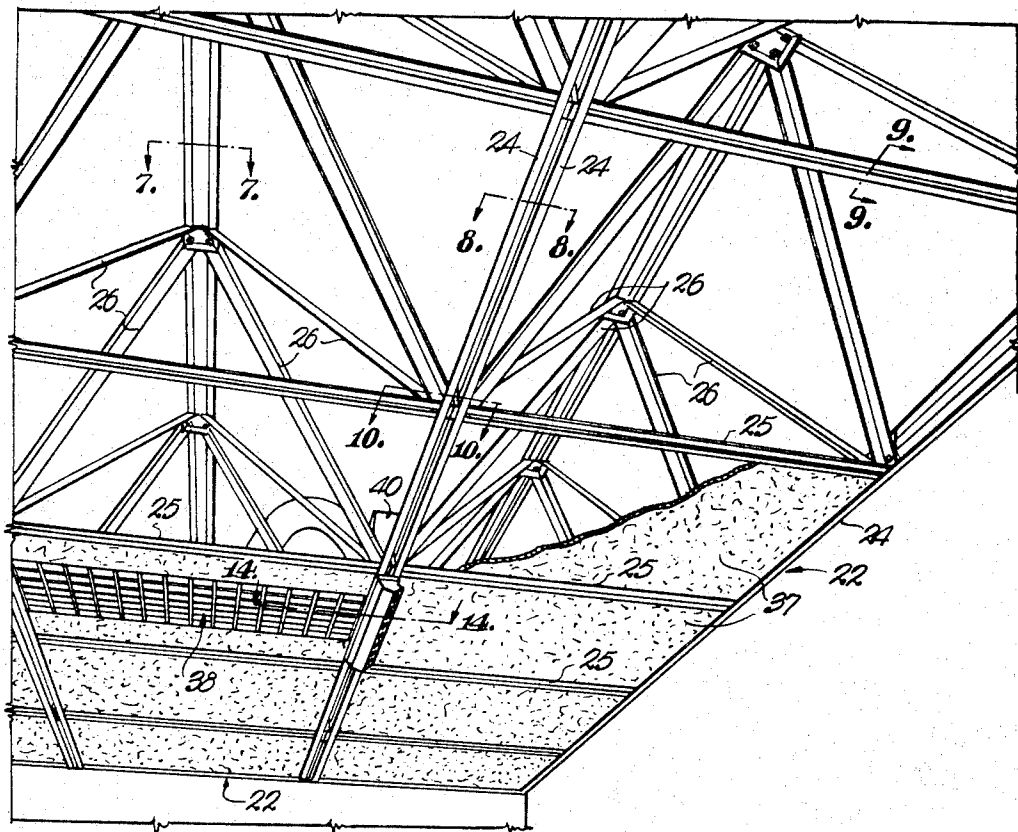


Fig. 2.

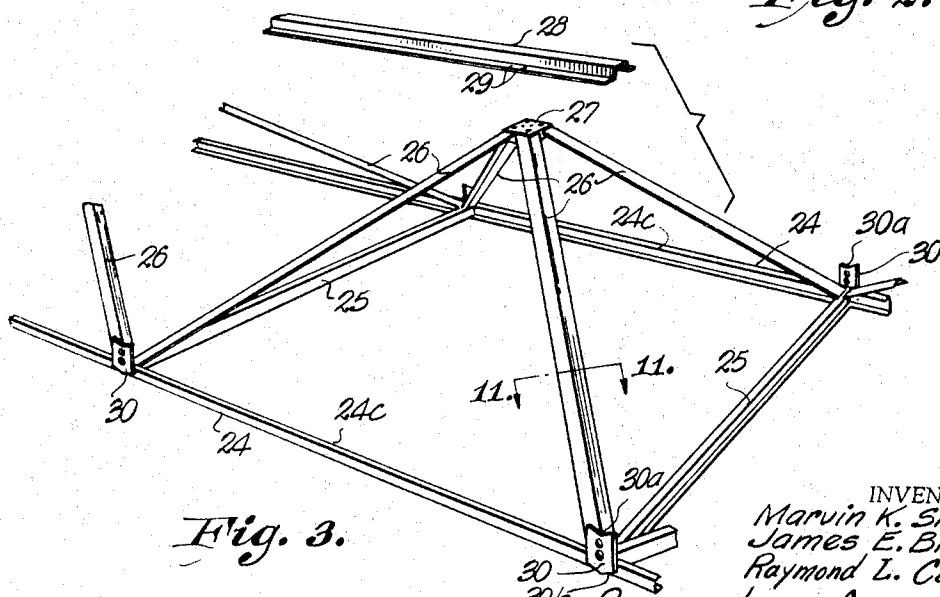


Fig. 3.

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5 Sheets-Sheet 3

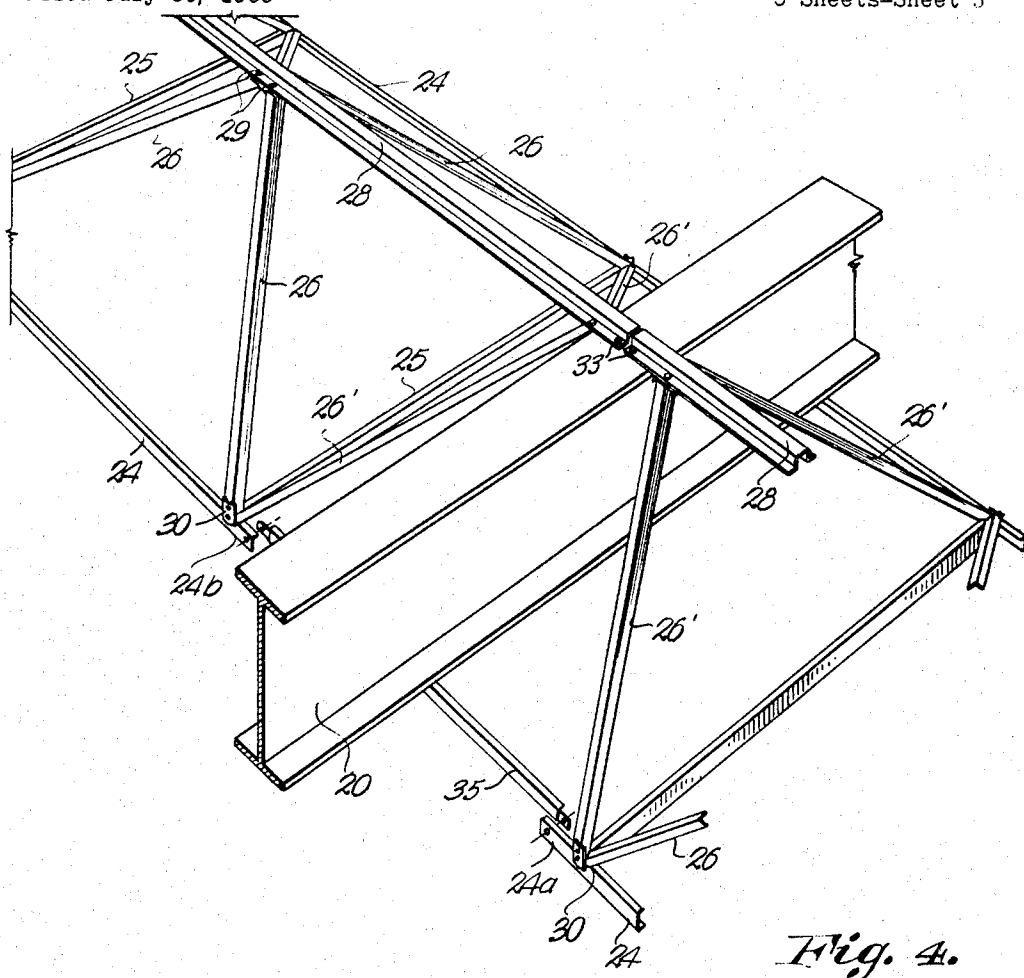


Fig. 4.

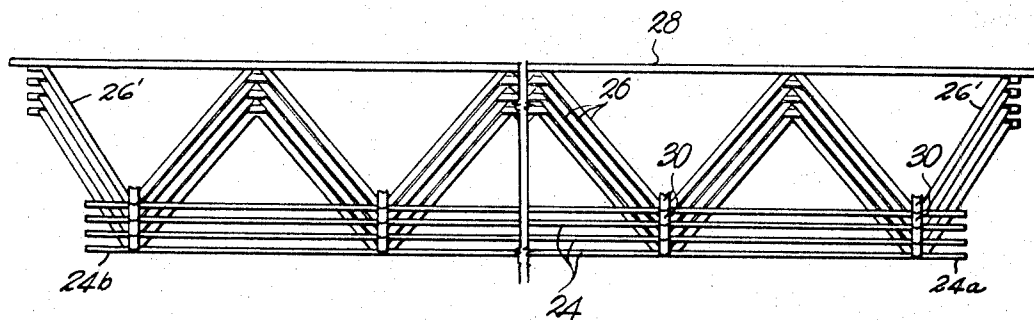


Fig. 13.

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5 Sheets-Sheet 4

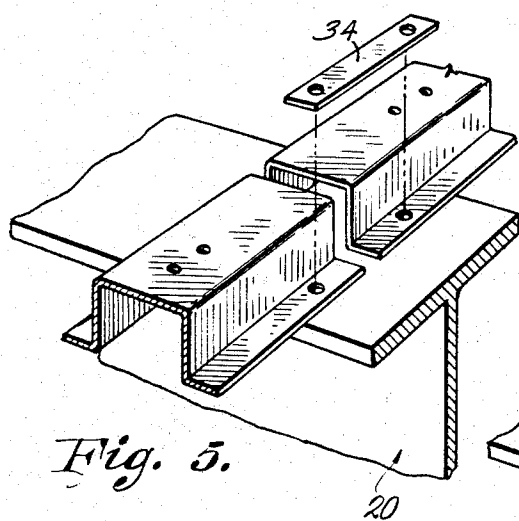


Fig. 5.

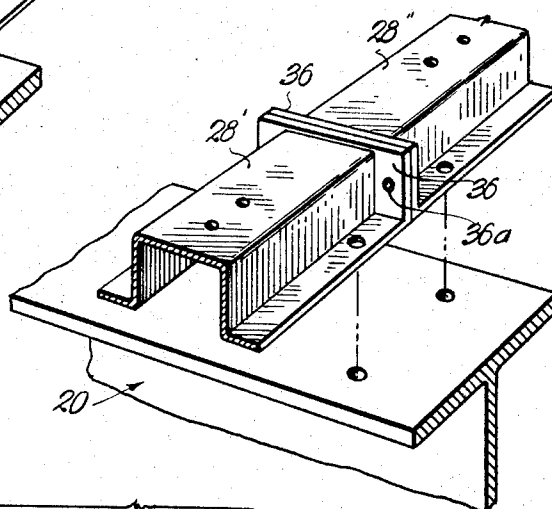


Fig. 6.

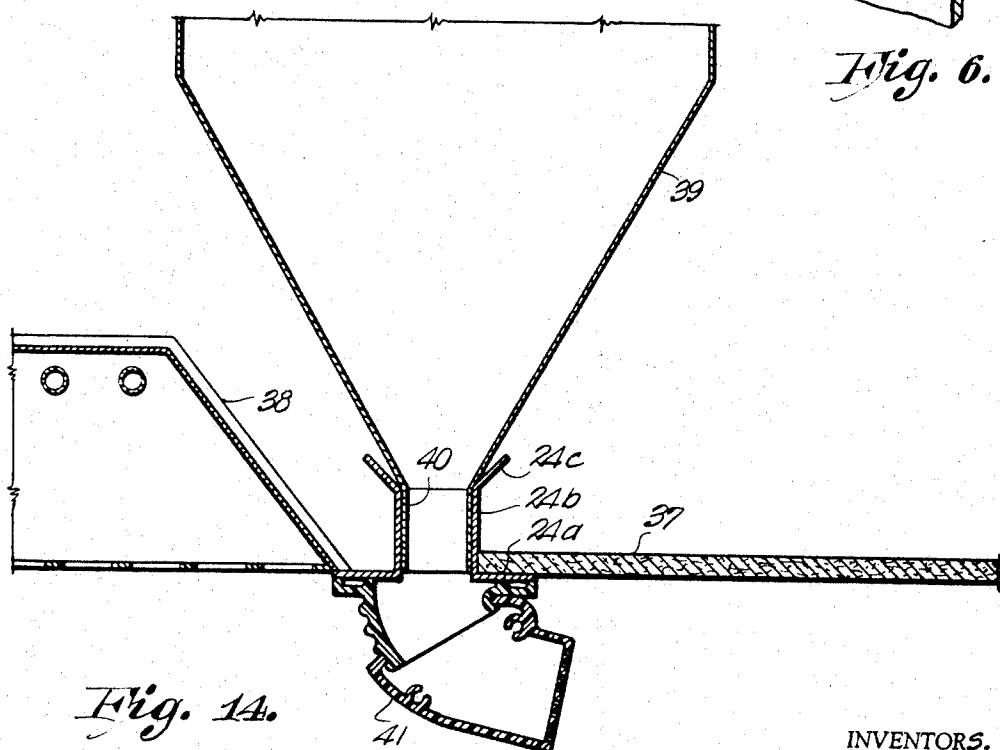


Fig. 14.

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5 Sheets-Sheet 5

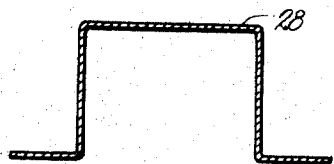


Fig. 7.

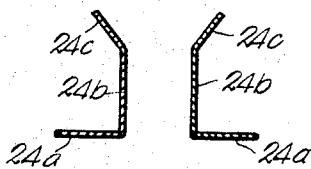


Fig. 8.

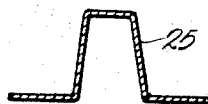


Fig. 9.

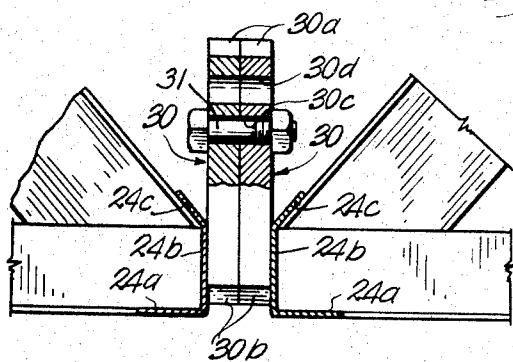


Fig. 10.



Fig. 11.

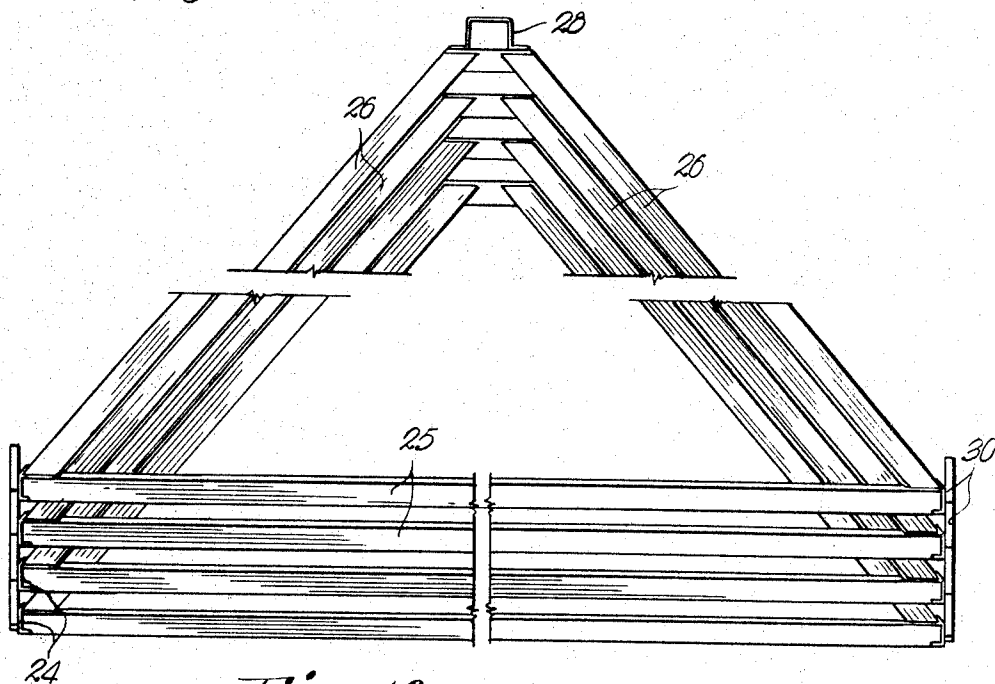


Fig. 12.

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TRUSS OF SPACED PYRAMIDAL UNITS

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Filed July 30, 1965, Ser. No. 475,960

9 Claims. (Cl. 52—263)

ABSTRACT OF THE DISCLOSURE

A structural framework for a building roof comprising a plurality of side by side elongate truss-like members, each made up of parallel bottom chords and sequentially disposed pyramidal modules formed from upwardly inclined struts joined to the bottom chords. The apices of the modules are connected by a top chord running parallel with the bottom chords. These struts and bottom chords provide surfaces for supporting ceiling panels and heating and lighting components. The truss members include side mounted combined connectors and spacers which in an assembled roof establish a gap between adjacent side chords and during shipping and prior to assembly support the trusses in a desired nested relationship.

This invention relates to buildings and refers more particularly to an improved prefabricated structural frame and support therefor providing the basic structural framework for the roof of a building.

One object of the invention is to provide an easily fabricated and assembled combination of column supported beams and truss components which provides a simplified yet highly effective arrangement affording an optimum unobstructed floor space within the building relative to the number of beams required.

Another object of the invention is to provide a combination of the character described in which the truss components serve dually as structural members in the overall roof system and support surfaces for the support of ceiling panels and light fixtures, thus eliminating the need for separate drop ceiling components, furring means, or other ceiling supporting or attaching means.

Still another object of the invention is to provide a combination of the character described in that the trusses are arranged and so constructed that they provide for a ceiling and access openings spaced uniformly across the internal ceiling plane and which are capable of utilization for various purposes, a principal one of which is to permit of flow to and from air circulating equipment or ducting located above the internal ceiling plane.

A further object of the invention is to provide a truss construction for the purposes described which can be utilized in a wide range of lengths and which requires little effort for fastening of the trusses to one another and to the beams.

Yet another object of the invention is to provide a truss construction for the purposes described which lends itself to storage and shipping in nested condition with like trusses and with all the trusses firmly supported in properly spaced relationship with the others and incapable of longitudinal shift relative to one another. A feature of the invention in this respect resides in the combining of the truss shipping support function with the truss spacing and fastening function in a single set of components.

A further object of the invention is to provide a building construction system which embodies a simple way of interconnecting individual pyramidal stress modules with a limited number of fasteners and the assembly of which requires only the simplest of tools.

Other and further objects of the invention together with

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the features of novelty appurtenant thereto will appear in the course of the following description.

In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals indicate like parts in the various views:

FIG. 1 is a perspective view of a portion of a building structure embodying the preferred form of the invention;

FIG. 2 is a fragmentary perspective view of the inside of a preferred structure looking upward toward the ceiling, some of the ceiling panels being absent and at least one other shown in breakaway section for purposes of illustration;

FIG. 3 is an enlarged perspective view of an intermediate fragmentary portion of a typical truss member, the top chord being shown in detached, exploded relationship;

FIG. 4 is an enlarged perspective view of a portion of a truss and beam and showing a typical joint at a cross beam to maintain the truss essentially continuous;

FIG. 5 is a greatly enlarged fragmentary perspective view showing the joint at a beam between the top chords of standard truss members;

FIG. 6 is a greatly enlarged fragmentary perspective view showing the joint at the beam between the top chord of a standard and cantilevered truss;

FIG. 7 is an enlarged sectional view through a typical top chord of a truss member being taken along line 7—7 of FIG. 2 in the direction of the arrows;

FIG. 8 is an enlarged sectional view taken along line 8—8 of FIG. 2 in the direction of the arrows;

FIG. 9 is an enlarged sectional view taken along line 9—9 of FIG. 2 in the direction of the arrows;

FIG. 10 is an enlarged sectional view taken along line 10—10 of FIG. 2 in the direction of the arrows;

FIG. 11 is an enlarged cross sectional view through a typical inclined strut, being taken along line 11—11 of FIG. 3 in the direction of the arrows;

FIG. 12 is an enlarged end elevational view of a stack of nested truss members, the break lines indicating interrupted length;

FIG. 13 is a side elevational view on a reduced scale from FIG. 12 of a stack of nested truss members, the break lines again representing interrupted length;

FIG. 14 is an enlarged sectional view taken along the line 14—14 of FIG. 2 in the direction of the arrows; and

FIG. 15 is a greatly enlarged fragmentary side elevational view showing the relationship between the spacer lugs when truss members are stacked one upon another.

Referring now to the drawings, and initially to FIG. 1, for purposes of illustrating the invention we have shown a roof frame structure comprising the two parallel horizontal beams 20, 20' of I-cross section. These are supported near their opposite ends on the upright columns 21 which in turn are anchored and supported at their lower ends (not shown). Spanning between the beams 20 are a plurality of side by side truss members 22, the details of which will subsequently be described. The right hand ends of the truss members have joined therewith the cantilevered extensions 23. Additional truss members 22' are shown extending to the left of the beam 20 and it will be understood that they are similarly supported at the other end.

Referring now also to FIGS. 2, 3 and 7—14, inclusive, each truss member 22 is made up of two spaced parallel bottom chords 24 having secured thereto a plurality of substantially equi-spaced transverse cross struts 25. The cross struts 25 are generally hat shaped in cross section, as shown in FIG. 9. The ends of the cross struts are welded to the chords 24. The chord cross section is best seen in FIGS. 8 and 10, it comprising in each case an inturned

horizontal flange 24a, a vertical leg 24b and an upwardly and inwardly inclined lip portion 24c.

Each truss member includes a plurality of upwardly inclined strut members 26 which are arranged in sets of four to form with the bottom chords and with pairs of cross struts 25 a series of rectangular pyramidal modules. The struts 26 are of angular cross section as seen in FIG. 11, with the angle between the legs of the strut obtuse so that the respective surfaces on the strut on a given side of a module lie in a common plane. The upwardly and inwardly extending lips 24c on the chords 24 are in substantially the same plane as the corresponding side surfaces of the struts 26. Each set of four converging struts 26 has a cap member 27 to which the upper ends of the struts are respectively welded. In the installed truss member a top chord member 28 of hat cross section extends parallel with the bottom chords 24 and is secured to the individual cap members, as by bolts 29.

It will be noted from FIG. 13, which shows a stack of truss members in nested unassembled condition, that the individual truss members are constructed to terminate in an incomplete pyramid, i.e. the struts 26' at the opposite ends joined with top chord 28. The bottom chords have short extensions 24a and 24b at the opposite ends which along with a connector 24', and, as will be seen in FIG. 4, provide the means for interconnecting the aligned bottom chords of truss members arranged in end-to-end relationship so that the respective struts 26' of end adjacent truss members can form another pyramidal module.

Secured along the bottom chords 24 of each truss member on the outside of the chords are the heavy, approximately chevron shaped lugs 30. Preferably there is a lug at each juncture of the struts 25 and 26 with the chords. The lugs are welded securely to the outside of the chords with a substantial portion projecting above the upper edge of the side of the chord. By virtue of the chevron shape, they have a concave, in this case V-shaped, upper surface 30a and a convex lower surface 30b of similar configuration. Each lug 30 is preferably provided also with two apertures or openings 30c and 30d, one above the other.

The lugs 30 serve important and valuable purposes not only in the assembled roof framework but also in the handling, storage, shipping and assembly operations.

Taking up first the function served in shipping and storage, it will be observed that lugs provide the inter-fitting surfaces 30a, 30b which register with one another when the truss sections are stacked upon one another as shown in FIGS. 12, 13 and 15. The lugs are so arranged as to properly space and support each truss section on the one below it so that no wedging or jamming can take place between the struts, bottom chords or cross members. The cooperation between the concave and convex upper and lower surfaces 30a, 30b of adjacent truss sections in the stack also prevents longitudinal shifting of the sections relative to one another. Lateral shifting, that is shifting in a direction sideways of the stack, is prevented by the side confining action of the upper portions of the respective lugs on the truss below; as can best be seen in FIGS. 12 and 13, the upper lug portions overlap the sides of the bottom chords of the truss above and thus prevent movement in either direction while the trusses remain stacked.

In the handling of the truss sections individually, the lugs 30 provide strong and convenient locations at which to connect hooks and slings for purposes of lifting and transporting the truss sections during stacking or during final assembly of the roof framework. The hooks or slings (not shown) can be engaged in the openings of the lugs and are strategically located for ease in handling the connections with the slings or hooks.

During the assembly of the truss members into the side by side relationship which they occupy in the completed structure the lugs 30 of adjacent sides of adjacent truss members are brought into abutting relationship with one

another as can be seen in FIGS. 1 and 10. The lugs match generally so that the holes 30c, 30d therethrough are close to, if not exactly, in alignment. To bring them into exact alignment a hand tool (not shown) in the form of a drift pin or a strong screw driver can be inserted through one set of corresponding openings and manipulated to perfect, by prying action, the alignment of the other set so that a connecting bolt such as at 31 in FIG. 10 can be inserted therethrough. Upon tightening of nuts 32 on the bolts, the truss members are firmly joined to one another along the bottom chords 24.

It is important to observe that once the truss members are joined together the adjacent bottom chords of adjacent truss members are spaced from one another a short distance, this providing a gap between the bottom chords running lengthwise between the lugs 30. Preferably the width of the groove portion of each cross strut 25 is made equal to the spacing between the chords so that the visual impression gained from below is of separate rectangular frames formed into a uniform pattern. In addition to visual effect, it will be seen the gaps between the chords provide a simple and effective means of providing circulation paths for air through the ceiling plane of the roof structure or for passage of electrical lines or the like.

Continuing with the description of the connection of the truss members into the final roof structure, the opposite end portions of the top chords 28 of the truss members are seated on the top plates of the spaced horizontal supporting beams 20 and are bolted thereto. Where a complete truss proceeds on to another beam the connection is of the type illustrated in FIGS. 4 and 5. The bolts joining the chords to the top plate of the beam are indicated at 33. A template 34 (FIG. 4) is used for obtaining the proper spacing of the ends of the respective truss member on the beam. Beneath the beam, the extensions 24a, 24b on the bottom chords are interconnected by connector members 35 which are bolted to and form continuations of the bottom chords beneath the beams. Thus it is seen that the pyramidal arrangement is carried across the beam.

In some cases it is desired to provide a cantilever structure continuing on from the beam, as for example seen at 23 at the right hand side of FIG. 1. In this case, we prefer to form the top joint on the beam in the manner illustrated in FIG. 6. Here the ends of the top chord 28' and 28'' of the abutting truss sections are provided with vertical end plates 36 welded to the respective top chords. These plates are apertured as at 36a to receive bolts (not shown) extending in the longitudinal direction of the top chords and which resist the tension resulting from the cantilever loads. The bottom chord connector members in the cantilever arrangement (members like members 35 of FIG. 4) are made sufficiently strong as to resist the compressive forces resulting from the cantilever load.

Once the complete roof structure has been assembled, the ceiling can be installed and formed simply by using acoustical or ceiling panels designed to fit within the rectangular space defined between pairs of cross struts 25. As will be evident from the description that has preceded, the horizontal flanges 24a of the bottom chords form ledges or shelves which cooperate with the horizontal flanges of the cross struts 25 to provide support for the edges of the ceiling panels 37. This can best be appreciated perhaps by referring to FIG. 14, which shows one edge of a panel 37 seated on flange 24a. The manner of installation of the panels is the same as in the usual drop ceiling, i.e. the panels can be tipped on edge, moved up through the opening and then dropped into place with the margins resting on the supporting surfaces as described.

The ledges 24a also provide support in substantially the same manner for lighting fixtures as at 38.

Reference has earlier been made to the gaps between the bottom chords 24. Referring to FIGS. 1, 2 and 14, it will be seen that a duct 39 is located in a space above the ceiling plane, this duct having a tapering lower end

ending in a section 40 extending downwardly in the gap between the bottom chords. A diffuser 41 of any convenient construction is located below the ceiling plane, the one illustrated being adjustable to vary the angle of discharge of air. The entire ceiling itself, i.e. the gaps defined by the bottom chord spacings can form the return air flow path for the system. In other words, the gaps provide paths through which return air can move through the ceiling plane to the blower for the system, the space above the ceiling serving as a plenum. The blower is not shown but would have its intake vented to the open space above the ceiling plane so that air could be drawn through all gaps. Alternatively, return air ducts can be connected with the gaps in much the same fashion that the discharge duct 39 is, thus localizing the points of return air intake to desired zones.

We have not shown any roof decking or panels for the structure, but it will be evident that the top chords 28 of the system provide substantial horizontal surface area for supporting same and to which such decking or panels can be attached with ease and facility. Moreover, the hat shaped cross section of the top chords also provides a channel into which electrical conduits or other lines can be placed to keep them out of the way. The roof decking, along with the usual side closures in the form of fascias or other side panels and with the ceiling panels, form an enclosed space which, as earlier noted, can be utilized as a plenum, and which serves also to provide ample concealed and readily available space for accessory equipment, conduits and the like.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. A building ceiling structure comprising in combination,
a plurality of elevated spaced horizontal beams,
a plurality of side by side truss members extending between and supported at their ends by said beams, each said truss member having a pair of spaced, parallel bottom chords, said chords being interconnected by strut members arranged to form a plurality of similar pyramidal units integral with the truss member, and a top chord parallel with said bottom chord and connected with the apices of said units,
a plurality of combined truss connecting bracket and spacer lugs secured to each bottom chord on the outside and along the length thereof, said lugs on adjacent bottom chords of adjoining truss members having confronting surfaces abutting one another and holding the said bottom chords spaced apart so that there is a substantial gap between said truss members in the zones between said lugs, and ceiling closure members positioned within the spaces bounded by the chords of each truss to provide a ceiling which is interrupted at intervals by said gaps, said truss members including means inside the chords thereof supporting said closure members.

2. The combination as in claim 1,
said lugs having portions projecting above the upper surfaces of said bottom chords, and

fasteners extending through aligned apertures in the said portions of abutting lugs.

3. The combination as in claim 2,
said lugs located at the positions where said struts join said bottom chords.

4. The combination as in claim 1, wherein
said bottom chords and struts have coplanar surfaces on all sides of the pyramidal units common thereto.

5. The combination as in claim 1,
said strut members including bottom cross members which extend between the bottom chords of a truss member, said cross members being hat shaped in cross section and positioned with the open side down, the width of the open sides being substantially equal to the width of the said gaps between trusses and defining simulated gaps in the ceiling of substantially the same width as the said gaps and running transversely with respect to said gaps.

6. A truss member for use in multiple in side by side relationship for formation of a roof structure, said truss member comprising,

a pair of parallel bottom chords,
cross members equi-spaced along and extending between said bottom chords, said cross members secured to said bottom chords,
upwardly extending strut members arranged in converging sets of four and defining with said bottom chords and adjacent cross members a plurality of pyramidal units along the length of the truss member, and

a plurality of combined bracket and spacer lugs secured to said bottom chords on the outside thereof, said lugs having upper and lower surfaces adapted for registry with the similar surfaces of the bracket and spacer lugs on a like truss member when said truss members are arranged in vertically superposed relationship.

7. A truss member as in claim 6, including
a top chord member extending parallel with said bottom chords, and
means detachably securing said top chord member to the apices of said pyramidal units.

8. A truss member as in claim 6,
said surfaces of said bracket and spacer lugs provided with matching V-shapes.

9. A truss member as in claim 6,
said bracket and spacer lugs provided with apertures therethrough for receiving fastener means and an aligning tool.

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U.S. Cl. X.R.

52—127, 650, 732, 655.