United States Patent [19]

Ollman

[11] **3,882,653**

[45] **May 13, 1975**

[54] **TRUSS CONSTRUCTION**

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[73] Assignee: **C-O, Inc.,** Detroit, Mich.

[22] Filed: **Mar. 16, 1973**

[21] Appl. No.: **342,199**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 158,567, June 30, 1971, abandoned, which is a continuation of Ser. No. 864,982, Oct. 9, 1969, abandoned.

[52] **U.S. Cl.** ..... **52/694;** 29/155 R

[51] **Int. Cl.** **E04c 3/02;** E04b 1/343

[58] **Field of Search** ..... 52/615, 690–694, 52/639–644, 696, 619, 648, 650, 634–636; 29/6.1, 155 R

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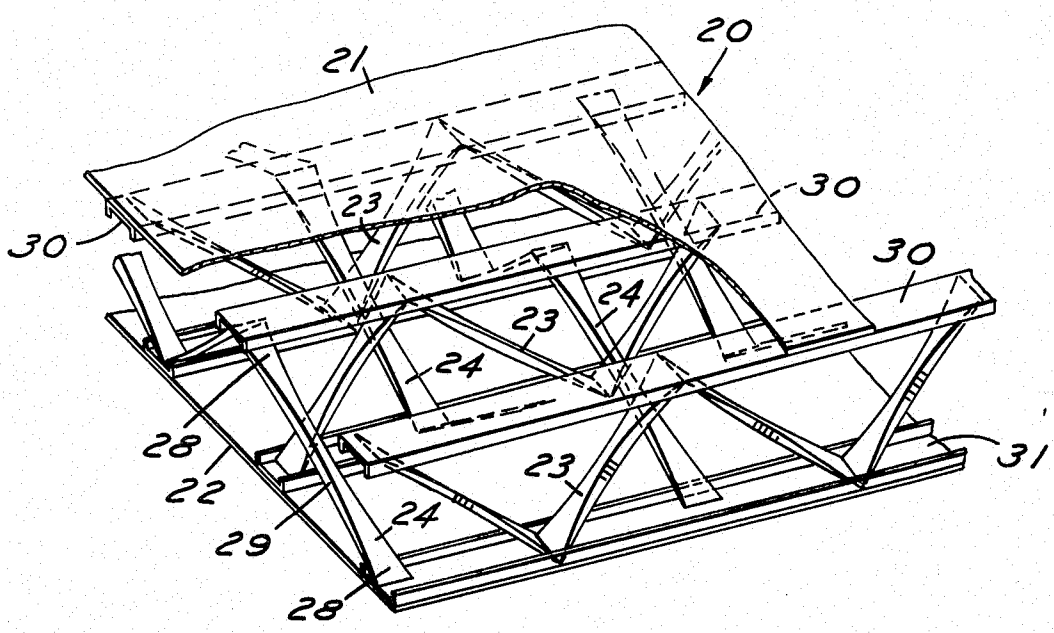
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Attorney, Agent, or Firm—Barnes, Kisselle, Raisch & Coate

[57] **ABSTRACT**

A truss structure comprising spaced first and second channel members and an undulating truss member between the first and second members. The undulating truss member comprises a strip of substantially uniformly thick material having a greater width than thickness and having alternately first and second apices interconnected by struts or leg members, each apex being in the form of a substantially single line and being secured to the channel members. The struts have generally U-shaped cross sections which are symmetrical about the plane containing the apices of the struts and have a base that increases in width from the center of the strut toward each of the apices and walls that decrease progressively in height from the center of the strut toward each of the apices.

24 Claims, 28 Drawing Figures



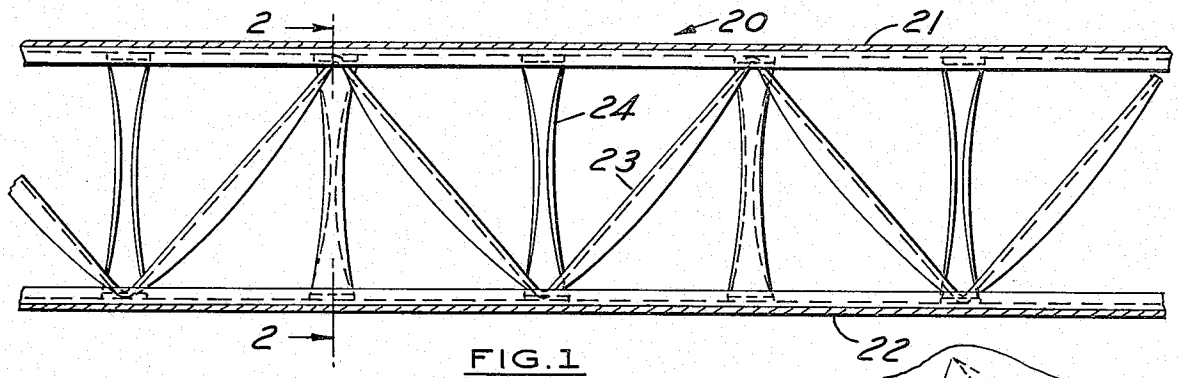


FIG. 1

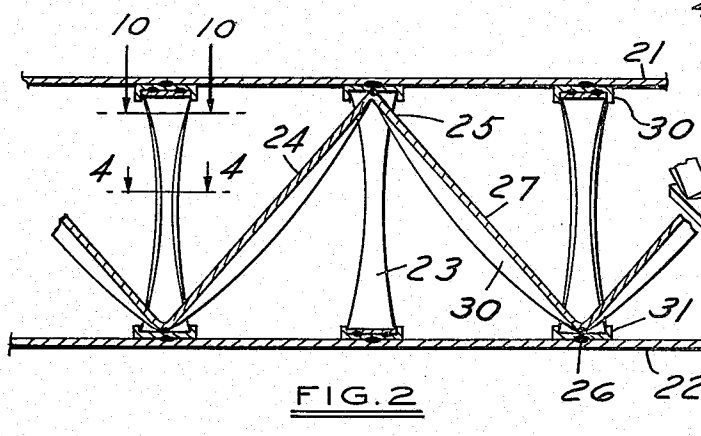


FIG. 2

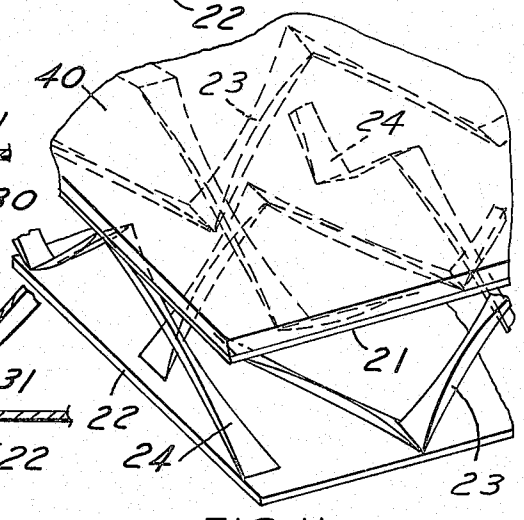


FIG. 11

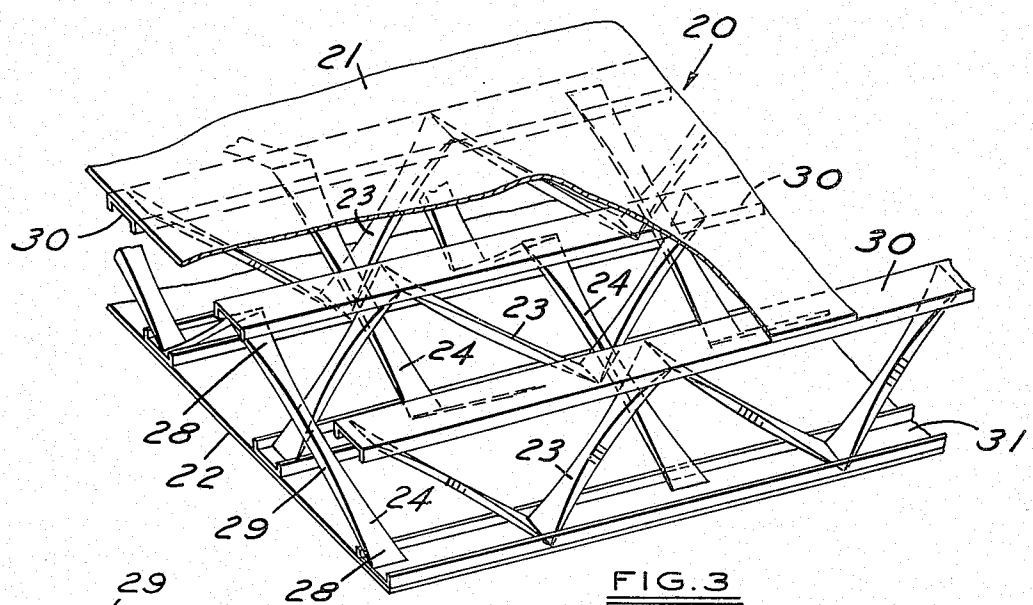


FIG. 3

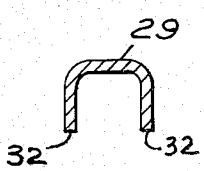
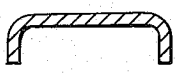


FIG. 4

FIG. 10



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FIG. 5

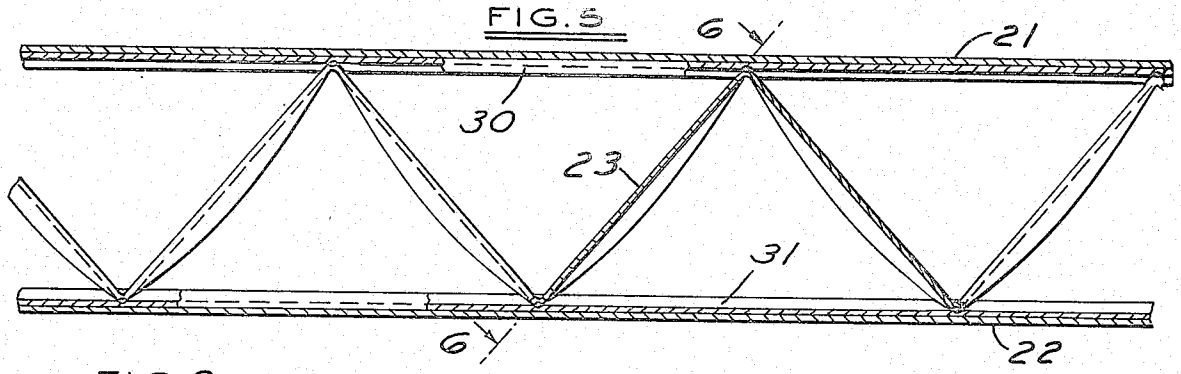


FIG. 6

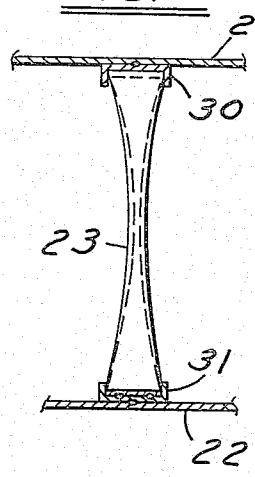


FIG. 7

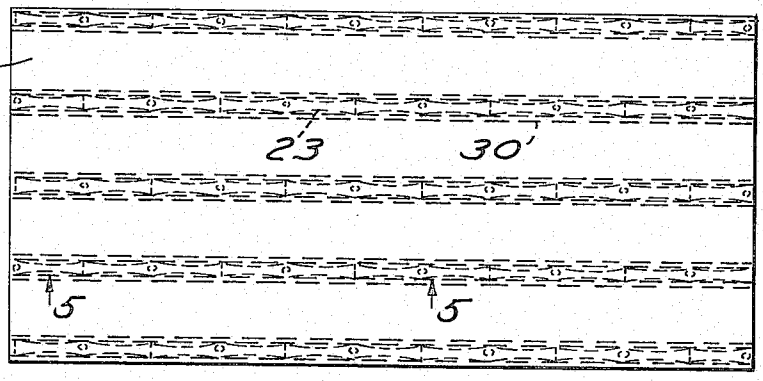


FIG. 8

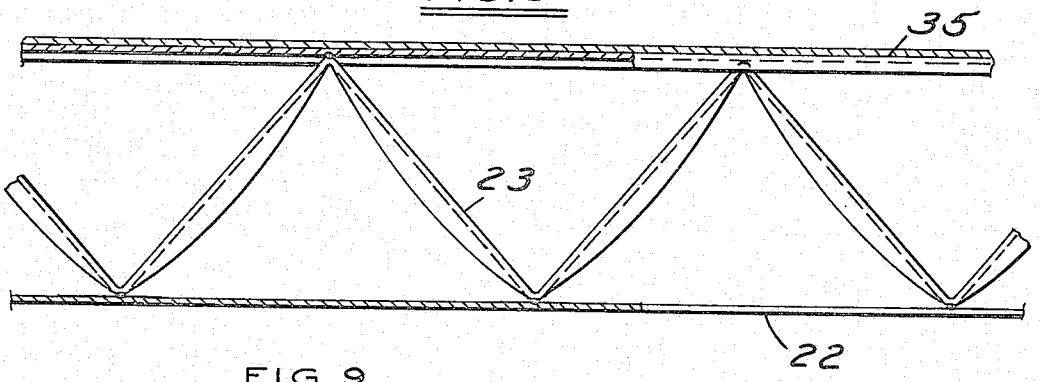
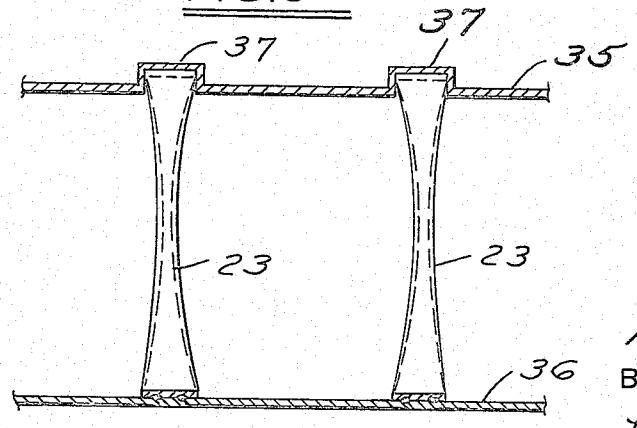


FIG. 9



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FIG.12

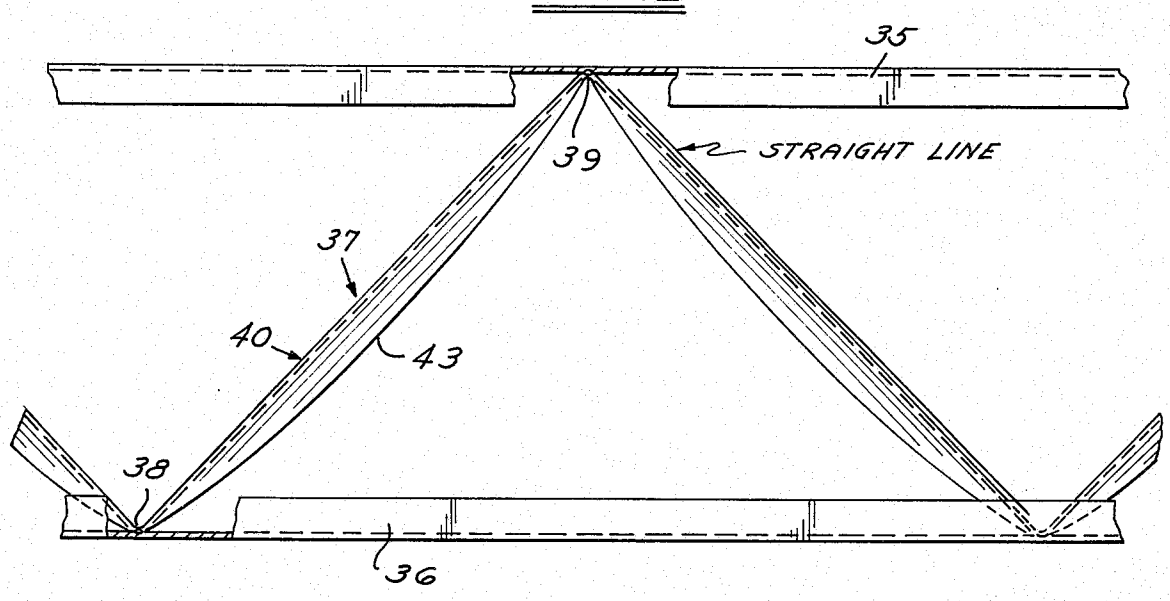


FIG.13

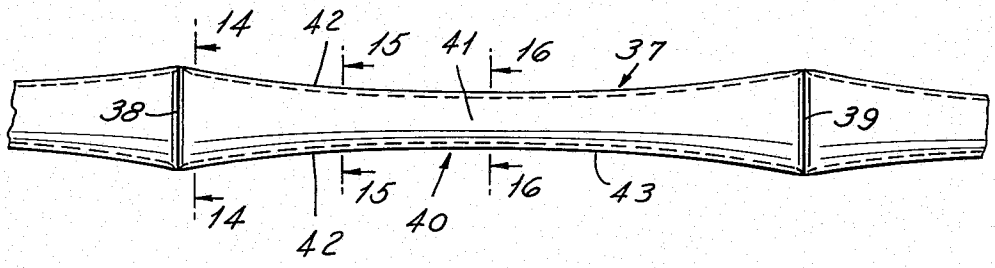


FIG.14

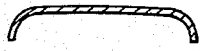
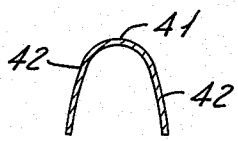


FIG.15



FIG.16



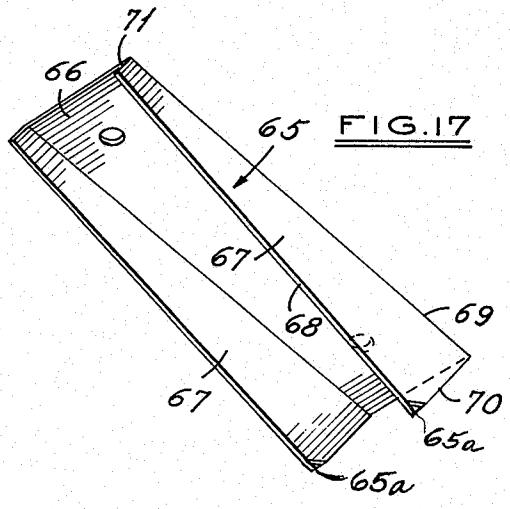


FIG.17

FIG. 18

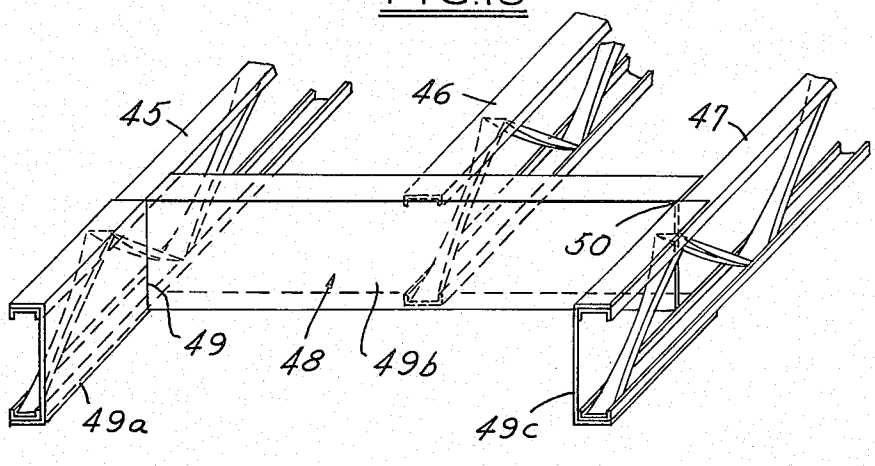


FIG. 19

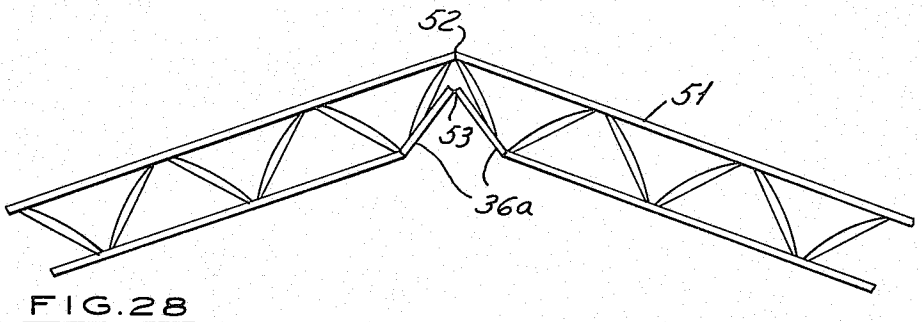


FIG. 28

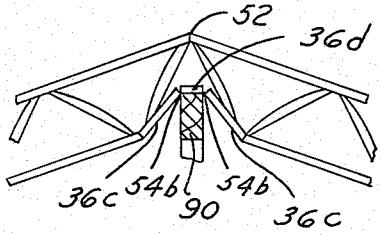


FIG. 20

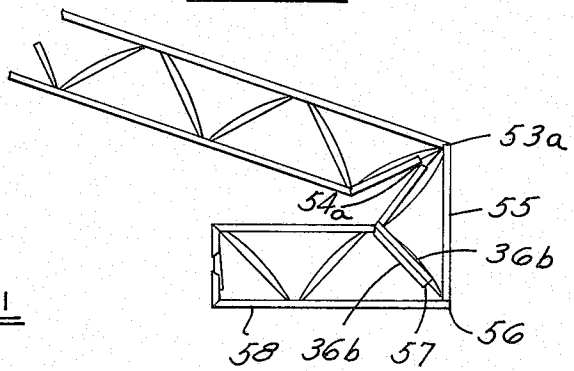


FIG. 21

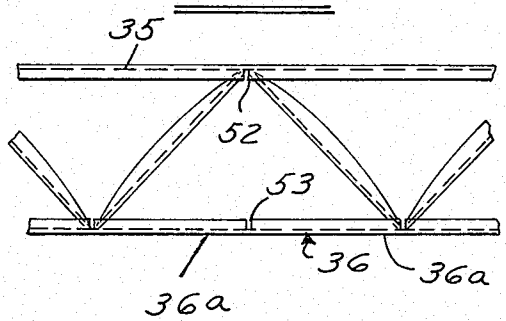


FIG. 22

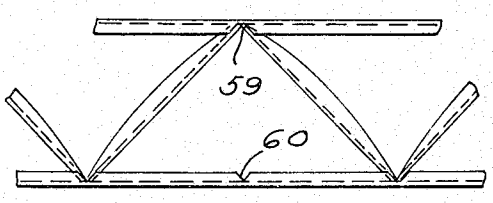


FIG. 23

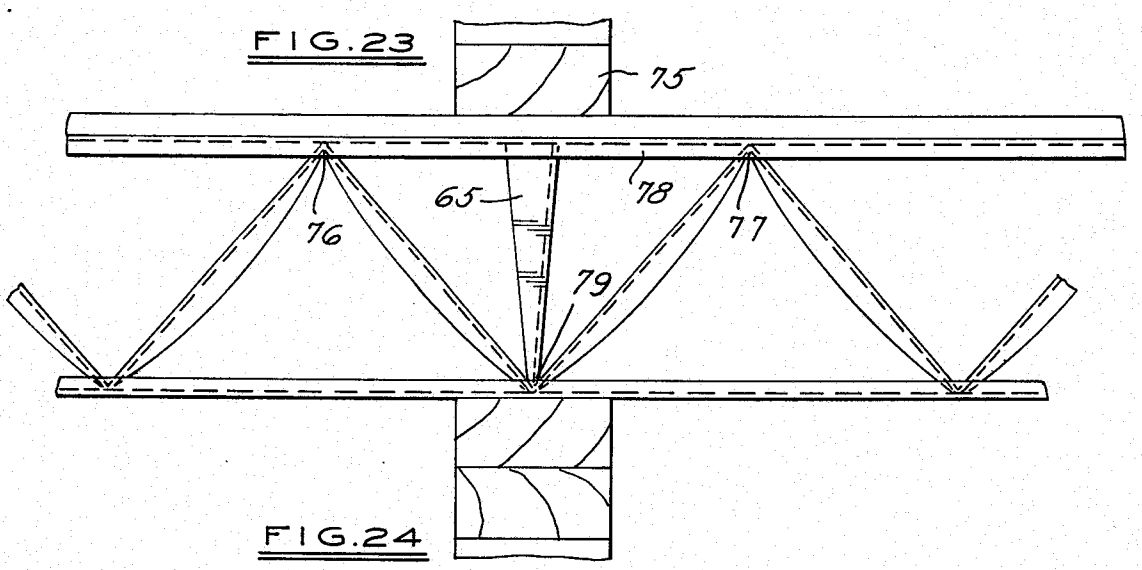


FIG. 24

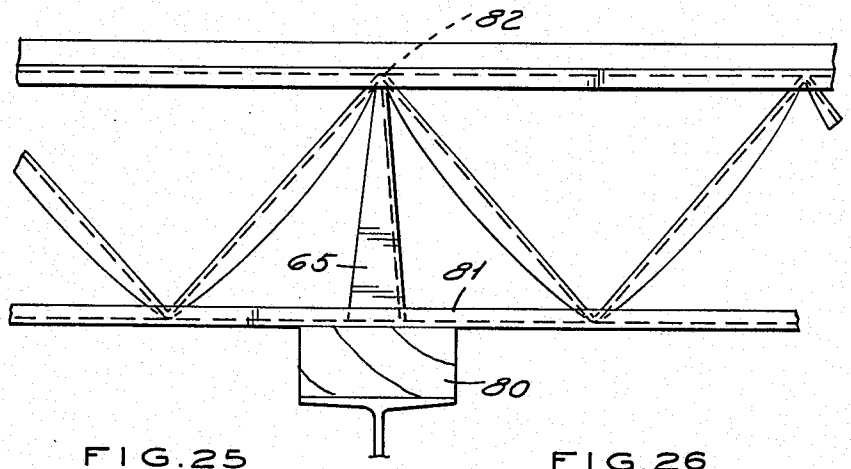


FIG. 25

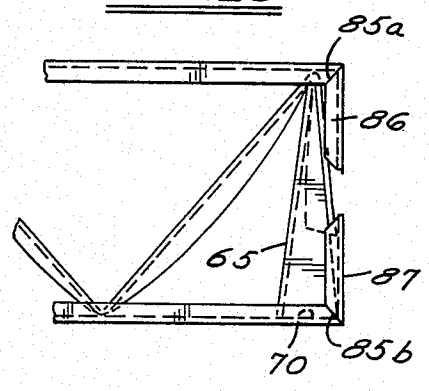


FIG. 26

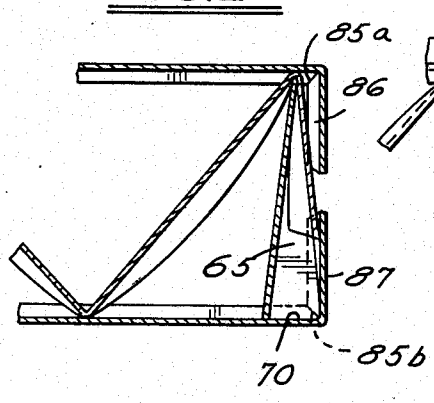
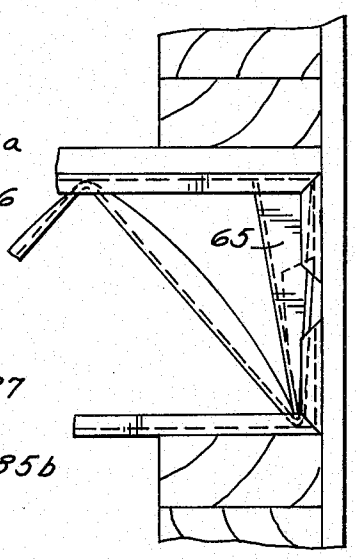


FIG. 27



TRUSS CONSTRUCTION

This application is a continuation-in-part of application Ser. No. 158,567, filed June 30, 1971, now abandoned, which in turn is a continuation of application Ser. No. 864,982 filed Oct. 9, 1969, now abandoned.

This invention relates to truss construction.

BACKGROUND OF THE INVENTION

In structures such as roof and floor decks and wall construction, it is desirable to have maximum strength with minimum weight.

Among the objects of the invention are to provide a truss construction which is lightweight, economical, can be readily handled, withstands relatively large loads per unit weight with minimum deflection, and which can have many uses in varying parts of buildings and the like.

SUMMARY OF THE INVENTION

In accordance with the invention, the truss structure comprising spaced first and second members and an undulating truss member between the first and second members. The undulating truss member comprises a strip of substantially uniformly thick material having a greater width than thickness and having alternately first and second apices interconnected by struts or leg members, each apex being in the form of a substantially single line and being secured to the first and second members. The struts have generally U-shaped cross sections which are symmetrical about the plane containing the axes of the struts and have a base that increases in width from the center of the strut toward each of the apices and walls that decrease progressively in height from the center of the strut toward each of the apices.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary sectional view of a structural panel embodying the invention.

FIG. 2 is a fragmentary sectional view taken along the line 2—2 in FIG. 1.

FIG. 3 is a fragmentary, part sectional, perspective view of the panel shown in FIGS. 1 and 2.

FIG. 4 is a fragmentary sectional view on an enlarged scale taken along the line 4—4 in FIG. 2.

FIG. 5 is a longitudinal sectional view taken along the line 5—5 in FIG. 7.

FIG. 6 is a fragmentary sectional view taken along the line 6—6 in FIG. 5.

FIG. 7 is a plan view of the panel shown in FIG. 5.

FIG. 8 is a longitudinal sectional view through a further modified form of panel.

FIG. 9 is a fragmentary sectional view of a further modified form of panel.

FIG. 10 is a sectional view taken along the line 10—10 in FIG. 2.

FIG. 11 is a fragmentary, part sectional, perspective view of a further modified form of the invention.

FIG. 12 is a fragmentary part sectional side elevational view of a truss structure embodying the invention.

FIG. 13 is a plan view of a portion of the truss structure shown in FIG. 12 prior to being placed in position.

FIG. 14 is a sectional view taken along the line 14—14 in FIG. 13.

FIG. 15 is a sectional view taken along the line 15—15 in FIG. 13.

FIG. 16 is a sectional view taken along the line 16—16 in FIG. 13.

FIG. 17 is a perspective view of a brace element used in connection with the truss structure.

FIG. 18 is a perspective view of a header construction utilizing the truss structures.

FIG. 19 is a fragmentary elevational view of a roof structure utilizing the truss structure.

FIG. 20 is a fragmentary elevational view of another part of a roof structure utilizing the truss structure.

FIG. 21 is a fragmentary side elevational view of a truss structure showing a form of notching.

FIG. 22 is a fragmentary elevational view of a truss structure showing another form of notching.

FIG. 23 is a fragmentary side elevational view of a building embodying the truss structure.

FIG. 24 is a fragmentary sectional view of another form of building construction embodying the truss structure.

FIG. 25 is a fragmentary side elevational view of another form of truss structure.

FIG. 26 is a longitudinal sectional view of the structure shown in FIG. 20.

FIG. 27 is a fragmentary sectional view of another building construction embodying the truss structure.

FIG. 28 is a fragmentary elevational view similar to FIG. 19 of a modified form of roof structure utilizing the truss structure.

DESCRIPTION

Referring to FIGS. 1–4, the structural panel 20 embodying the invention comprises spaced sheets 21, 22 of relatively thin material which bends under its own weight, such as sheet metal, and longitudinally extending truss members 23 and 24.

Each truss member 23, 24 comprises strips of material which have a greater width than thickness, such as sheet metal, and include alternating apices 25, 26 connected by diagonal legs 27. Each leg member 23, 24 has a substantially straight line end portion 28 and a non-flat intermediate portion 29 herein shown as U-shaped in cross section which gradually merges with the straight line end portions 28. By this construction, the apices form relatively sharp V-shaped configurations.

In the form shown, channel members 30, 31 are provided between the sheet members and the truss members 23 and are engaged by the apices of the longitudinally extending members 23. The apices are preferably welded to the channels 30, 31 and the sheets 21, 22 are, in turn, bonded to the panels as by welding or the use of a suitable adhesive such as epoxy resin.

The apices of the transversely extending truss members 24 are also welded to alternate channels 30, 31 as shown in FIG. 3. The truss members do not physically intersect one another, the apices of one member overlying those of the other.

In the form of the invention shown in FIGS. 5–7, the transverse truss members 24 are eliminated. Otherwise, the construction is identical to that shown in FIGS. 1–4. This construction is suitable for long, narrow spans such as roof deck panels.

In the form of invention shown in FIG. 8, the channel 31 is eliminated and the lower apices are welded directly to sheet 22.

In the form of the invention shown in FIG. 9, the channels 30, 31 are eliminated and the longitudinally

extending truss members 23 are welded directly to an upper sheet member 35 and a lower sheet member 36. The upper sheet member 35 is formed with longitudinally extending grooves 37 into which the apices of the truss members 23 extend. In placement of the form of the invention shown in FIG. 8, channel 30 takes compressive loads while in FIG. 9, the sheet 35 of the panel is placed so as to take tensile loads.

In the form of the invention shown in FIG. 10, the structural panel is similar to that shown in FIGS. 1–4 except that the channel members 30, 31 are entirely eliminated and the truss members are welded directly to the panels. a relatively stiff panel 40 such as plywood or cement board is bonded to one sheet to increase its compressive load carrying characteristics.

In each of the forms of the invention an important feature is the gradual change in cross section of each leg 27 of the truss members. The cross section changes from a straight line at each end gradually to a generally U-shaped cross section (FIGS. 10, 4). The change in cross section is such that a minimum change in thickness of the material occurs during the forming operation. As shown in FIG. 2, the free edge 32 assumes a generally curved configuration due to this gradual change. As shown in FIGS. 4 and 10, the cross section is symmetrical about a plane containing the axes of the legs 27.

The truss members are preferably made by bending strips of sheet metal in presses or by forming rolls. When bent to the configuration shown, the edges 32 are placed under tension. As a result, any compressive load on the panels must first offset this tension before compressive buckling can occur. Thus, the net overall buckling strength of the truss member is increased.

FIG. 12 is a part sectional elevational view of a truss structure embodying the invention and shows opposed first and second channel members 35, 36 having their flanges facing inwardly toward one another and an undulating member 37 between the members 35, 36. The undulating member is made of a strip of substantially uniformly thick material having a greater width than thickness and is formed with alternating first and second apices 38, 39 connected by struts 40. Each apex 28, 29 is in the form of a substantially single line extending at a right angle to a plane containing the axes of the struts 40. Each strut 40 has a generally U-shaped cross section which is symmetrical about the plane containing the axis of the strut. The U-shaped cross section of the strut has a base 41 that progressively increases in width from the center of the strut 40 (FIG. 16) toward each of the apices 38, 39 and walls 42 that decrease progressively in height from the center of the strut 40 (FIG. 16) toward each of the apices 38, 39. The base 41 and walls 42 merge gradually and progressively throughout the length of each strut. The width of the base 41 at the center of the strut is preferably equal to the height of each wall 42 at the center of the strut. As heretofore described, the edges 43 of the walls are curved and are under tension. By placing the edges 43 under tension and having the material substantially uniformly thick throughout without any substantial thinning during forming, it has been found that the strut 40 not only has its base 41 with a curvature substantially throughout its length, but in addition has a slight curvature longitudinally such that a straight line shown in FIG. 12 is tangent to only a portion of the outer surface of the base 41 of the strut 40. In other words, the line of thrust or axis of each strut from apex to apex lies within the strut.

FIG. 18 is a perspective view showing the manner in which a plurality of trusses can be positioned to form a floor which has an opening therein for a stairway or the like. In this form, trusses 45, 46, 47 are positioned such that the end of the truss 46 is spaced lonitudinally from the ends of the trusses 45, 47. A header 48 of metal is made from a channel by cutting the flanges of the channel bending the channel as at 49, 50. The end of truss 45 is telescoped in the portion 49*a*, the end of the truss 46 is telescoped into the end of the portion 49*b*, and the end of the truss 47 is telescoped into the portion 49*c*.

Referring to FIG. 19, a truss 51 embodying the invention can be used to form a roof by cutting the flanges of the channels 35, 36 as at 52, 53 (FIG. 21) so that the portion 36*a* of channel 36 can be bent upwardly at 53 permitting a gable to be defined as shown in FIG. 19. Alternatively, as shown in FIG. 28, the bottom channel 36 can be bent as at 54*b* to define angle portions 36*c* and a horizontal portion 36*d*, the latter engaging a horizontal beam 90.

The ends of such trusses 51 can also be formed to define the edge of a roof and the underlying structure similarly by cutting the flanges and bending as at 53*a*, 54*a* to define a vertical leg portion 55 and cutting the flanges and bending as at 56, 57 to bring the portions 36*b* into abutment and define a horizontal underlying portion 58.

Alternatively, to form the gable and roof edge, instead of slitting the channels 35, 36 as at 52, 53, notches 59, 60 can be provided as shown in FIG. 22.

Where the truss is to be supported in a building at places such that a concentrated load is applied to the channel at an area other than an area at which an apex of the undulating member 40 is positioned, a brace member 65 of sheet metal comprising a base 66 and side walls 67 is provided (FIG. 17). Each side wall 67 is triangular in shape and includes side edges 68, 69, a base 70 and a truncated apex 71. The configuration of each side wall 67 is preferably that of an isosceles triangle. The distance between the base 70 and the apex 71 is preferably slightly greater than the distance between the inside surface of an apex of the undulating member 40 and the opposite inside surface of the base of the channel member so that the brace can be frictionally positioned as shown in FIGS. 23–27.

In the form of the invention shown in FIG. 23, a load bearing wall 75 applies a load intermediate the apices 76, 77 tending to bend the portion of the channel 78. The brace member 65 is positioned with the base 70 contacting the inner surface of the channel portion 78 and the apex engaging the inner surface of the apex 79 thereby reinforcing the truss.

In the form of the invention shown in FIG. 24, the beam 80 on which the truss is positioned engages an intermediate portion 81 of the lower channel tending to bend the channel. Accordingly, the brace 65 is positioned with the apex 71 engaging the apex 82 along the upper channel and the base engaging the base of the portion 81 of the lower channel.

In the form of the invention shown in FIG. 25, an end closure for the truss is provided by notching as at 85*a*, 85*b*, and bending the portions 86, 87 toward one another.

If a load is expected at the extreme end of the truss, a brace **65** can be provided. In this eventuality, the notches **85***a*, **85***b* are so interrelated that the apex of the isosceles triangle is spaced from the bend line in order that the base **70** lies in full contact with the inner surface of the lowermost channel (FIG. **26**).

Where the truss terminates at a position where the upper channel is not supported by an apex adjacent its end, the brace is reversed as shown in FIG. **27** to provide proper support for the load bearing wall.

In order to assure ease of placement of the brace member **65**, the free corners **65***a* are bent inwardly thereby avoiding any sharp edges from cutting into the channels.

I claim:

1. The combination comprising an undulating member comprising a strip of substantially uniformly thick material having a greater width than thickness,

said undulating member comprising alternating first and second apices connected by legs,

the first apices of said undulating member being bonded to said first channel,

a second channel comprising a base and spaced side walls,

the second apices of said undulating member being bonded to said second channel,

the walls of one of said channels are cut substantially throughout their widths adjacent an apex and the walls of the other of said channels are cut substantially throughout their widths intermediate a pair of apices opposed to said apex of said one channel, the bases of each said channel being bent inwardly at said cut portions.

2. The combination comprising an undulating member comprising a strip of substantially uniformly thick material having a greater width than thickness,

said undulating member comprising alternating first and second apices connected by legs,

the first apices of said undulating member being bonded to said first channel,

a second channel comprising a base and spaced side walls,

the second apices of said undulating member being bonded to said second channel,

the walls of one of said channels are cut substantially throughout their widths at an apex and the walls of the other of said channels are cut substantially throughout their widths intermediate a pair of apices opposed to said apex of said one channel, said base of said one channel being bent outwardly and said base of said other channel being bent inwardly at said cut portions to form a gable.

3. The combination comprising an undulating member comprising a strip of substantially uniformly thick material having a greater width than thickness,

said undulating member comprising alternating first and second apices connected by legs,

the first apices of said undulating member being bonded to said first channel,

a second channel comprising a base and spaced side walls,

the second apices of said undulating member being bonded to said second channel,

the walls of one of said channels are cut substantially throughout their widths at an apex and the walls of the other of said channels are cut substantially throughout their widths at longitudinally spaced points along a length of said channel between a pair of apices opposed to said apex of said one channel, said base of said one channel being bent outwardly and said base of said other channel being bent inwardly at said cut portions to form a gable.

4. The combination comprising an undulating member comprising a strip of substantially uniformly thick material having a greater width than thickness,

said undulating member comprising alternating first and second apices connected by legs,

the first apices of said undulating member being bonded to said first channel,

a second channel comprising a base and spaced side walls,

the second apices of said undulating member being bonded to said second channel,

the base of one of said channels is cut at longitudinally spaces apices and the walls of the other of said channels are cut substantially throughout their widths at longitudinally spaced points intermediate successive pairs of apices and the base of said one channel is bent outwardly at said cut portions and the base of said other channel is bent inwardly at said cut portions to form an underlying portion of a roof.

5. The combination comprising an undulating member comprising a strip of substantially uniformly thick material having a greater width than thickness,

said undulating member comprising alternating first and second apices connected by legs,

each apex comprising a substantially single line extending at a right angle to a plane containing the axes of said legs,

each said leg being substantially imperforate and having a generally U-shaped cross section which is symmetrical about the plane containing the axes of said legs,

the U-shaped cross section of each said leg comprising a transversely curved base that progressively increases in width from the center of the leg toward each said apex,

the base of each said leg being also curved outwardly longitudinally of said leg,

the cross section of each said leg comprising walls that decrease progressively in height from the center of the leg to each said apex,

the free edge of each said wall being curved outwardly longitudinally of said leg

said walls and said base of each said leg merging gradually through a curved area of juncture such that the thickness of the material comprising said undulating member is substantially constant throughout the base, legs and area of juncture,

a first channel comprising a base and spaced side walls,

the first apices of said undulating member being bonded to said first channel,

a second channel parallel to said first channel comprising a base and spaced side walls,

the second apices of said undulating member being bonded to said second channel.

6. The combination set forth in claim **5** wherein said undulating member and said channels are made of metal and are welded to one another at the apices of said undulating member.

7. The combination set forth in claim 5 wherein said side walls of one said channel extend toward the side walls of the other said channel.

8. The combination set forth in claim 5 including a header having a channel shaped cross section with longitudinally spaced angularly related portions, a plurality of said truss members, at least one truss member having the channels thereof extending into a respective channel portion of the header.

9. The combination set forth in claim 5 wherein the base of each said strut is substantially equal in width to the height of the walls of each said strut.

10. The combination set forth in claim 5 wherein the walls of one of said channels are cut substantially throughout their widths adjacent an apex and the walls of the other of said channels are cut substantially throughout their widths intermediate a pair of apices opposed to said apex of said one channel, the bases of each said channel being bent inwardly at said cut portions.

11. The combination set forth in claim 5 wherein the walls of one of said channels are cut substantially throughout their widths at an apex and the walls of the other of said channels are cut substantially throughout their widths intermediate a pair of apices opposed to said apex of said one channel, said base of said one channel being bent outwardly and said base of said other channel being bent inwardly at said cut portions to form a gable.

12. The combination set forth in claim 5 wherein the walls of one of said channals are cut substantially throughout their widths at an apex and the walls of the other of said channels are cut substantially throughout their widths at longitudinally spaced points along a length of said channel between a pair of apices opposed to said apex of said one channel, said base of said one channel being bent outwardly and said base of said other channel being bent inwardly at said cut portions to form a gable.

13. The combination set forth in claim 5 wherein the base of one of said channels is cut at longitudinally spaced apices and the walls of the other of said channels are cut substantially throughout their widths at longitudinally spaced points intermediate successive pairs of apices and the base of said one channel is bent outwardly at said cut portions and the base of said other channel is bent inwardly at said cut portions to form an underlying portion of a roof.

14. The combination set forth in claim 5 including a plurality of said channel and truss members and a sheet member bonded to one set of said channels.

15. The combination set forth in claim 14 including a second sheet member bonded to said other channel members.

16. The combination set forth in claim 15 including a relatively rigid sheet bonded to one of said sheets.

17. The combination set forth in claim 5 including a reinforcing member extending between an apex of said undulating member and an opposite one of said first and second channels.

18. The combination set forth in claim 17 wherein said reinforcing member comprises a U-shaped transverse cross section including a base and side walls.

19. The combination set forth in claim 18 wherein the side walls have a triangular configuration.

20. The combination set forth in claim 19 wherein said triangle comprises an isosceles triangle.

21. The combination comprising an undulating member comprising a strip of substantially uniformly thick material having a greater width than thickness,

said undulating member comprising alternating first and second apices connected by legs,

the first apices of said undulating member being bonded to said first channel,

a second channel comprising a base and spaced side walls,

the second apices of said undulating member being bonded to said second channel,

a reinforcing member extending between an apex of said undulating member and an opposite one of said first and second channels.

22. The combination set forth in claim 21 wherein said reinforcing member comprises a U-shaped transverse cross section including a base and side walls.

23. The combination set forth in claim 22 wherein the side walls have a triangular configuration.

24. The combination set forth in claim 23 wherein said triangle comprises an isosceles triangle.

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