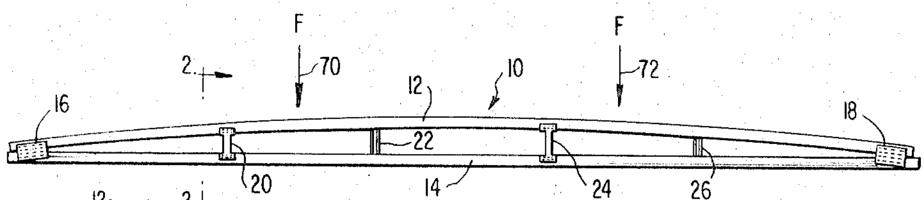
Jan. 17, 1967 J. C. JUREIT 3,298,151

TRUSS WITH MULTI-TOOTH CONNECTOR

Filed Sept. 16, 1964

FIG. 1



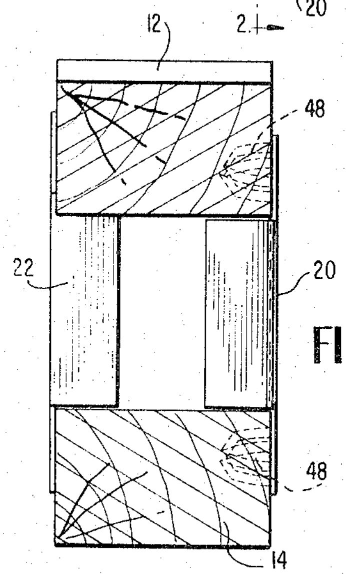


FIG. 2

FIG. 3

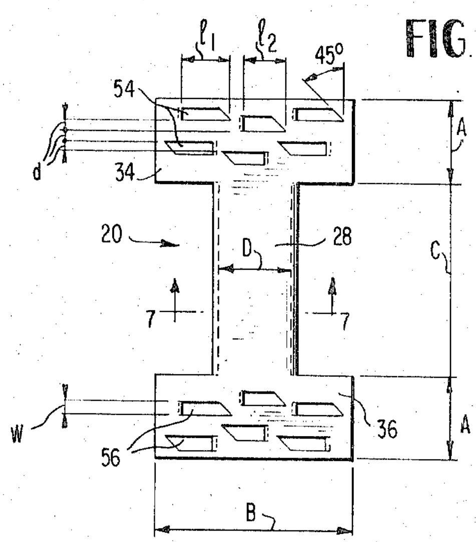


FIG. 4

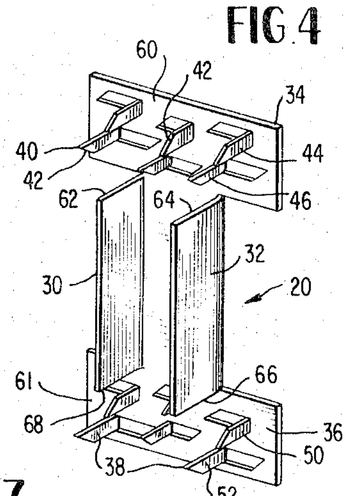


FIG. 5

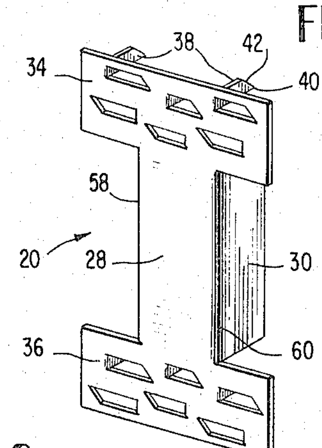


FIG. 7

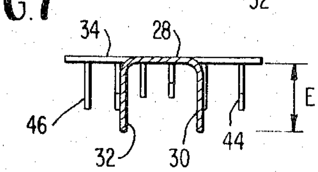
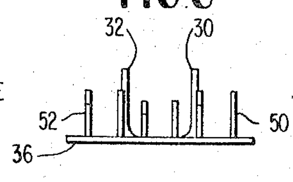


FIG. 6



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TRUSS WITH MULTI-TOOTH CONNECTOR

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This invention relates to metal lumber connectors and more particularly to a novel bowstring truss and spacer connectors used in forming the truss.

In mobile homes and in other light-framing installations builders sometimes use a ceiling supporting structure referred to as a bowstring truss. This truss consists of two elongated structural wood elements referred to as the upper and lower chords which are joined at their ends but are separated midway of their ends by one or more transverse elements in the nature of spacing webs or struts. The chords are unitary pieces of wood several feet in length with the lower chord substantially straight or having only a slight camber while the upper chord is bent or arched between its ends so that its center point midway between the ends of the truss is spaced several inches from the lower chord. The upper chord is prestressed into the arcuate or bent position and this curved shape is maintained by the previously mentioned intermediate webs.

In constructions of this type the loads to which the truss is subjected are relatively small as compared to those to which the heavier construction of a larger, permanent home or an office building is subjected, and economy is usually an all-important factor in mobile home construction. In the past, difficulty has been experienced in maintaining proper curvature in a bowstring truss and no completely satisfactory low-cost method has been found to provide adequate strength in the truss which is necessarily formed from relatively light weight structural load supporting members.

In the prefabricated construction of bowstring trusses with a conventional nailing technique the utilization of lap joints for the intermediate web members results in a structure lacking a coplaner configuration since the overlapping web members necessarily lie outside the plane of the upper and lower chords. This increases the costs of handling and shipping the trusses. On the other hand, the provision of butt joints for the spacing webs necessitates trimming at least one end of each web so as to match the curvature of the abutting chord in order to obtain a rigid, strong and tight-fitting nailed joint between the intermediate web and the respective chord. Furthermore, in this latter type of construction the nails must be driven into the ends of the webs either at an angle or completely through the chord, which not only increases the cost of manufacture but also increases the chances of wood splitting and the accompanying weakening of the over-all truss structure.

The present invention avoids the above-mentioned difficulties by providing a prefabricated bowstring truss joined by a plurality of relatively flat connector plates carrying integral teeth which are driven or pressed into the chord members on one or both sides of the truss. The flattened plates not only preserve the over-all coplaner configuration of the upper and lower chord members of the truss but substantially increase its strength and rigidity so as to make it more resistant not only to direct vertical loads but also to bending and twisting as a result of the application of a torsion load to the truss. An important feature of the present invention includes the incorporation of channels defining integral spacer flanges on the intermediate truss connectors, which in addition to strengthening the truss help to accurately position and maintain the curvature of the upper chord during the various stages of truss fabrication.

It is therefore one object of the present invention to provide a novel load bearing truss structure.

Another object of the present invention is to provide a novel bowstring truss.

Another object of the present invention is to provide a truss construction particularly suited for use in mobile homes.

Another object of the present invention is to provide a truss structure of relatively light-weight load-bearing materials having increased resistance to both direct and torsional loads.

Another object if the present invention is to provide a novel intermediate connector plate for trusses.

Another object of the present invention is to provide a connector plate for trusses having integral load-bearing and chord-spacing flanges.

Another object of the present invention is to provide a novel channeled connector plate having integral scarfed teeth formed therein and provided with intermediate bent-over portions or flanges, which act to separate the spaced chords of a bowstring truss.

These and further objects and advantages of the invention will be more apparent upon reference to the following specification, claims, and appended drawings wherein:

FIGURE 1 is an elevational view of a bowstring truss constructed in accordance with the present invention.

FIGURE 2 is a vertical cross-section through the truss taken along line 2—2 of FIGURE 1.

FIGURE 3 is an elevational view of one of the intermediate connectors of the truss of FIGURE 1.

FIGURE 4 is a perspective view of the rear side of the connector of FIGURE 3.

FIGURE 5 is a corresponding perspective view showing the front or punch surface of the connector of FIGURE 3.

FIGURE 6 is an end view of the connector of FIGURE 3; and

FIGURE 7 is a cross-section through the intermediate connector taken along line 7—7 of FIGURE 3.

Referring to the drawings, the novel bowstring truss of the present invention generally indicated at **10** in FIGURE 1 comprises an upper chord **12** and a lower chord **14** joined at the ends on one or both sides by flat connector plates such as are indicated at **16** and **18**. Plates **16** and **18** and the corresponding plates on the other side of the truss, if used, are flat, rectangular strips of galvanized sheet metal having integral teeth punched therefrom and may take the form of the plates disclosed in U.S. Patent No. 2,877,520 or the form disclosed in copending application Serial No. 293,949, filed July 10, 1963.

Upper chord **12** is an integral elongated piece of lumber of several feet and is provided with a substantial curvature at the center so as to define a spacing between the chords **12** and **14** of several inches. Lower chord **14** will ordinarily have some slight camber but this is small relative to the curvature of the upper chord **12** and for the sake of clarity lower chord **14** is illustrated in the drawings as substantially horizontal and straight. Joining the upper chord **12** to the lower chord **14** at spaced points along the lengths of the chords are a plurality of intermediate connectors **20**, **22**, **24** and **26**. The details of connector **20** are shown in FIGURES 3–7 and the other connectors are of similar construction, the only difference being the length of the central adjoining web or channel of the connectors.

Each connector comprises an elongated central channel **28** having a substantially U-shaped cross-section to define a pair of spaced flanges **30** and **32** with the connector terminating at each end in the flat rectangular plates 34 and 36. Punched out from the plates so as to extend vertically therefrom are a plurality of slender elongated teeth 38 adapted to be driven into the chord members 12 and 14 in the manner illustrated in FIGURE 2. Each tooth is slender and nail-like in appearance and has a length at least six times the thickness of the connector. The teeth are all provided with scarfed points 40 formed by the flat beveled end surfaces 42 such that the beveled edges 42 of the teeth in adjacent rows such as rows 44 and 46 in FIGURE 4 face outwardly away from each other. When driven into the web members by a punch press or the like the reaction force of the wood bearing on the flat beveled surfaces 42 cause the teeth to deflect or bend over in the manner illustrated at 48 in FIGURE 2 to produce a tight gripping or clenching action which increases the withdrawal resistance of the teeth.

Each of the connectors is preferably formed from an originally flat rectangular sheet of mild steel stock, either plain or galvanized, having an over-all width or dimension B in FIGURE 3 of 1½ inches. In the preferred embodiment the sheet stock is of 20-gauge galvanized steel (U.S. Standard gauge) having a minimum thickness of .0382 inch and a maximum thickness of .0425 inch. In this embodiment the dimension A in FIGURE 3 is ⅝ of an inch, which dimension remains the same irrespective of the length of the connector. The only thing that varies in size is the length of the channel 28 and the various channel lengths currently manufactured are 1⅜ inches, 2 inches, 2⅝ inches, 3¼ inches, 3⅞ inches and 4½ inches. Thus suitable connector lengths are available for positioning the connectors at any desired position along almost any sized bowstring truss.

The original flat rectangular blank is subjected to a stamping treatment in which the flanges 30 and 32 are punched out and folded over into the generally U-shaped position illustrated. During the punching operation the teeth 38 are also punched out to form the two rows of teeth 44 and 46 in the top plate 34 and the similar two rows of teeth 50 and 52 in the bottom plate 36. The teeth are punched out to leave the corresponding slots 54 in the top plate and 56 in the bottom plate.

In the preferred embodiment previously mentioned, the angle of the scarf point of each of the teeth is forty-five degrees as illustrated by the corresponding slot 54 in FIGURE 3. The perpendicular distance of the flanges 30 and 32 from the base of the channel 28 (dimension E in FIGURE 7) is preferably a minimum of .510 inch and a maximum of .540 inch and the channel is provided with radii at junctures 58 and 60 having a radius of curvature of from .020 to .030 inch. The width of each tooth illustrated by the dimension W in FIGURE 3 is preferably $\frac{1}{10}$ of an inch. The interior channel width (dimension D in FIGURE 3) is .550 inch.

As previously mentioned, each of the plates 34 and 36 is provided with two rows of three teeth each defining as a total six teeth for each of the end plates of the connector. However, in order to provide adequate strength across these plates, the center tooth of each row is preferably slightly shorter than the two end teeth and furthermore is slightly offset from the center line of the row as best seen in FIGURE 3. The outside teeth, that is the end teeth in each row, have an over-all length of .350 inch as measured from the adjacent or back surface 60 and 61 of the end plates while the middle or offset teeth of each row have an over-all length of .312 inch from this same surface. The center teeth of each row have their center lines offset from a center line passing through the end teeth, that is, are offset by the distances *d* indicated in FIGURE 3 of .062 inch. This difference in tooth length and offset position of the center teeth are provided so as to insure a sufficient net section of metal in the end plates so as to provide adequate resistance to forces exerted on the truss. Other important features determining the dimensions and locations involve the provisions of enough metal to make practical the fabrication of the teeth in the punch die, the necessity of getting enough working space in the die, and locating the teeth so as to avoid any likelihood of splitting the lumber when they are pressed or otherwise driven into the truss chords.

In assembly the top and bottom chords 12 and 14 may be laid out on a table and positioned in a bow truss configuration by suitable clamps. The end connector plates 16 and 18 may then be driven into one or both sides of the truss to form the end of the joints and, if desired, the intermediate connectors 20, 22, 24 and 26 may be simultaneously driven into position. As an alternative, separate pressing operations may be applied at each connector location with preferably the end connectors 16 and 18 first driven into the wood and then the intermediate connectors. The web channels formed by the flanges 30 and 32 help to position the bowed chord elements and after assembly the prestressing forces of the chords may act against the flange edges 62, 64, 66 and 68 to hold the accurate bowed position of the truss and greatly aid in the resistance of not only direct forces such as the vertical forces 70 and 72 illustrated in FIGURE 1 but when located on both sides of the truss greatly aid in the resistance of the truss to torsion or twisting forces which might otherwise tend to damage or pull the connector plates out of the wood.

It is apparent from the above that the present invention provides a novel bowstring truss particularly suited for light framing such as is found in mobile-home construction and also a novel intermediate connector construction provided with a channeled web having flange edges acting against the spaced chords of the truss thus imparting substantially increased strength to the truss. Trusses of the type herein disclosed have been tested for failure and have been found to withstand substantially increased loads. For example, 12-foot trusses of the type illustrated in FIGURE 1 have withstood loads of over 50 pounds per square foot, failing at a load of approximately 700 pounds per truss, while similar 10-foot trusses have withstood loads of over 80 pounds per square foot with failure occurring at approximately 1,000 pounds per truss. Thus it is seen that a structure of high strength and rigidity is provided through the use of relatively thin, inexpensive and economically manufactured connector elements of novel construction. While significally improving the resistance of the truss to both direct and torsional forces, the relatively flat nature of the plates preserves the over-all coplaner configuration of the truss, making it economical and easy to handle during shipping and during pre-assembly operations at the ultimate construction site. The truss is particularly adaptable to prefabrication techniques where the trusses are factory-assembled and the connectors driven into place by suitable presses.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A connector for spaced truss elements comprising an elongated flat strip of sheet metal having intermediate rectangular portions of its longer edges folded over to define a pair of spaced rectangular end plates joined by an integral channel member, two rows of three teeth each punched out of and extending perpendicular to each said end plate, said teeth having scarfed points defining flat tapered end surfaces with the tapered surfaces of teeth in adjacent rows facing away from each other, the teeth in each row of a plate leaving corresponding slots pointed toward the opposite longer edges of said strip, the center

tooth in each row being shorter than and offset from the remaining teeth in its row toward said channel member, the teeth in each row of an end plate alternating across the width of said strip in a direction perpendicular to the longitudinal axis of said channel member.

2. A connector according to claim 1 wherein said strip is 20 gauge.

3. A connector according to claim 1 wherein said teeth are slender and nail-like in appearance having a length at least six times the thickness of said plate.

4. A bow string truss comprising a lower chord, a bowed upper chord joined to said lower chord at each end by at least one flat connector plate, and a pair of intermediate connectors driven into opposite sides of said chords at spaced points along the length of said truss, said intermediate connectors each comprising an elongated flat strip of sheet metal having intermediate rectangular portions of its longer edges folded over to define a pair of spaced rectangular end plates joined by an integral channel member, two rows of three teeth each punched out of and extending perpendicular to each said end plate, the teeth of said end plates being driven into the respective chords and said flanges projecting into the space between said chords with the ends of said flanges bearing against said chords, said teeth having scarfed points defining flat tapered end surfaces with the tapered surfaces of teeth in adjacent rows facing away from each other, the teeth in each row of a plate leaving corresponding slots pointed toward the opposite longer edges of said strip, the center tooth in each row being shorter than and offset from the remaining teeth in its row toward said channel member, the teeth in each row of an end plate alternating across the width of said strip in a direction perpendicular to the longitudinal axis of said channel member.

5. A truss according to claim 4 wherein said teeth are scarfed at an angle of 45°.

6. A bow string truss comprising a single element lower chord, a single element bowed upper chord joined to said lower chord at each end by at least one flat connector plate and spaced from said lower chord intermediate its ends, at least two intermediate connectors driven into each side of said chords at spaced points along the length of said truss, said intermediate connectors extending substantially perpendicular to said lower chord and being driven into alternate sides of said chords along the length of said truss, said intermediate connectors each comprising a pair of flat end plates of steel of a thickness substantially no greater than 20-gauge steel, joined by an integral web, said web being folded over to define at least one rectangular flange having parallel upper and lower edges extending in a perpendicular direction from the web between said chords, said upper and lower edges of said rectangular flange abutting said upper and lower chords respectively, and a plurality of nail-like punched out teeth extending from each connector end plate substantially perpendicular thereto and embedded in said chords, said teeth being shorter than the perpendicular extension of said rectangular flange, the intermediate connectors nearer the center of said chords being longer than the intermediate connectors nearer the ends of said chords to define a symmetrical bow in said upper chord.

7. A bow string truss according to claim 6 wherein said teeth have bevelled edges adjacent their points.

8. A bow string truss according to claim 6 wherein the web length of the longest of said intermediate connectors is a maximum of 4½ inches.

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