Oct. 25, 1966 M. J. DUFFICY 3,281,168

TRUSS CONNECTOR PLATE

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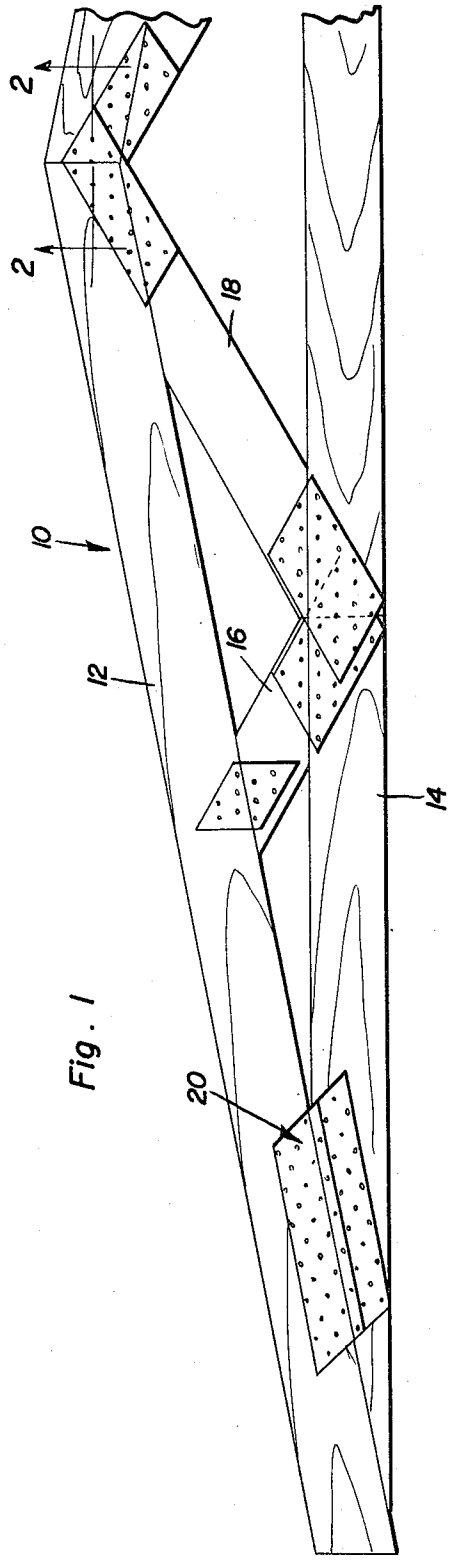


Fig. 1

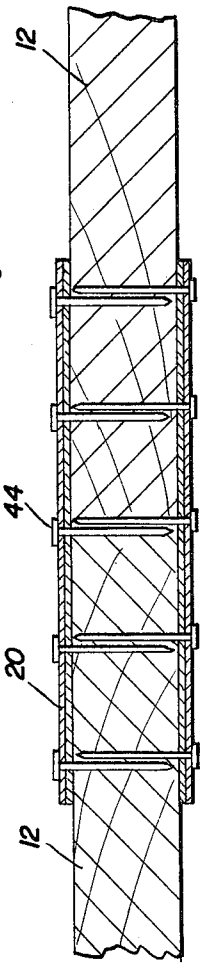


Fig. 2

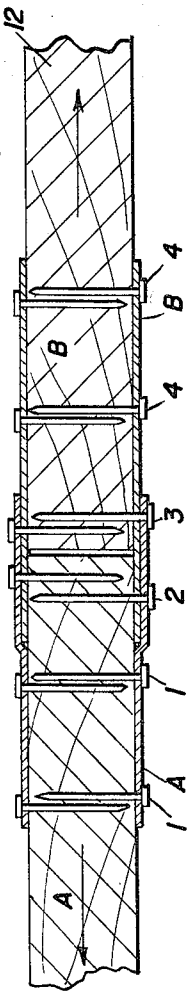


Fig. 3

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TRUSS CONNECTOR PLATE

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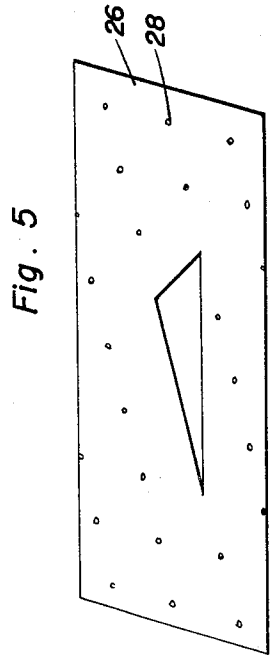


Fig. 5

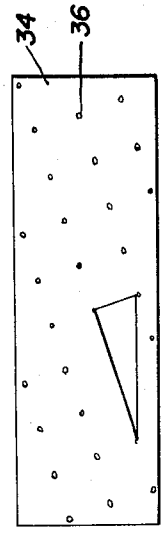


Fig. 7

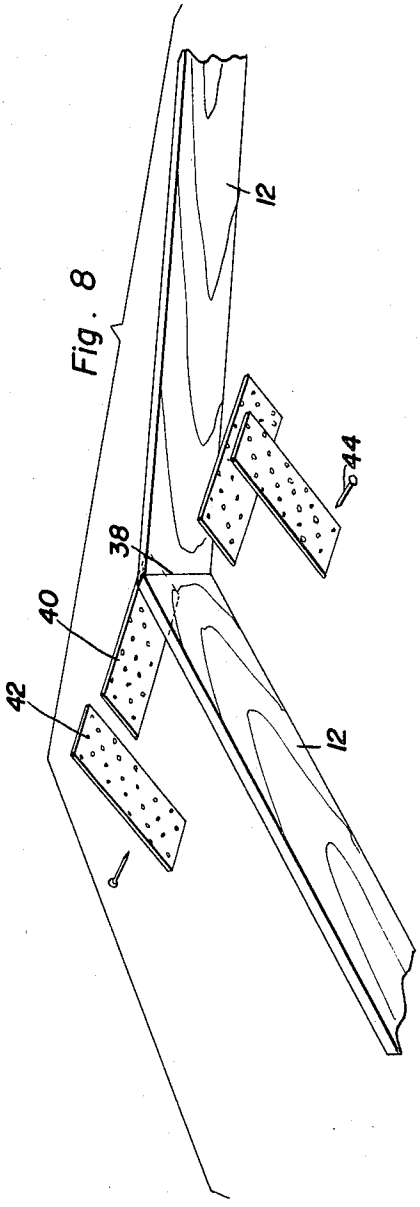


Fig. 8

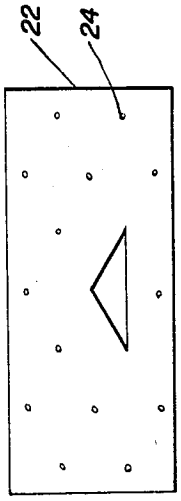


Fig. 4

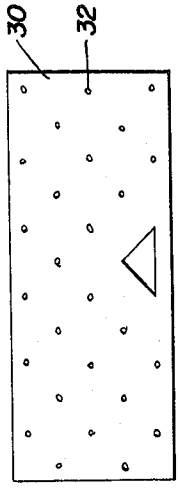


Fig. 6

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TRUSS CONNECTOR PLATE

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1 Claim. (Cl. 287—20.92)

The present invention generally relates to novel improvements in the construction of wood trusses and more particularly to a connector plate or plates for connecting the components of the wood truss having certain novel features especially adapted for use with connector plates having nail holes punched therein for attachment of the connector plates to the wood with nails but with certain of the features adapted for use in toothed plates, this is, plates having teeth struck out therefrom.

The essential object and point of novelty of the present invention is the particular pattern or layout of the nail holes punched in the plate whereby two of the plates may overlap each other so that the holes match in several angular positions of the plates. This feature enables the plates to be more precisely fitted to the angled members or in other words enables rotatability of the plates which will eliminate overhang of the plates in relation to the wood members.

The rotatability of the connector plates renders a spread joint configuration practical which will eliminate center line eccentricities where more than two members intersect. Rotatability also provides a double thickness of metal at the top and bottom chord joints where the stresses are greatest and a single thickness of metal on the web joint where the stresses are less thus providing a more balanced metal reinforcement and thus stiffening the joints.

Another of the advantages derived from the connector plate construction is the provision of overlapped plates at the point nearest the joint which is the point in which the nails are most likely to tear out of the wood. By providing an overlapped metal thickness at this point, to reduce failure due to nail tear out, the present invention will materially increase the strength of a truss.

For the purposes of the present invention, the nail hole pattern punched in the connector plate must form a regular or semi-regular tessellation such as one composed of congruent squares, equilateral triangle or other congruent polygons and combinations of congruent regular polygons.

Another object of the present invention is to provide a connector plate for connecting the components of a wood truss which is simple in construction, easy to install, effective for increasing the strength and rigidity of a wood truss and quite inexpensive to manufacture.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of a wood truss employing the connector plates of the present invention therein;

FIGURE 2 is a detailed sectional view taken substantially upon a plane passing along section line 2—2 of FIGURE 1 illustrating a balanced lapping of plates;

FIGURE 3 is a sectional view illustrating a joint with the plates partially overlapped such as may be used in the bottom chord of a truss;

FIGURE 4 is a plan view of a connector plate with one pattern of nail holes therein;

FIGURE 5 is a plan view of another connector plate;

FIGURE 6 is a plan view of another form of connector plate;

FIGURE 7 is a plan view of another type of connector plate; and

FIGURE 8 is a perspective exploded view of the connector plate assembly at the apex of the wood truss.

FIGURE 1 illustrates a truss construction generally designated by the numeral **10** which includes the usual top chord **12**, bottom chord **14**, web member **16** and web member **18** which terminates at its upper end under the apex of the truss. Interconnecting the components is a plurality of connector plates generally designated by the reference numeral **20** and having particular dimensions and orientation of nail holes as defined hereinafter.

FIGURE 4 illustrates one form of connector plate designated by the numeral **22** having a plurality of nail holes **24** punched therein which forms a regular triangular tessellation with the principal plate axis being parallel to the tessellation axis. When two of these plates are overlapped, the holes will match only in two angular positions of the overlapping plate in relation to the underlying plate even if the overlying plate is flipped over.

FIGURE 5 illustrates a connector plate **26** having the shape of a parallelogram having punched out nail holes **28** defining a regular triangular tessellation with the axis of the tessellation tilted to the principal longitudinal axis of the plate as indicated by the top line in the triangular diagram formed on the plate. With this construction, there are six matching positions of the nail holes by using the plates either in an erect or normal position or by flipping over one of the plates. The angles of the matched positions may be changed by changing the ratio of the angles of the diagrammatic triangle illustrated in FIGURE 5 which, of course, means changing the position of the nail holes.

FIGURE 6 illustrates a connector plate **30** having nail holes **32** therein which are arranged in a square pattern which may be considered regular rectangular or square tessellations with the axis of the tessellation parallel with the principal axis of the connector plate thus also providing two positions of matching holes with the angles being determined by the relation of the tessellation to the principal axis of the plate. The heavy triangles are provided simply to show the angular relationship between an axis of the tessellation and the edge of the plate. FIGURE 7 illustrates a connector plate **34** having nail holes **36** therein in which the square tessellation is disposed at a different angle from that in FIGURE 6 so that the angles of matching holes differ and which is an arrangement in which the matching holes are registered with each other when overlapping plates are in perpendicular relation or in alignment with each other.

FIGURE 8 illustrates the butt joint **38** between the ends of the upwardly inclined top chord **12** and the relationship of the pair of connector plates **40** and **42** on each surface thereof which is the same arrangement as illustrated in FIGURES 1–3.

Previously, connector plates have had punched holes or punched out pegs arranged in a random pattern although such patterns may be repetitious which eliminated any possible overlapping of the plates so that the nail holes would be aligned at more than one angular position. Thus, this invention provides connector plates having holes arranged at the intersections of the polygons of a regular or semi-regular tessellation such that when a plate is rotated upon another plate of identical tessellation, the connector holes match in more than one position relative to the principal axis of the plate. Also, the axes of the tessellation is in some cases tilted to the axes of the plate in the proportion of triangles formed by basic proportions of the tessellation so that spacing of the connector holes parallel and perpendicular to the plate axis may be varied without varying the figure of the tessellation. In order to provide this arrangement,

the tessellation must be composed of a basic polygon or polygon group in which intersection points to be matched lie upon the same concentric circles about the point of rotation and coincide at the same angle of rotation. The angles at which the plate axes intersect can then be varied by varying the angle between the plate axis and the axis along which the intersection points coincide and by using the plates directly superimposed or flipped and superimposed. Three regular tessellations may be employed in the form of regular polygons all exactly alike and meeting corner to corner such as equilateral triangular, square and regular hexagonal tessellations. Semi-regular tessellations are also usable and these are tessellations having two or more kinds of regular polygons fitted together corner to corner in such a way that the same polygons in the same cyclic order surround the vertex or point of intersection. For example, the arrangement may be varied about the vertex or point of intersection as long as the cycle remains the same in each plate. For example, around the vertex there may be a triangle, hexagon, triangle, hexagon; octagon, octagon square; dodecagon, hexagon, square; hexagon, square, triangle, square; triangle, triangle, square, triangle, square; dodecagon, dodecagon, triangle; hexagon, triangle, triangle triangle, triangle. The foregoing listed seven semi-regular tessellations satisfy the requirements of the present invention and for purposes of description, the tesselation may be defined as the fitting of polygons together to cover a plane with no hiatus or overlapping of figures.

In order to obtain rotatability of the plates in relation to each other, it is absolutely necessary that the tessellations be regular or semi-regular. Further, the arrangement of the present invention enables the number of angular positions in which the holes match to be doubled by flipping an overlying plate in relation to an underlying plate. As illustrated in FIGURE 1, the rotatability of the plates enables them to be fitted more precisely to the angled members. Metal overhangs not stiffened by lumber backing tend to crumble and disengage the working portion of the connector plate as well as being wasteful. The feature of rotatability eliminates such overhangs. As illustrated in FIGURE 1, rotatability provides a double thickness of metal at the top and bottom chord joints where the stresses are greatest while it provides a single thickness of metal on the web joints where the stresses are less thus providing a more balanced metal reinforcing and thus stiffening the joints.

The nails designated as 44 nearest the joint which are most likely to tear out of the wood are the nails which insert through two thicknesses of metal and this definitely has certain advantages. Another feature of the invention enables that each plate used in lapped joint assemblies have more nails into the wood member on one side of the joint than into the wood member on the other side of the joint. However, FIGURE 2 illustrates a balanced nailing pattern and tension on both of the top chords tend to cause the nail heads to move towards the point of juncture relative to the wood members. Also, it is impossible to predict, at failure, which of the chord members will retain the plates attached thereto.

FIGURE 3 shows the unbalanced nailing arrangement which is an important feature of the present invention which is accomplished by the connector plate. In this assembly plate A will pull nail heads 2 and 3 to the left, plate B will pull nail heads 2 and 3 to the right thus resulting in a preponderate tendency for nail heads 2 and 3 to remain stationary which is very important in connection with the nail type wood joint strength. Since all joints tend to pull out in one direction, the balancing of the forces will materially reduce the pull out or tear out tendency of the nails.

In further explanation of the reason for the increased strength of the joint illustrated in FIGURE 3, it is pointed out that the plates A are committed to the left hand member inasmuch as three nails driven through each of

the plates A are driven into the member to the left hand side which may be considered member A. The plates B on the other hand are committed to the member B inasmuch as three of the nails driven through the plates B are engaged with the member B. Thus, if outward tension is placed on members A and B, plates B will move with member B and plates A will move with member A. Normally, the single plates are uncommitted, that is, they will go with either of the members unless an unbalanced nailing situation is provided. In either event, when single plates are used or when completely overlapped plates are used, the only force which resists outward movement is the wood material and when the wood material fails and the nails tear out, the joint is thus rendered useless. In actual practice, a joint is considered to have failed when the members A and B have moved apart a distance of .015 inch. However, in the device of FIGURE 3, in order for plates A to move relative to plates B, it is necessary that either the plate B through which the nail 3 extends be ruptured or the nail itself be ruptured in shear. Nail 2 would also have to be ruptured or the area in which nail 2 extends through plate B would have to be ruptured or failed in order for plate A to move outwardly in relation to plate B. Conversely, when plate B moves outwardly in relation to plate A, nails 2 and 3 would either have to be ruptured in shear or the area of plate A through which nails 2 and 3 extend would have to be ruptured. This evidently will materially increase the strength of the wood inasmuch as the metal plates would have to fail rather than the wood in order for the members A and B to move outwardly.

The strength increase feature is used in joints between chord members and not in joints between web members and chord members since the stresses between chord members are high while the stresses in web members are low.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

In a truss assembly, a joint between two abutting wood members comprising a first metal plate having a major portion engaged with a first one of the wood members and secured thereto and a minor portion secured to the second of the wood members, a second plate secured to the second of the wood members by a major portion thereof and the minor portion secured to the first of the wood members, each of said plates having a principal longitudinal axis, said plates having their minor portions in overlapping relation, said plates each having a plurality of nail holes preformed therein, said nail holes located at the vertices of polygons which form a regular or semi-regular tessellation whereby the holes in the plates will align with each other at a plurality of angular positions as one plate is rotated in relation to the other, said tessellation having axes in an acute angular relation to the principal axis of the plates and the angle of the plates in which the holes match being varied by the angular relation between the axes of the tessellation and the principal axis of the plates, and nails having a cross-sectional area generally approximating the area of the preformed holes extended through the preformed holes into the wood members whereby relative movement of the plates will cause shear of the nails or rupture of the overlapping minor portions of the plates through which they extend thereby materially increasing the strength of the joint, each of the plates having two or more of said nails extending solely through the major portion of the plate, and each of the plates having two or more of said nails extending through the overlapping minor portions

thereof with these nails being generally symmetrically disposed on opposite sides of the joint between the wood members.

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