

Sept. 24, 1963

A. C. SANFORD

3,104,429

DOUBLE TOOTH CONNECTOR PLATE

Filed Sept. 30, 1959

5 Sheets-Sheet 1

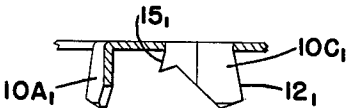
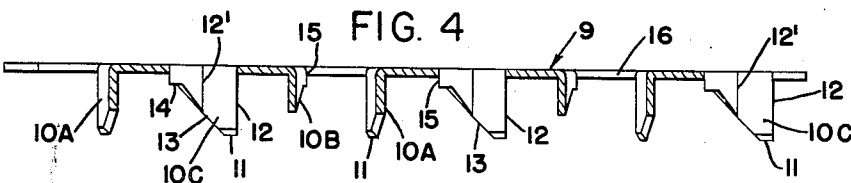
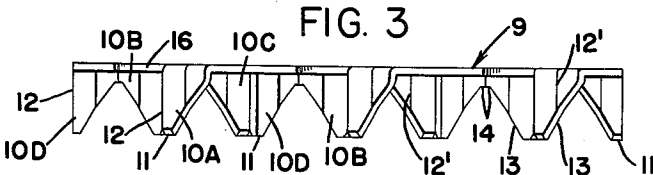
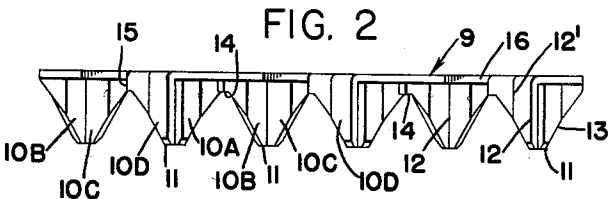
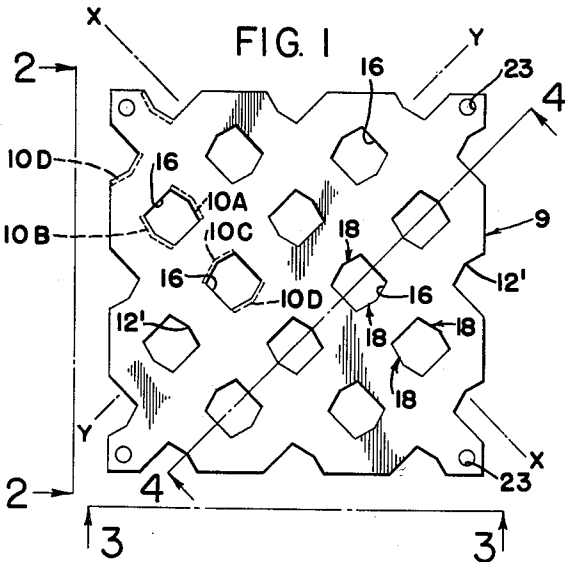


FIG. 4a

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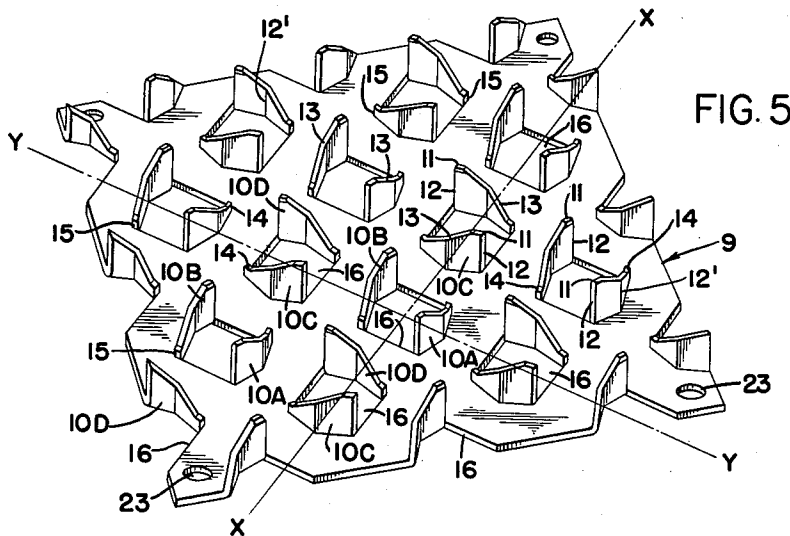


FIG. 5

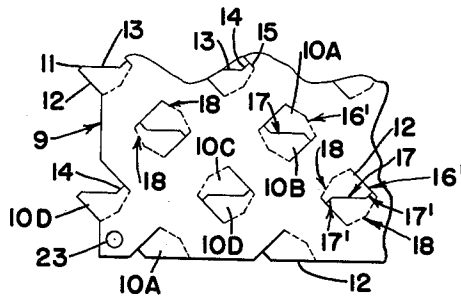


FIG. 6

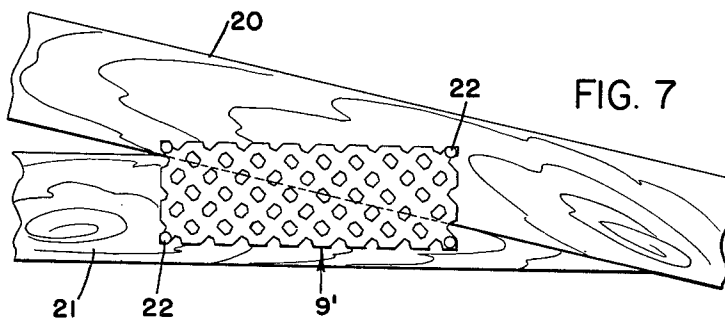


FIG. 7

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FIG. 9

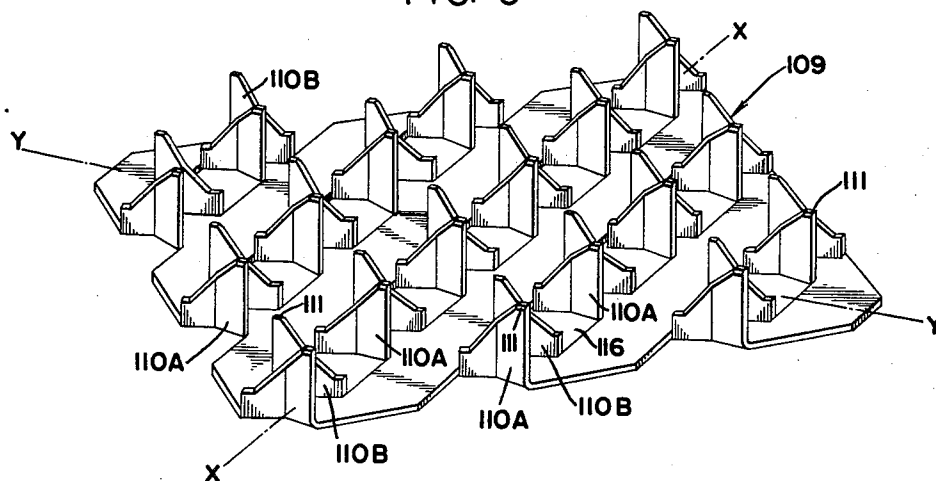
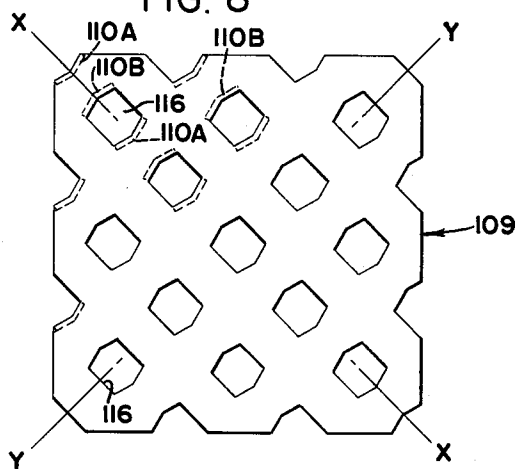


FIG. 8



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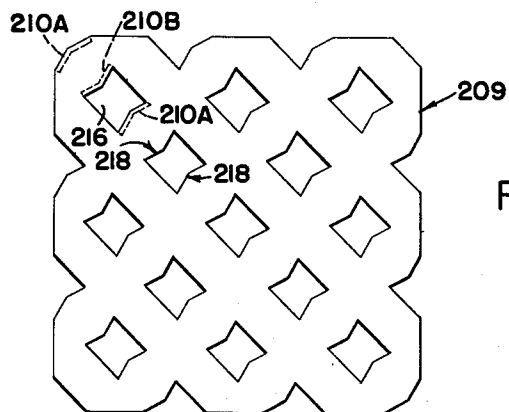


FIG. 10

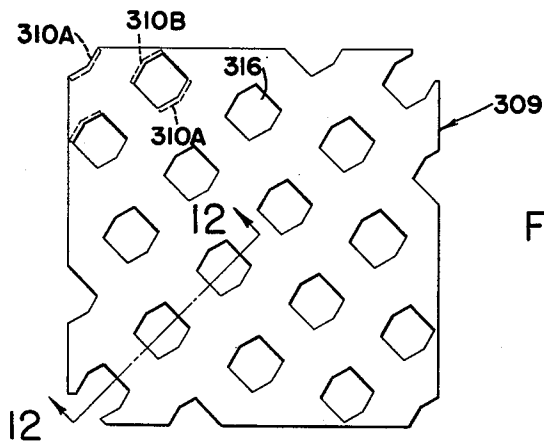


FIG. 11

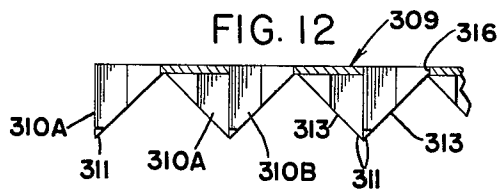


FIG. 12

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FIG. 13

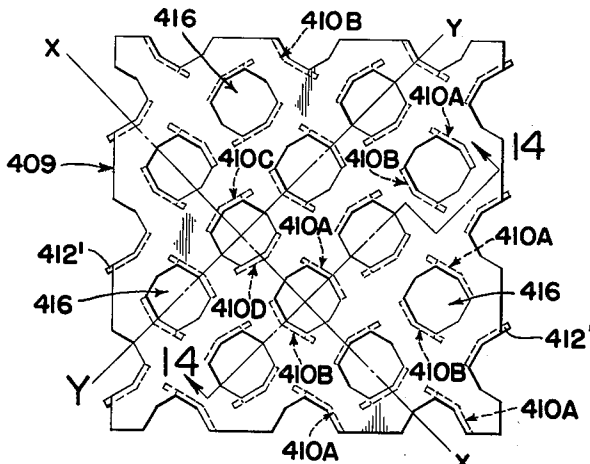


FIG. 14

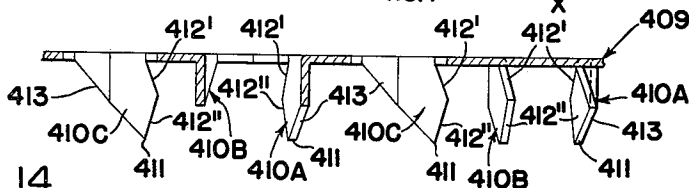
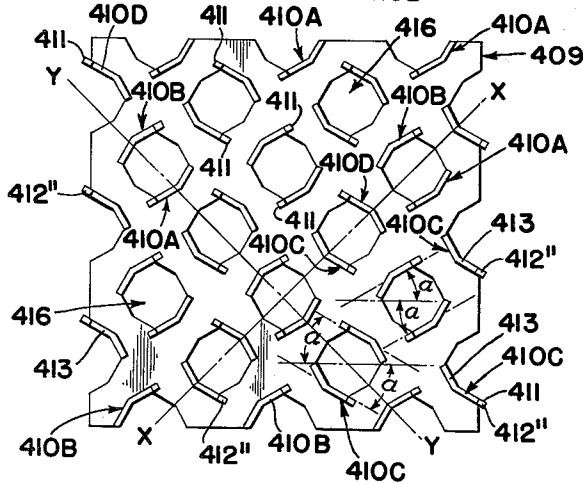


FIG. 15



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3,104,429

DOUBLE TOOTH CONNECTOR PLATE

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4 Claims. (Cl. 20—92)

The invention relates generally to connector plates for connecting wood members together at a joint and more particularly to connector plates having a plurality of punched out teeth which are pressed into the wood. This application is a continuation-in-part of my copending application Serial No. 793,491, filed February 16, 1959 and now abandoned.

This type of plate is particularly adapted for connecting coplanar wood truss members at the joints thereof, and one prior embodiment for this purpose is disclosed in my Patent No. 2,827,676, issued March 25, 1958. The present improved construction is also adapted for use as a truss connector plate, as well as for connecting the joints of various other wood structures.

It was pointed out in said patent No. 2,827,676 that by having a multiplicity of teeth embedded into the wood members at a joint therebetween, the stresses transmitted through the joint are uniformly resisted throughout the plate by the teeth in shear, and the strength of the plate in tension or compression is equal to the aggregate shear strength of the teeth. However, tension and compression forces tend to cause the plate to buckle and pull out the teeth before the aggregate shear strength of the teeth is reached. Obviously, increasing the number of teeth would increase the holding power of the plate, but the spacing of the teeth should not be so close as to cut off the wood fibers at too close intervals and weaken the wood members.

The purpose of the present invention is to provide an improved toothed plate having adequate plate strength with an increased number of teeth per unit area, which increases the aggregate shear strength of the teeth as well as their aggregate holding power.

A further object is to improve the design and arrangement of the teeth so that they can be punched out in pairs, the individual teeth of which cooperate to provide increased holding power in the wood in which they are embedded.

Another object is to provide an improved plate having individual teeth of novel design to give maximum holding power.

A still further object is to provide an improved plate having teeth terminating in the edges of the plate.

These and other objects are accomplished by the improved connector plate of the present invention, preferred embodiments of which are shown by way of example in the accompanying drawings and described in detail in the following specification. Various modifications and changes in details may be made within the scope of the appended claims.

In the drawings:

FIG. 1 is a top plan view of one embodiment of the novel plate of the invention.

FIG. 2 is an enlarged end elevation thereof as on line 2—2 of FIG. 1.

FIG. 3 is an enlarged front elevation thereof as on line 3—3 of FIG. 1.

FIG. 4 is an enlarged sectional view on line 4—4 parallel to one diagonal.

FIG. 4a is a similar view showing a slightly modified form of tooth.

FIG. 5 is an enlarged bottom perspective view thereof.

FIG. 6 is a fragmentary top plan view showing the

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manner of shearing and punching out pairs of teeth to form the plate of FIG. 1 from a blank.

FIG. 7 is a side elevation of the heel joint of a wood truss having an elongated plate according to the embodiment of FIGS. 1—5 applied thereto.

FIG. 8 is a plan view similar to FIG. 1 of another embodiment of the invention.

FIG. 9 is a bottom perspective view of the plate of FIG. 8.

FIG. 10 is a plan view of another embodiment in which the convex sides of each pair of teeth face each other.

FIG. 11 is a plan view similar to FIG. 1 of another embodiment in which the teeth are staggered relative to lines parallel to one diagonal.

FIG. 12 is an enlarged fragmentary sectional view on line 12—12 of FIG. 11.

FIG. 13 is a plan view of another embodiment of the novel plate in which the teeth are arranged similarly to those in FIG. 1, but the shape of the teeth and of the openings from which they are punched is slightly different.

FIG. 14 is an enlarged sectional view on line 14—14 of FIG. 13.

FIG. 15 is a bottom plan view.

The plate 9 shown in FIGS. 1—6 is square but may be shortened or elongated in either direction, as shown for example in FIG. 7. The plate is preferably sheet steel of about 20 gauge to give adequate strength to the teeth and to facilitate their penetration into and between the wood fibers. The steel plate is preferably galvanized or otherwise coated to be corrosion resistant.

The teeth 10A, 10B, 10C and 10D are identical except as to orientation, and are preferably substantially triangular with narrow points 11 at their outer ends or apices to facilitate penetration into the wood when pressure is applied to the plate with the teeth normal to the surface of the wood. As shown, each tooth is substantially a right angled triangle with one edge 12 substantially perpendicular to the plate 9 and terminating at its apex in the point 11, which may be termed a chisel point and is disposed at right angles to the edge 12. The other edge 13 is inclined at substantially 45° to edge 12 and extends from the chisel point 11 to a narrow shoulder 14 matching the chisel point in width and terminating at a short edge 15 substantially perpendicular to and connecting with the plate. In the punching and bending operation, the chisel points 11 are peened somewhat, which has the effect of sharpening the point.

As best shown in FIGS. 1 and 5, each tooth is transversely dishd or crimped at its central portion along a line 12' parallel to the edge 12. This dishd shape increases the rigidity and strength of the tooth in shear and bending, resisting forces imposed parallel to the plane of the plate.

The teeth 10A₁, 10C₁, shown in FIG. 4a are slightly modified in that their edges 12₁ and 15₁ are inclined away from each other instead of being perpendicular to the plate, giving the teeth a substantially dovetail shape which tends to increase its holding power when driven into the wood.

Referring to FIG. 6, the teeth are punched out of the plate in pairs 10A—10B and 10C—10D, each tooth being one-half of a substantially rectangular area indicated generally at 16', which becomes a substantially rectangular opening 16 in the plate 9.

During the punching operation the plate is sheared to form the four outer edges of the plate. As shown, the outer edges of the plate pass through the diagonals of the openings 16 along the outer edges of the plate.

Substantially along a diagonal of each area 16' is a zig-

zag shear line 17, the intermediate portion of which forms the inclined edges 13 of the two teeth punched out of that area. The short angular lines 17' at the ends of the shear line 17 form the chisel points 11 and the shoulders 14, respectively, of the two teeth at diagonally opposite corners of the rectangular area 16'. The bend lines 18, shown dotted in FIG. 6, are preferably slightly divergent to give the dished shape to the teeth and are angled away from each other in this embodiment to form the teeth with their dished or concave sides facing each other.

As seen in FIG. 1, the rectangular areas 16 are lined in one direction along 45° lines parallel to one diagonal of the plate, as represented by the line X—X. The areas 16 are also aligned along 45° lines parallel to the other diagonal as represented by the line Y—Y. Referring to FIG. 5, alternate areas along each of the lines X—X and Y—Y are turned 90° to the other areas 16 so that the pairs of teeth 10A and 10B formed from the alternate areas are substantially at right angles to the teeth 10C and 10D formed from the other areas 16. Since the vertical edges 12 of each pair of teeth 10A and 10B are at diagonally opposite corners of the opening 16, the points 11 of each pair of teeth 10A and 10B are laterally offset with respect to the line Y—Y and the points 11 of the teeth 10C and 10D are laterally offset with respect to the line X—X. The teeth 10C and 10D are bodily offset laterally of the lines Y—Y and the teeth 10A and 10B are bodily offset with respect to the lines X—X.

All of the teeth 10A, 10B, 10C and 10D are aligned in vertical and horizontal directions, the teeth 10A forming rows in both vertical and horizontal directions, the teeth 10B forming other rows in vertical and horizontal directions, etc. The arrangement and orientation of all of the teeth provide for substantially uniform spacing of the teeth and their points in all directions parallel to the plane of the plate. Along either of the 45° lines X—X or Y—Y, the points of the teeth are spaced from each other diagonally of the openings 16 and the substantially rectangular spaces therebetween. For example, along the line X—X the points of a pair of teeth 10A and 10B are at diagonally opposite corners of the opening 16 from which they are formed. The points of the next adjacent pair of teeth 10C and 10D along the line X—X are also at opposite corners of the opening 16 from which they were formed. The point of the tooth 10A is located at the corner of its opening 16 diagonally across from the point of tooth 10D formed from the next adjacent opening 16. Likewise, the point of the tooth 10B at the diagonally opposite corner of its opening 16 is located diagonally across from the point 11 of the tooth 10C of the next adjacent opening 16 in the other direction.

Accordingly, while the teeth are spaced apart along diagonal or 45° lines in both directions at intervals of about one tooth width, the points of the teeth are spaced apart a greater distance in all directions. For example, if the teeth are about $\frac{5}{16}$ inch wide and the openings 16 are about $\frac{5}{16}$ inch square, with the spaces between openings along 45° lines about $\frac{5}{16}$ inch, the points of the teeth in any direction will be spaced about $\frac{1}{2}$ inch apart while the points of the teeth 10A, 10B, 10C and 10D along their vertical and horizontal rows will be about 1 inch apart. This arrangement provides for facilitating entering the teeth into and between the fibers of the wood of connected members without materially weakening the fibers because the teeth are spaced apart at substantial intervals along the length of the fibers. At the same time, the arrangement wherein alternate pairs of teeth along the inclined lines are turned transversely to the other pairs provides for engaging the fibers in substantially all directions so that the full resistance of the fibers to tension and compression forces is realized.

By forming teeth along and intersecting with the edges of the plate, the holding power of the marginal teeth is utilized to anchor the outer edges of the plate securely in the wood members which it abuts.

The improved plate 9 is shown in FIGS. 1–5 as being square, but it may be elongated or shortened in either horizontal or vertical directions, as desired, while maintaining the same arrangement of teeth and shearing the horizontal and vertical edges along the diagonals of the openings 16 out of which the teeth are formed. In FIG. 7, for example, a heel joint of a wood truss is shown in which the upper chord 20 is connected to the lower chord 21 by an elongated plate 9' having its teeth embedded into the chords. Preferably, a similar plate would be applied to the opposite sides of the joint. This plate 9' is provided at its corners with stitching nails 22 such as nails having grooved or corrugated shanks, and these nails may be used to position the plates before the teeth are pressed into the wood. However, the holding power of the teeth is so much greater than the holding power of a plate of the same size constructed according to the embodiment disclosed in my prior Patent No. 2,827,676 that the use of stitching nails may not be necessary. Four holes 23 may be provided at the corners of the plate 9 to receive stitching nails if desired.

In operation, when the teeth of the improved connector plate are pressed into two abutting wood members, the large number of closely spaced teeth oriented in different directions provides for penetration into and between the wood fibers with a minimum amount of shearing or weakening of the fibers, with the result that maximum holding power is obtained, resisting forces tending to pull the teeth out of the wood when the joint is stressed.

This increased holding power is probably due in part to the fact that the edges 13 of each pair of teeth are inclined in opposite directions, so that when the plate is subjected to a force acting to buckle or distort the plate, thereby tending to pull the teeth from the wood, the two teeth of each pair tend to rotate in opposite directions, generating opposing forces which resist the pulling force. Moreover, the holding power of the plate as a whole is substantially improved because alternate pairs of teeth are oriented transversely of other pairs, and because all edges of the plate have teeth along and intersecting those edges where a plate under stress usually begins to pull away from the wood surfaces.

Referring to the plate 109 shown in FIGS. 8 and 9, in this embodiment the openings 116 from which the pairs of teeth are formed are aligned along diagonal or 45° lines in both directions but the pairs are all turned or oriented in the same direction rather than having alternate pairs turned transversely, as in the embodiment of FIGS. 1 to 5. The teeth 110A and 110B have the same substantially triangular shape as the teeth 10A, 10B, 10C and 10D, and the points 111 of each pair are at diagonally opposite corners of the openings from which they are formed. The points of the teeth 110A and 110B are laterally offset with respect to the inclined lines X—X and alternate teeth 110A and 110B are staggered along those lines.

All of the teeth 110A have their points aligned and all of the teeth 110B have their points aligned along lines parallel to X—X. Along 45° lines Y—Y at 90° to lines X—X, the teeth 110A form parallel rows in exact alignment and the teeth 110B also form parallel rows in exact alignment. The teeth 110A are also aligned along horizontal and vertical rows and teeth 110B are also aligned along horizontal and vertical rows.

The embodiment 209 shown in FIG. 10 shows an arrangement of teeth in which the pairs of teeth 210A and 210B are formed out of substantially rectangular openings 216 in the plate, and the openings are aligned along diagonal or 45° lines in both directions. The teeth 210A and 210B are all oriented or turned in the same direction, but in this embodiment the fold lines 218 at opposite sides of each opening are slightly inwardly convergent, so that when the teeth are bent out at right angles to the plane of the plate, the convex sides of each

pair 210A and 210B face each other, rather than the concave sides as in the plates 9 and 109.

Referring to the embodiment shown in FIGS. 11 and 12, the plate 309 has rectangular openings 316 from which pairs of teeth 310A and 310B are formed and the teeth of each pair have their concave sides facing each other as in the plates 9 and 109. In this embodiment, the teeth are all oriented or turned in the same direction. The rectangular openings 316 are aligned along 45° lines in one direction, as represented by the line 12—12, but along the inclined lines at 90° thereto alternate openings 316 are staggered laterally. As shown in FIG. 12, the teeth 310A and 310B can be formed as substantially exact right angled triangles so that the inclined sides 313 terminate in sharp points 311 rather than in chisel points. These points may be slightly peened in the punching and bending operation to have the effect of further sharpening. Obviously, the form of tooth shown in FIG. 12 can be substituted in the plates 9, 109 and 209.

In the embodiment of plate 409 shown in FIGS. 13—15, the substantially rectangular openings 416 are actually octagonal with a pair of teeth extending from opposite sides of each opening, alternate pairs of teeth 410A, 410B, and 410C, 410D along inclined lines X—X and Y—Y being turned 90° to each other. As shown, the teeth preferably have sharp points 411 which are diagonally opposite to each other so that the points of each pair 410A and 410B are laterally offset with respect to the lines Y—Y, and the points of each pair 410C and 410D are laterally offset with respect to lines X—X. The teeth 410C and 410D are bodily offset laterally of the lines Y—Y and the teeth 410A and 410B are bodily offset laterally of the lines X—X.

By making the openings 416 octagonal, the crimping of the teeth is facilitated when they are punched or bent out of the plate, because the crimping takes place at two opposite points of the octagonal opening. Furthermore, the octagonal opening provides each tooth with an undercut edge portion 412' along one projecting edge under its outer point 411 which substantially increases its holding power when embedded into the wood. The outer edge portion 412'' is at a flat or obtuse angle to the undercut portion 412', so that the tooth is still substantially a right-angled triangle. The other projecting edge 413 is generally inclined from the plate to the outer point 411.

Accordingly, the teeth of FIGS. 13—15 accomplish the same advantages as the teeth of FIGS. 1—5 for example, with respect to ease of entering into and between the fibers of connected wood members without materially weakening the fibers, and with respect to generating opposing forces resisting a force tending to pull the teeth out of the wood, while the undercut edge portions of the teeth greatly increase their holding power when embedded into the wood.

As previously stated, the holding power of the embodiment of teeth shown in FIGS. 1—5 is such that a minimum number of stitching nails 22 can be used, for example, four nails at the corners of each plate. It has been determined by actual tests that the teeth 410A, 410B, 410C and 410D have such increased holding power that no stitching nails whatever may be necessary.

By positioning any of the several embodiments of the plate on a truss heel joint in the manner shown in FIG. 7, when the truss is passed under a press such as a roller press in a direction substantially from left to right as viewed in FIG. 7, the teeth are all angled to the line of travel of the truss so that they will penetrate the wood without bending over. In other words, referring to FIG. 15, the teeth points are all inclined to the horizontal at acute angles α , so that if the truss is passed under the press in a direction substantially parallel to the

horizontal chord 21, the projecting edges of the teeth will penetrate the wood without bending over.

In all embodiments of the invention the teeth are bent out in pairs from opposite sides of substantially rectangular openings, enabling close spacing and maximum number of teeth and resulting in maximum holding power. Also, the individual teeth of each pair are substantially right angled triangles with their points at diagonally opposite corners, so that their edges generate opposing forces resisting a force tending to pull out the plate. Further, the teeth are spaced apart a substantial distance along the wood fibers so as to use the resistive strength of the fibers without weakening them. The novel plate is inexpensive and gives maximum strength with minimum weight.

What is claimed is:

1. A connector plate for abutted wood members having a multiplicity of pointed teeth punched out of the plate and arranged in horizontal and vertical rows, said teeth being arranged along parallel inclined lines in at least one direction in aligned pairs, each pair being bent out on one side of the plate from opposite ends of a substantially rectangular area, the teeth of each pair extending fully across the ends of said area and having their points at diagonally opposite corners of said area, and alternate pairs of teeth along said inclined lines being disposed transversely of the other pairs.

2. A connector plate for abutted wood members having a multiplicity of transversely curved pointed teeth punched out of the plate and arranged in horizontal and vertical rows, alternate horizontal and vertical rows facing in opposite directions, said teeth being arranged along parallel inclined lines in one direction in aligned pairs, each pair being bent out on one side of the plate from opposite ends of a substantially rectangular area having its sides parallel to at least one of said inclined lines, the teeth of each pair extending fully across the ends of said area with their diagonally opposite edges extending perpendicularly from the corners of said area and terminating at the apices of said teeth, and alternate pairs of teeth along said inclined lines being disposed transversely of the other pairs.

3. A connector plate for abutting wood members having a multiplicity of substantially pointed teeth punched out of the plate in one direction therefrom and arranged in horizontal and vertical rows with reference to a horizontal edge of the plate, said teeth being arranged in pairs along inclined lines extending at right angles to each other, each pair being punched out of the same opening, the individual teeth of each pair being opposed to each other with their points laterally offset, and each tooth having one projecting edge inclined to the plate and an undercut portion on the other edge extending to a point substantially halfway between the plate and the outer end of the tooth, and alternate pairs of teeth along said inclined lines being disposed transversely of the other pairs.

4. A connector plate as defined in claim 3 in which the teeth punched out of the plate in one direction are transversely dished.

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