Jan. 9, 1968 W. G. MOEHLENPAH ETAL 3,362,277

CONNECTOR PLATES

Filed April 21, 1966 2 Sheets-Sheet 1

FIG. 1.

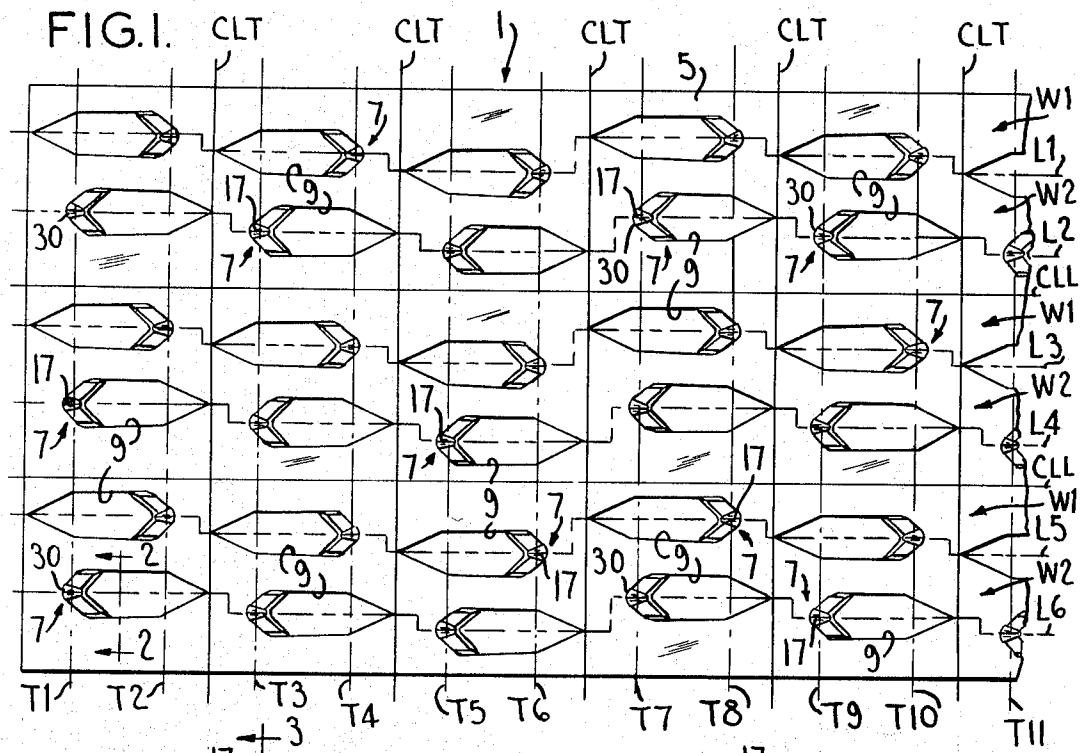


FIG. 2.

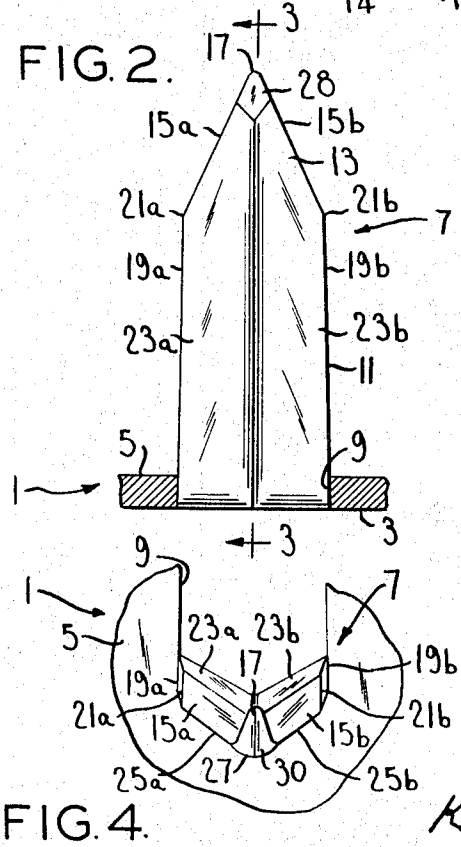


FIG. 3.

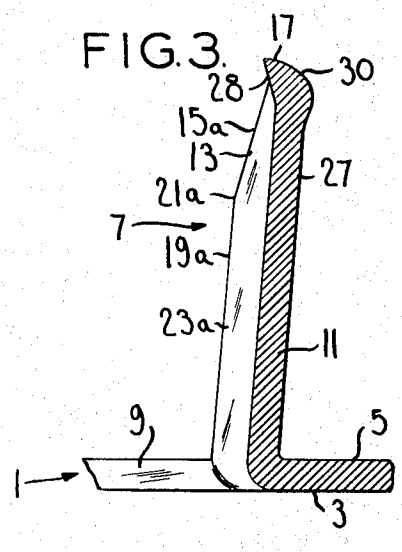


FIG. 4.

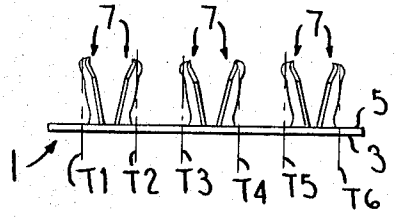
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Jan. 9, 1968 W. G. MOEHLENPAH ETAL 3,362,277

CONNECTOR PLATES

Filed April 21, 1966 2 Sheets-Sheet 2

FIG. 5.



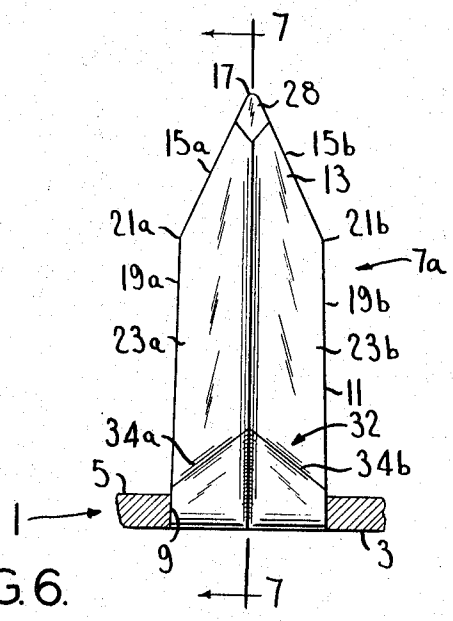


FIG. 6.

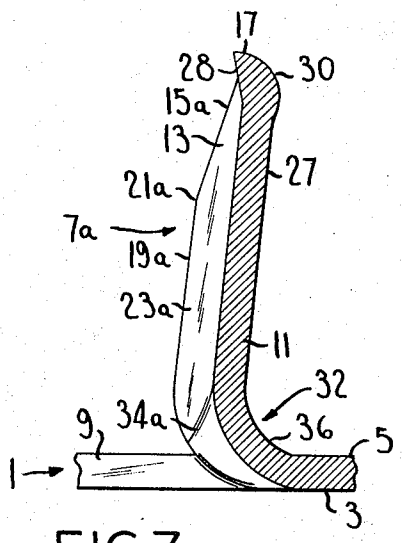


FIG. 7.

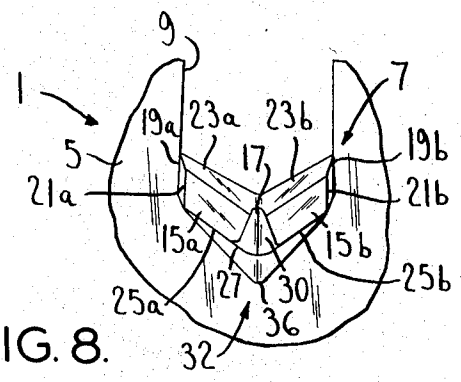


FIG. 8.

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3,362,277

CONNECTOR PLATES

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9 Claims. (Cl. 85—13)

ABSTRACT OF THE DISCLOSURE

A connector plate for securing together adjacent wood structural members comprising a metal plate having a plurality of elongate integral teeth extending from one face thereof. Each of the teeth having a shank portion of generally V-shape in transverse cross section to render the teeth more rigid and a tip portion configured to prevent splitting of the wood and to cause the teeth to bend into locking engagement therewith as the teeth are driven.

This invention relates to connector plates, and more particularly to metal connector plates having a plurality of projecting teeth for securing together adjacent wood structural members.

Among the several objects of this invention may be noted the provision of connector plates having teeth with improved stiffness and bending resistance characteristics so that they may be forced or driven into wood to form joints without bending or collapsing; the provision of such plates which may be made from very thin gauge stock, such as 18 to 20 gauge steel, and from wood joints able to withstand high tension, compression, shear and torsion stresses; the provision of thin gauge connector plates which are strong enough to hold the wood members together under substantial loads; the provision of thin gauge metal connector plates of the class described in which there is high utilization of the metal stock; the provision of connector plates which can be driven into wood members with minimum matting of fibers of the wood; and the provision of thin gauge connector plates which may be used to form wood joints with a minimized splitting or weakening of the wood and provides a high degree of stiffness and load transfer. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

FIG. 1 is a fragmentary plan of the toothed side of a connector plate of this invention;

FIG. 2 is an enlarged section taken on line 2—2 of FIG. 1;

FIG. 3 is a section taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged fragmentary plan of one tooth of the FIG. 1 plate;

FIG. 5 is a fragmentary elevation showing a typical pattern of teeth after they have been driven into a wood member;

FIG. 6 is a view similar to FIG. 2 showing one tooth of another connector plate of this invention;

FIG. 7 is a section taken on line 7—7 of FIG. 5; and

FIG. 8 is a plan of the tooth shown in FIGS. 6 and 7.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now to FIGS. 1–4 of the drawings, a connector plate of the present invention comprises a metal plate, indicated generally by reference numeral 1, having

an outer face 3 and an inner face 5. Elongate teeth generally designated 7 are struck or punched from plate 1 and extend in a direction generally perpendicular to faces 3 and 5 of plate 1, each tooth leaving an elongate vacated opening or slot 9 which generally conforms to the tooth shape. Teeth 7 are struck from plate 1 so that they are arranged in successive series of generally parallel longitudinally extending rows indicated by phantom lines L1–L6, and generally parallel transverse rows indicated by phantom lines T1–T11. The teeth 7 in any pair of adjacent longitudinal rows face in opposite directions. Adjacent teeth 7 in each longitudinal row are slightly offset or staggered transversely one from the other so that they are not aligned longitudinally of the plate. Each tooth in each longitudinal row R1—L6 is exactly aligned with the third tooth from it in each longitudinal direction. As to the transverse rows, the teeth 7 in the odd-numbered rows (T1, T3, T5, etc.) are from even-numbered longitudinal rows (L2, L4, L6) only and teeth in even-numbered transverse rows (T2, T4, T6, etc.) are from only odd-numbered longitudinal rows (L1, L3, L5). The teeth in any pair of adjacent transverse rows face in opposite directions.

The teeth (and thus the resulting slots) in the various longitudinal rows L1, L2, etc., are so disposed relative to each other that at least one line CLT can be drawn across the plate substantially perpendicular to the longitudinal rows between any two adjacent slots in any longitudinal row without crossing any of the slots in the plate.

The six teeth which are commonly in both longitudinal rows L1, L2 and transverse rows T1, T2 and T3 constitute a pattern which is repeated both longitudinally and transversely throughout the length and width of the plate. The number of times the pattern is repeated will depend on the dimensions of the particular connector.

Within each longitudinal row and each transverse row there is a regular or constant spacing between adjacent teeth. However, each even-numbered longitudinal row of teeth is closer to the next lower odd-numbered row than it is to the next higher odd-numbered row. For example, the teeth in row L2 are closer to the teeth in row L1 than they are to the teeth in row L3. This leaves wide slot-free areas or webs W1 between transversely adjacent patterns of teeth and narrower webs W2 between teeth within a pattern of six teeth. Because of this spacing pattern plates of many different widths can be manufactured from long lengths of sheet stock of corresponding widths from a multipunch die and still provide adequate clearances so that punches used for wider width material will not accidently strike the edges of narrower strips and be damaged. The plates are preferably produced in widths comprising two, four, six or more longitudinal rows of teeth.

As each tooth 7 is of a substantially identical configuration, a detailed description of one tooth will suffice for all. Each tooth is constituted by a struck-out portion of the plate and it projects above face 5 at one end of its respective slot 9 in the plate. Tooth 7 has a shank portion 11 joined at its lower end to face 5 of the plate. Preferably the teeth are overbent when struck from the plate so that the included angle between a tooth and the plane of the slot it leaves in the plate is about 91 to 95°. The projecting end of the tooth terminates in a tip portion 13. The tip portion has generally straight edges 15*a* and 15*b* which converge from the shank and meet in a rounded point 17 having a radius of about 1/32 to 1/64 of an inch. The shank portion 11 has straight edges 19*a* and 19*b* which diverge at a small angle from tip portion 13 to plate face 5. The edges 15*a*, 19*a* and 15*b*, 19*b* of the tip and shank portions intersect at 21*a* and 21*b*.

Sides 19*a* and 19*b* form an angle of about 1 degree relative to a plane perpendicular to face 5. This taper of

sides 19*a* and 19*b* makes it easier to punch the teeth from the plate but does not significantly reduce the resistance to withdrawal or pull-out of the nailing plate. The edges 15*a* and 15*b* are preferably disposed at an included angle of about 50 degrees. The configuration of the tip permits the tooth to cut through wood members instead of splitting them or matting fibers of the wood as it is driven into the wood.

Tooth 7 is crimped along its medial longitudinal axis whereby the tooth is generally V-shaped in transverse cross section throughout the extent of its shank and tip portions, thereby forming a generally concave inner surface comprising faces 23*a* and 23*b* and a concave outer surface consisting of generally flat faces 25*a* and 25*b*. The faces 25*a* and 25*b* meet at a rounded ridge 27 which is inclined at an angle of about 85–89 degrees relative to the face 5. The ridge extends substantially the full length of the shank and tip portions. The included angle between faces 23*a* and 23*b* and the faces 25*a* and 25*b* between shoulder 21*a*, 21*b* is preferably approximately 100 degrees to 110 degrees.

The distal end of the tip portion of each tooth is constituted by a flat diamond shaped surface 28 on the inside of the tooth which surface faces toward the respective slot and merges with faces 23*a*, 23*b* at the V-shaped edge of surface 28 closest to face 5 of the plate. The flat surface of each tooth projects upwardly and is inclined toward the respective slot 9 from the lower edge of the surface at an included angle of about 160 degrees relative to the intersection of faces 23*a* and 23*b*. The distal end of the tip portion is bulged outwardly opposite from surface 28 as shown at 30. This distal end configuration tends to cause the teeth to bend away from the slots 9 when the teeth are driven into a piece of wood. This tendency is opposed to some extent by the V-shaped cross section of the teeth which limits bending of the teeth. Teeth of this construction even though formed from very thin gauge metal are quite strong and rigid and will not collapse or fail when driven into wood.

FIG. 5 shows the position of the six teeth in rows L1, L2 and T1, T2, T3, T4, T5 and T6 after they have been driven into a piece of wood and the wood then removed by burning. Each tooth has been bent away from its respective slot in the plate. This bending of the teeth and the fact that teeth in adjacent rows are at opposite ends of the slots provides high resistance to withdrawal or pull-out of the nailing plate.

Plates 1 of this invention may be fabricated from very thin metal, such as 20 U.S. standard gauge steel which has a thickness of about 0.0396 inch. This gauge metal may vary in thickness from about 0.0382 to about 0.0425 inch. The metal is preferably zinc coated (galvanized) in any conventional manner. The individual teeth 7 (and thus slots 9) are preferably about ½ inch long and about 11/64 inch wide where the shank 11 meets plate face 5. The distance between the pointed end of any slot 9 and the adjacent tooth in the same longitudinal row is preferably about 0.142 inch. The center lines of teeth in two transversely adjacent longitudinal rows of teeth in a pattern of teeth (such as L1, L2) preferably are spaced apart about 9/32 of an inch. The center lines of teeth in two transversely adjacent longitudinal rows of teeth in adjacent patterns of teeth (such as rows L2 and L3) preferably are spaced apart about 13/32 of an inch. For the tooth widths specified above, this results in the width of web W2 being about 7/64 inch and web W1 being about 15/64 inch. Thus the width of each tooth is about 1.6 times the web distance between teeth in adjacent longitudinal rows within a pattern of teeth, and the width of each tooth is also about .7 times the distance between the teeth in adjacent longitudinal rows of teeth in transversely adjacent patterns.

Connector plates 1 of the present invention are particularly useful in forming strong reliable joints between adjacent wood members such as are used in fabricating various wooden structures (e.g., trusses, box beams, wall panels, boxes and pallets) preferably by positioning two plates on opposite sides of the wood members to be joined, each spanning or bridging the area of contact between the members, and then pressing the plates so that the teeth 7 are entirely embedded in the wood and inner faces 5 of the plates are in contact with the wood surfaces. The continuous longitudinal V-groove throughout the length of each tooth 7 stiffens and reinforces the teeth so that as the plates are forced against the wood the teeth will not bend toward the respective slots or collapse even when the plates are formed from thin gauge metal stock, e.g., 20 U.S. standard gauge zinc coated steel. The tip end portion 13 cuts through the wood fibers rather than spreading them apart or matting them which would aggravate splitting of the wood. As the nose or tip portion or each tooth is narrower than the shank portion, the teeth tips are rather easily forced into the wood for initial penetration. This anchors or fixes the teeth ends in the wood. Each tooth becomes firmly fixed in the wood due to the shape and construction of the teeth. The shape of the teeth, particularly the V-shape cross section and the bending of the ridge away from the slot in the tip portion, prevents bending and collapsing of the teeth as the plate is forced into the wood. The enhanced stiffness and rigidity of the teeth 7, which prevents bending or collapsing of the teeth as they are pressed into the wood, also functions, when the teeth are fully embedded in the wood, to transfer the load deeper into the wood and distribute it along substantially the entire surfaces of the teeth 7. The overbent position of the shank portion and the arcuate portion 30 of the tip portion provide high resistance to any tooth withdrawal or pull-out forces. The staggered or offset pattern of the teeth in longitudinal rows L1–L6 and T1–T11 allows maximum utilization of the metal area of the plate while reducing any splitting tendencies. As half the teeth face in one direction and the other half face in the opposite direction, maximum resistance is provided against stress being applied in either direction.

FIGS. 6–8 show another form of teeth for a connector plate of this invention. This tooth construction is particularly suitable for plates manufactured from slightly thicker metal stock, such as 18 U.S. Standard gauge zinc coated steel. The teeth are generally designated 7*a* and they are the same as the teeth 7 previously described except for the provision of a gusset 32 at the base of each tooth between sides 23*a*, 23*b*. The gusset has sides 34*a*, 34*b* facing the respective slot 9 in the plate and a ridge 36 opposite from the slot and forming a continuation of ridge 27. Because of this gusset the teeth do not need to bent as sharply adjacent slots 9. This reduces the possibility of rupturing the plate at the base of the teeth when the teeth are punched from the plate. When the teeth of the FIGS. 1–4 embodiment are struck from steel plates thicker than 20 U.S. Standard gauge, then the spacing between the punch and die should be greater than normal to avoid rupturing the plate at the base of the teeth.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A connector for securing together adjacent wood structural members comprising a thin-gauge metal plate having a plurality of elongate integral teeth extending from one face thereof, each of said teeth being constituted by a struck-out portion of the plate vacating an elongate slot in the plate with each tooth projecting from said one face of the plate at one end of its respective slot in the plate, each of said teeth having a shank portion joined at

one end to said one face of the plate and extending from said one face, a tip portion having straight edges converging from the shank to a point and the shank having straight edges diverging at a small angle from the tip portion to said plate face, said shank portion being generally V-shape in transverse cross section substantially throughout a major portion of its length and concave on the face of the tooth toward the respective slot and convex on the other face thereby forming a ridge on said convex face substantially throughout the shank portion of each tooth, the ridge of each tooth being generally in a plane passing through the longitudinal center of the tooth perpendicular to said one face of the plate, the included angle between the ridge of a tooth and the plane of the slot left in the plate by the tooth being slightly greater than 90 degrees, the distal end of the tip portion of each tooth having a flat surface facing toward the respective slot in the plate and substantially merging with said concave face of the respective tooth at the edge of the flat surface closest to said one face of the plate, said flat surface of each tooth projecting upwardly from said edge of the flat surface and being inclined toward the respective slot from said edge of the flat surface, the teeth being arrayed in a plurality of generally parallel longitudinal rows and generally parallel transverse rows, each transverse row being generally perpendicular to each longitudinal row and containing teeth from alternate longitudinal rows only, the teeth in adjacent longitudinal rows facing in opposite directions, the teeth in adjacent transverse rows facing in opposite directions, the adjacent teeth in each longitudinal row being transversely staggered relative to each other thereby to minimize splitting of the wood structural members, and the array of teeth being in a repeating pattern comprising three adjacent teeth in each of two adjacent longitudinal rows.

2. A connector as set forth in claim 1 wherein the pattern of teeth is repeated at least twice between one side edge of the plate and the other side edge of the plate, and adjacent longitudinal rows of teeth in transversely adjacent patterns are spaced apart a distance greater than adjacent longitudinal rows of teeth within a pattern of teeth.

3. A connector as set forth in claim 2, wherein the plate is approximately .04 inch thick, and the width of each tooth at said plate face is about 1.6 times the distance between teeth in adjacent longitudinal rows within a pattern.

4. A connector as set forth in claim 3 wherein the width of each tooth at said plate face is about 0.7 times the distance between teeth in adjacent longitudinal rows of teeth in transversely adjacent patterns.

5. A connector as set forth in claim 3 wherein each tooth is about one-half inch long and about $1\frac{1}{64}$ inch wide at said plate face, and adjacent slots in each longitudinal row are spaced about 0.140 inch apart.

6. A connector as set forth in claim 1 wherein the teeth in the longitudinal rows are so disposed that at least one line can be drawn across the plate substantially perpendicular to the longitudinal rows between any two adjacent slots in any longitudinal row without crossing any of the slots in the plate.

7. A connector as set forth in claim 1 wherein the distal end of the tip portion of each tooth bulges outwardly away from the slot of the tooth, and the included angle between the side edges of the tip portion of each tooth is approximately 50 degrees.

8. A connector as set forth in claim 7 wherein the included angle formed by the concave face of the tooth is about 100 to 110 degrees.

9. A connector as set forth in claim 1 further comprising a gusset at the base of the shank portion of each tooth, the gusset of each tooth having a ridge forming a continuation of the ridge in the shank portion of the tooth.

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