Oct. 12, 1965 A. C. SANFORD 3,211,043

CORRUGATED CONNECTOR PLATE HAVING NOTCHED TEETH

Filed May 21, 1962 4 Sheets-Sheet 1

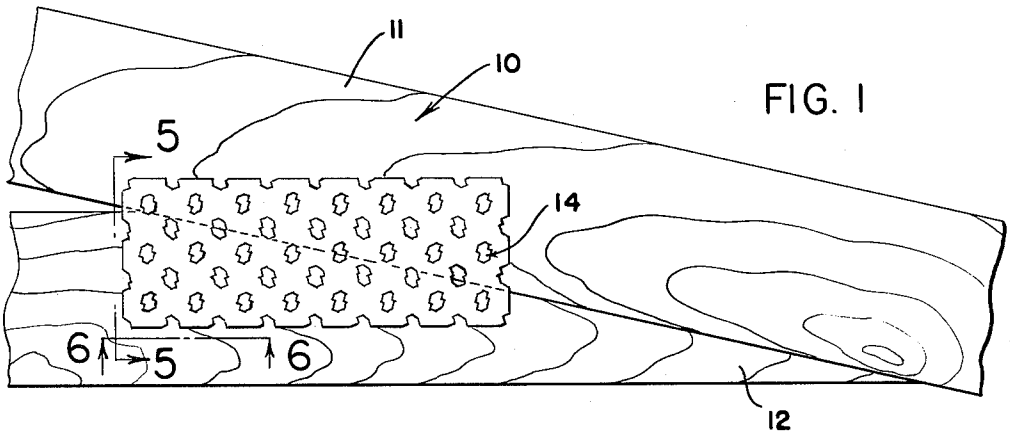


FIG. 1

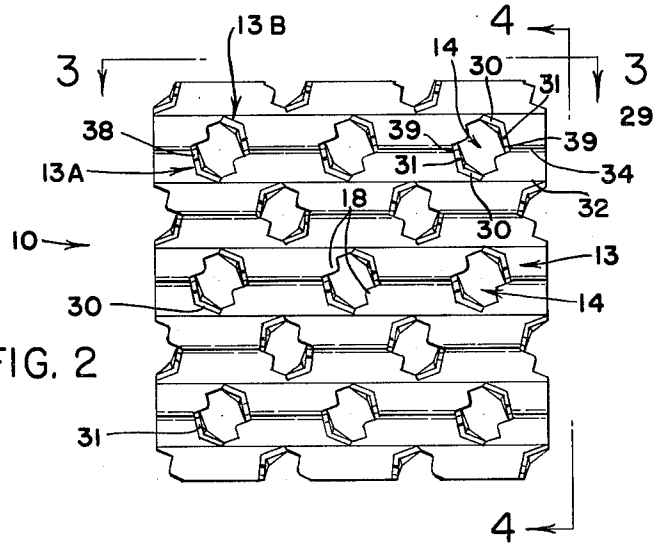


FIG. 2

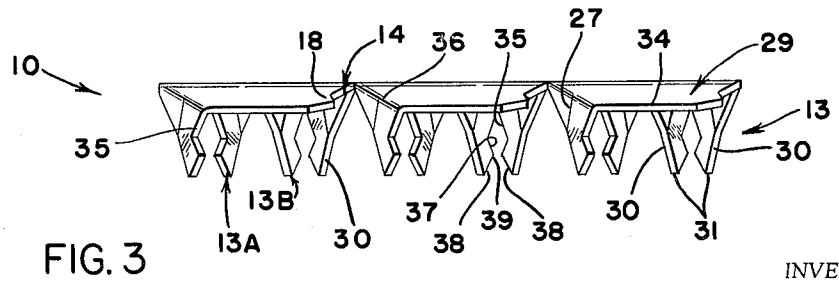


FIG. 3

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CORRUGATED CONNECTOR PLATE HAVING NOTCHED TEETH

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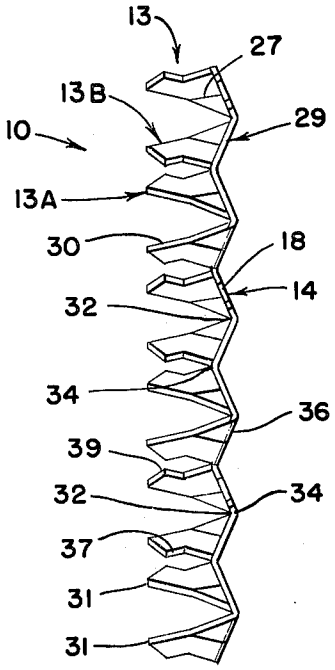


FIG. 4

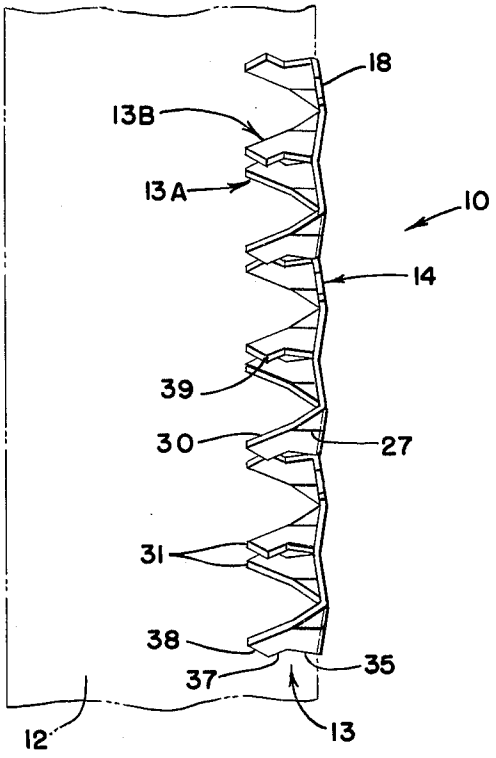


FIG. 5

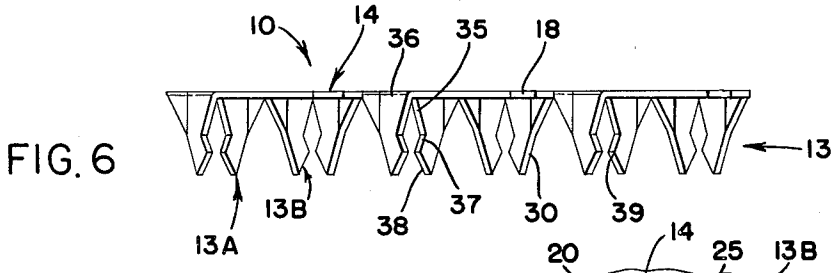


FIG. 6

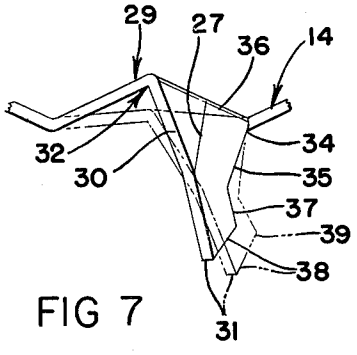


FIG 7

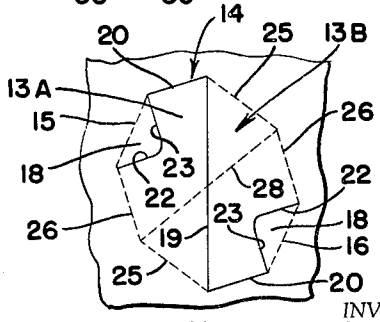


FIG. 8

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CORRUGATED CONNECTOR PLATE HAVING NOTCHED TEETH

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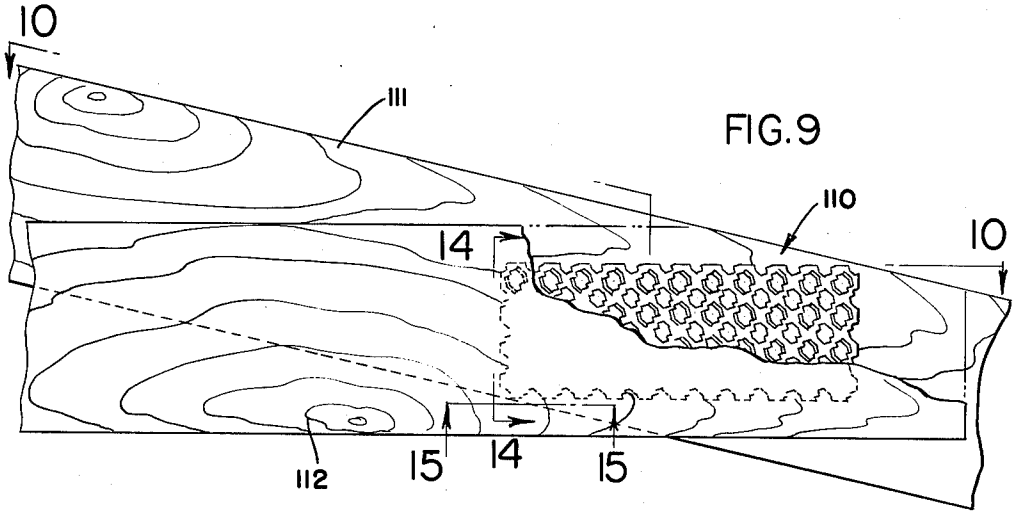


FIG. 9

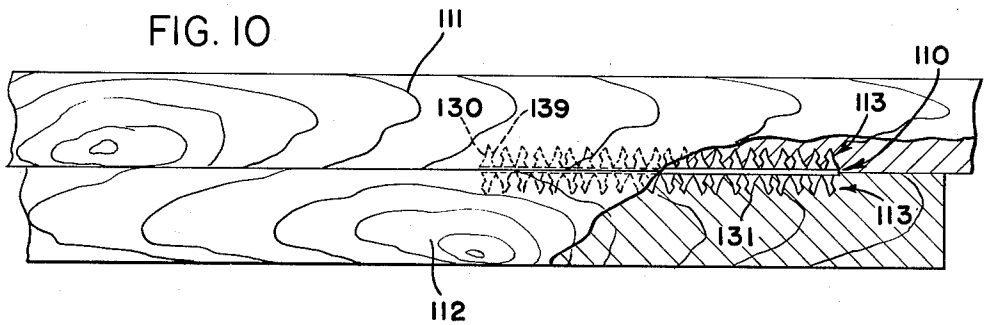


FIG. 10

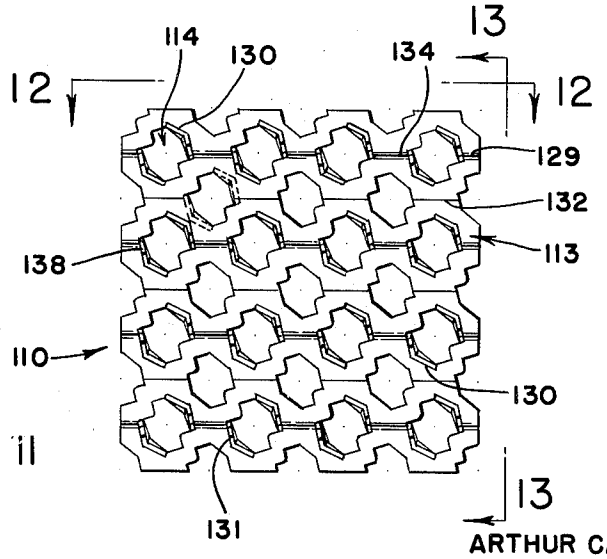


FIG. 11

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CORRUGATED CONNECTOR PLATE HAVING NOTCHED TEETH

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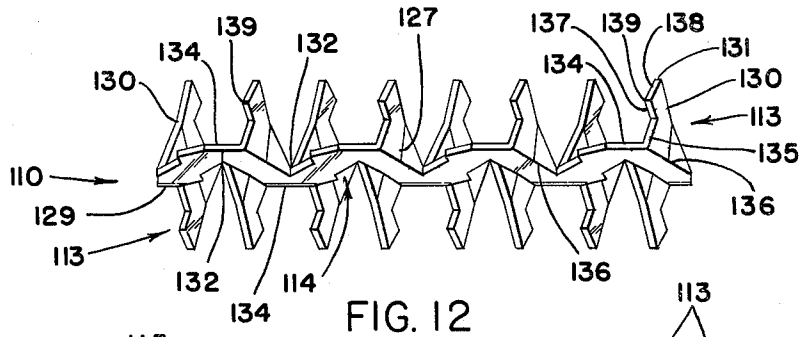


FIG. 12

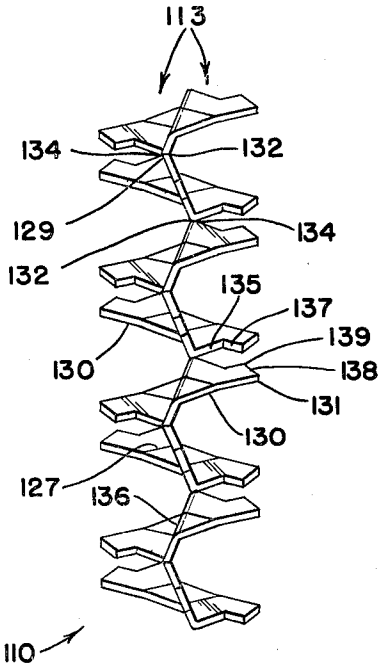


FIG. 13

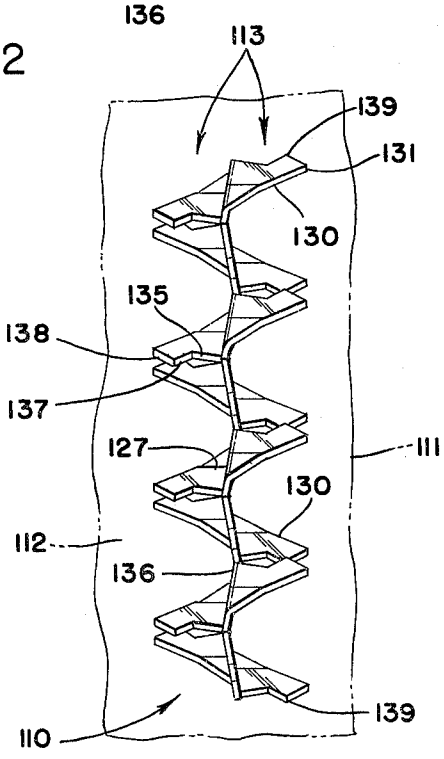


FIG. 14

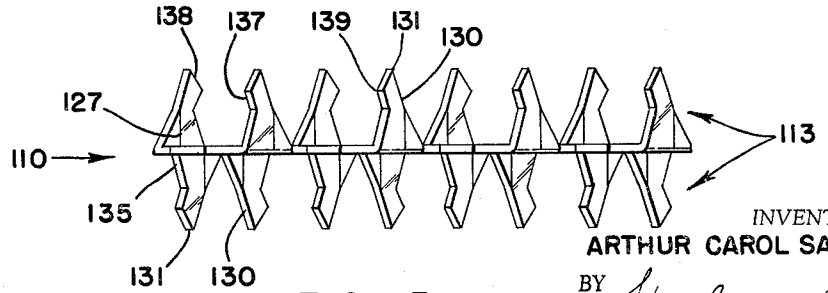


FIG. 15

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3,211,043

CORRUGATED CONNECTOR PLATE HAVING NOTCHED TEETH

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Filed May 21, 1962, Ser. No. 196,060
4 Claims. (Cl. 85—13)

This application is a continuation-in-part of my copending application, Serial No. 68,530, filed November 10, 1960, now United States Patent No. 3,094,748.

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 of the two members to be connected.

Toothed connector plates are particularly adapted for connecting wooden structural members at their joints and can be constructed to join both abutting and overlapping members. The ultimate strength the connector plate can impart to the joint is measured by the aggregate shear strength of the teeth. However, the stresses tend to cause the plate to buckle and pull out the teeth before the aggregate shear strength is reached. Of course, increasing the number of teeth would increase the holding power of the plate, but this in inefficient for several reasons. Increasing the holding power of the plate by increasing the number of teeth would also unnecessarily increase the aggregate shear strength, thus maintaining the inefficient ratio between the aggregate shear strength and the holding power. Furthermore, increasing the number of teeth per unit of plate area would cause the wood fibers to be cut at too close intervals and weaken the wood members; and, were the plate size increased in proportion to the increased number of teeth, there would be the further disadvantage of compounding the inefficiency by the additional metal required to manufacture a plate of the increased size.

In my copending application Serial No. 68,530, now Patent No. 3,094,748, I disclosed the concept that the holding power of the plate could be increased in relation to the aggregate shear strength of the teeth by corrugating the plate and punching rows of teeth out of the corrugations in such a manner that when the plate is flattened by pressing the teeth into the wood, the teeth are tilted laterally to compress the wood fibers so that their resilience resists pulling out the teeth.

I have now found that I can further improve the holding power in relation to the aggregate shear strength of the teeth by punching the teeth out of the corrugations of the plate in such a manner that each tooth will hook into the uncut fibers of the wood near the tip or extremity of the tooth and thereby add the tearing strength of the uncut wood fibers between the relatively deeply set hook and the surface of the wooden member to the resilient gripping strength of the fibers in order further to increase the holding power of each individual tooth.

It is therefore an object of the present invention to provide an improved toothed connector plate having adequate plate strength and increased holding power.

It is a further object of the present invention to provide an improved corrugated connector plate having teeth so shaped and so related to the corrguation that when the plate is applied and the corrugation flattened the teeth tilt to hook beneath the uncut fibers of the wooden members being joined.

It is a still further object of the present invention to provide concepts of corrugated and toothed connector plate construction which can be applied to either the so-called "sandwich" or "exterior" plates.

These and other objects which will become apparent from the following specification are accomplished by means hereinafter described and claimed.

One preferred embodiment is shown by way of example in the accompanying drawings and hereinafter described in detail without attempting to show all of the various forms and modifications in which the invention might be embodied; the invention being measured by the appended claims and not by the details of the specification.

In the drawings:

FIG. 1 is an elevational view showing one of the improved exterior plates embodying the concept of the present invention applied to the abutting heel joint of a wooden truss;

FIG. 2 is an enlarged bottom plan view of a section of the improved plate before being flattened;

FIG. 3 is a further enlarged side elevation of said plate on line 3—3 of FIG. 2;

FIG. 4 is a further enlarged end view of said plate on 4—4 of FIG. 2;

FIG. 5 is a view similar to FIG. 4, showing how the teeth are tilted laterally after the plate has been flattened, taken on line 5—5 of FIG. 1;

FIG. 6 is a view similar to FIG. 3, showing how the teeth are tilted laterally after the plate has been flattened, taken on line 6—6 of FIG. 1;

FIG. 7 is an enlarged perspective view of one tooth and a portion of the corrugation to which it is attached, showing in phantom the tilted position of the tooth after the plate has been substantially flattened;

FIG. 8 is a development depicting in plan the blank from which the teeth are struck;

FIG. 9 is an elevational view showing one of the improved "sandwich" plates embodying the concept of the present invention applied to the overlapping heel joints of a wooden truss;

FIG. 10 is a plan view taken substantially on line 10—10 of FIG. 9;

FIG. 11 is an enlarged view of a section of either face of said "sandwich" plate;

FIG. 12 is a further enlarged side elevation of said "sandwich" plate, taken on line 12—12 of FIG. 11;

FIG. 13 is a further enlarged end view of said plate, taken on line 13—13 of FIG. 11;

FIG. 14 is a view similar to FIG. 13 showing how the teeth are tilted laterally after the plate has been flattened, taken on line 14—14 of FIG. 9; and

FIG. 15 is a view similar to FIG. 12 showing how the teeth are tilted laterally after the plate has been flattened, as taken on line 15—15 of FIG. 9.

The present invention relates to both the "exterior" and "sandwich" type connector plates. The former, or exterior type, is used to connect structural members that are joined in abutting relation; the latter, or sandwich type, is used to connect structural members that are joined in overlapping relation. In general, a connector plate of either type embodying the concept of the present invention has parallel corrugations. Pairs of teeth are punched out of the opposing slopes of the corrugations in rows so that each tooth is disposed angularly with respect to the corrugations, and each pair of teeth are punched out of opposite sides of a single opening. Each tooth is formed with a hook on the leading edge thereof which faces toward the crest of the corrugation from which the tooth was punched.

Referring to FIG. 1, an exterior connector plate according to the present invention, designated generally by the numeral 10, is shown connecting the upper chord member 11 and the lower chord member 12 at the abutting heel joint of a wooden truss. Preferably, a similar plate is applied to the opposite side of the joint as well. The

teeth, indicated generally by the numeral **13**, which are embedded into the wood of the chord members **11** and **12**, are, as best shown in FIGS. 2–4, punched out in pairs from interrupted octagonal openings **14**. Referring particularly to FIG. 8, it can be seen that the dotted lines **15** and **16** complete the octagonal nature of the opening, but to effect the desired silhouette of the individual tooth **13** the octagonal periphery of the opening is interrupted at this side by the sawtooth projection **18**. During the punching process, a pair of teeth **13A** and **13B** are struck from the resulting interrupted octagonal opening **14**. The two teeth are separated from each other along the common cleavage line **19** and separated from the plate along head line **20** and the sawtooth lines **22** and **23**, and bent transversely to the plate along base lines **25** and **26**. Each tooth is also dished or crimped transversely to the plate, the apex of the dish or the crease **27** being represented by chain line **28** in the development FIG. 8. By making the openings **14** an interrupted octagon, the dishing is facilitated because it takes place generally between opposite points of the interrupted octagon.

The openings **14** are formed in rows by punching out teeth at intervals along the corrugations **29** in the plates. The teeth are so struck or punched as to stand angularly to the direction of the corrugations. In alternate rows the bases of the pairs of teeth are preferably at 90° to the bases of the teeth in the other rows, and the openings **14** in alternate rows are staggered relatively to each other.

Each tooth, as most clearly seen in FIG. 7, has an inclined rearward edge **30** extending from the plate to the outer extremity or point **31** of the tooth **13**. In relation to the corrugations **29**, the inclined edge **30** preferably extends from the valley or low point **32** of the corrugation **29** outwardly of the plate to the point **31**. The other, or leading edge of the tooth, extends upwardly from the crest or ridge **34** of the corrugation **29**. The shank portion **35** of the leading edge is slightly rearwardly inclined—i.e., convergent with the rearward edge **30**—and, approximately half way between the base **36** of the tooth **13** at the crest **34** and the point **31**, intersects a negatively inclined portion **37** which generally parallels the rearward edge **30** until it in turn intersects the positively inclined head portion **38**. The intersection of the portions **37** and **38** form a hook **39** on the head of the tooth in proximity to the point **31**. The intersection of the inclined rearward edge **30** and the head portion **38** forms the point **31**. This hook **39** is always disposed toward the crest **34** of the corrugation **29** from which the tooth **13** was punched, irrespective of which row of openings **14** is involved and irrespective of whether the openings are centered on the crest **34**, as shown, or whether the openings **14** are centered on the valleys **32**. As indicated in FIG. 4, reference to the crests **34** is to that side of the corrugations from which the teeth **13** extend.

The corrugations **29** are shown as being generally formed by intersecting inclined planes which are connected by the generally angular crests **34** and the generally angular valleys **32**. The corrugations may, however, be formed as rounded grooves connected by both rounded crests and rounded valleys.

Because the base **36** of each tooth extends generally along the slope of the corrugation between the crest **34** and valley **32**, and because the hook **39** of each tooth is disposed toward the crest of the corrugation from which the tooth was punched—i.e., toward the crest of the corrugation along which the base **36** of the tooth is joined—when the plate is flattened as the teeth are pressed into the wood, the teeth tilt laterally and thus the hook **39** is driven into the wood well beneath the surface.

The plate does not begin to flatten until the crest **34** of the corrugations **29** contact the surface of the wood. Thereafter, continued substantial pressure tends to flatten the corrugations, causing the teeth to continue to penetrate into the wood and at the same time causing the hook to penetrate the wood well below the surface as the tooth tilts. The inclined rearward edge **30** of the tooth acts as an inclined plane to assist the tilting of the teeth primarily initiated by the flattening of the corrugations to which the base of each tooth is attached.

In this way, only a minimum number of the wooden fibers are cut and each individual tooth is held in position both by the natural resiliency of the wood fibers as they grip the sides of the tooth and the now embedded tooth, which can only be removed by tearing all the fibers between the under edge **37** of the hook **39** and the surface of the wood. Thus the holding power of each tooth has been substantially increased.

So long as this tilting of the teeth toward the hook is accomplished, the base of the teeth may be oriented in alternating 90° relationship, as shown, or if it is found desirable they may be oriented all in the same relationship so as to accommodate, for example, the particular grain in certain woods. In the alternating relationship shown, each pair tends to rotate in opposite directions, generating opposing forces which tend to compress some of the wood fibers therebetween, adding an additional force opposing extraction of the teeth from the wood.

The general concept of the above described invention is incorporated in the sandwich plate depicted in FIGS. 9–15, and indicated generally by the numeral **110**, which is shown connecting the upper chord member **111** and the lower chord member **112** at the overlapping heel joint of a wooden truss.

The teeth on sandwich plate **110**, indicated generally by the numeral **113**, are of exactly the same configuration as the teeth **13** on exterior plate **10**, and are also punched out in pairs from interrupted octagonal openings **114** in the same way as the teeth **13** are punched from openings **14**, as described in detail above.

The openings **114** are formed in rows by punching out teeth at intervals along the corrugations **129** in the plate, so that the teeth are angularly disposed in the direction of the corrugation.

Because the plate itself is corrugated, the crest of the corrugation when looking at one face or side of the plate, becomes a valley when looking at the opposite side, and vice versa. Reference to the valley **132** or crest **134** of any corrugation **129** will therefore be to that side of the corrugation from which the teeth **113** extend.

Thus, every opening **114** is centered on a crest **134** and the base **136** of each of the teeth **113** punched therefrom is disposed angularly along the corrugations between the valley **132** and the crest **134**.

The teeth **113** on both sides of the plate **110** each are dished, as along the crimp **127**, and have an inclined rearward edge **130** extending from the valley **132** outwardly to the extremity or point **131**. The leading edge of each tooth extends outwardly from the crest **134** in a particular configuration. The shank portion **135** of the leading edge is slightly rearwardly inclined and, about half way between the base **136** at the crest **134** and the point **131**, intersects a negatively inclined portion **137** which generally parallels the rearward edge **130** until it in turn intersects the positively inclined head portion **138**. The intersection of portions **137** and **138** forms a hook **139** on the head of the tooth in proximity to the point **131**. The intersection of the inclined rearward edge **130** and the head portion **138** forms the point **131**.

Irrespective of which side of the plate is being considered, the hook **139** on each tooth must always be disposed toward the crest **134** of the corrugation from which the tooth was punched.

In the preferred embodiment, the openings punched from adjacent crests are aligned transversely to the direction of the corrugations **129**. By following this pattern on both sides of the plate, the maximum number of teeth are supplied for any given plate surface area and the strength of the plate itself is maintained.

Corrugations **129** are shown as being generally formed by intersecting rounded grooves connected by rounded

crests **134** and rounded valleys **132**. The corrugations may, however, be formed by intersecting inclined planes which are connected by generally angular crests and angular valleys.

When the chord members **110** and **111** are pressed together, the sandwich plate **112** therebetween, the teeth on one side of the plate penetrate into chord member **110** and the teeth on the other side of the plate penetrate into chord member **111**. As the plate is flattened the teeth tilt laterally and thus drive the hook **139** on each tooth into the wood as described above with respect to the exterior plate **10**.

The insertion of the teeth **113** on sandwich plate **110** into the wood and the increased holding power of each tooth is accomplished in exactly the same manner described in conjunction with the description relating to exterior plate **10**. The sole difference being that there are teeth on both sides of the sandwich plate **110** which are constructed and which function in exactly the same manner.

It is thus apparent that a connector plate embodying the concept of the present invention is inexpensive; gives maximum strength with minimum weight; has increased tooth holding power; and otherwise accomplishes the objects of the invention.

What is claimed is:

1. A connector plate for connecting wood members, said plate having corrugations and a plurality of teeth, each corrugation having slopes forming at least one crest and one valley, said teeth punched out of said corrugations and each tooth having a base traversing the slope from which it is punched substantially from the crest to the valley of said slope, each tooth having a positively inclined inner leading edge portion and a negatively inclined rear edge extending from the base, said inner leading edge portion being convergent to said rear edge and adjacent to the crest on that side of the corrugation from which the tooth was punched, an outer positively inclined leading edge portion intersecting said rear edge to form an outer point, a reentrant notch formed between said inner and outer leading edge portions and having a negatively inclined edge extending from said inner edge portion intersecting said outer leading edge portion to form a hook adjacent to said outer point, and each said tooth being tiltable in the direction of said hook when said corrugations are flattened.

2. A connector plate as in claim **1** in which the teeth are punched out of the corrugations in pairs, with the teeth of each pair formed from opposing slopes of each corrugation.

3. A connector plate as in claim **1** in which the corrugations are parallel.

4. A connector plate as in claim **1** in which the corrugations are parallel and have slopes forming crests and valleys on both sides of the plate, and the teeth are punched in rows from the corrugations on each side of the plate.

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