

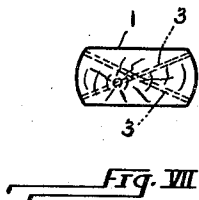
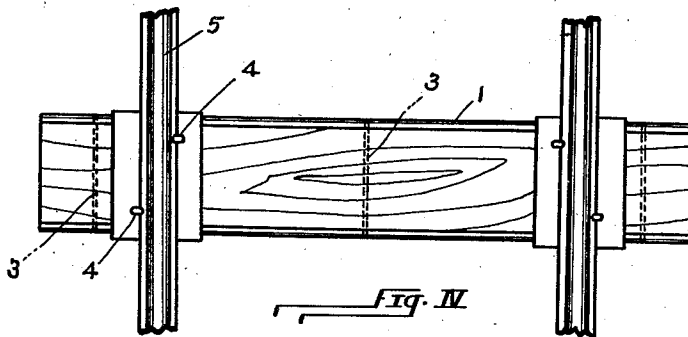
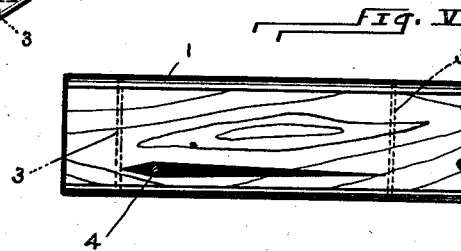
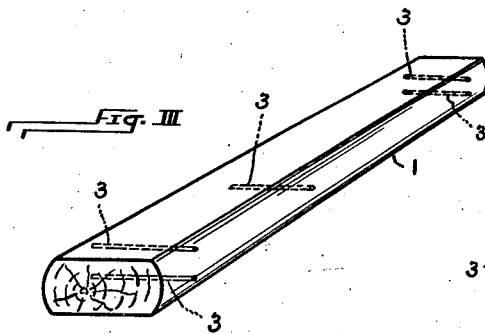
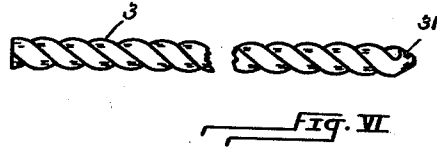
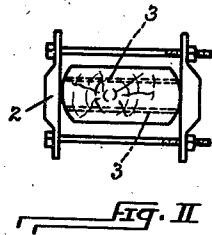
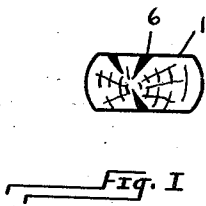
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H. C. GRAHAM ET AL
REINFORCEMENT OF TIMBER

2,014,892

Filed March 6, 1935

2 Sheets-Sheet 1



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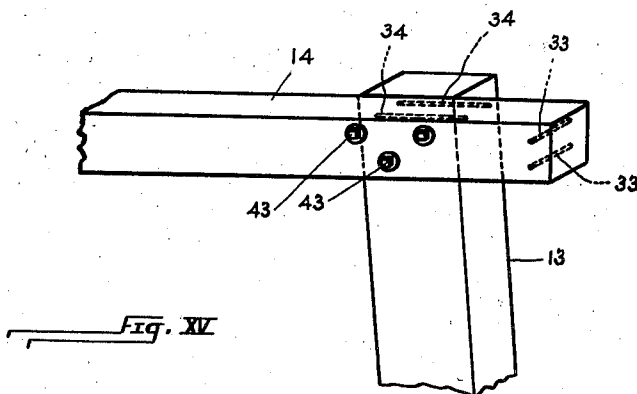
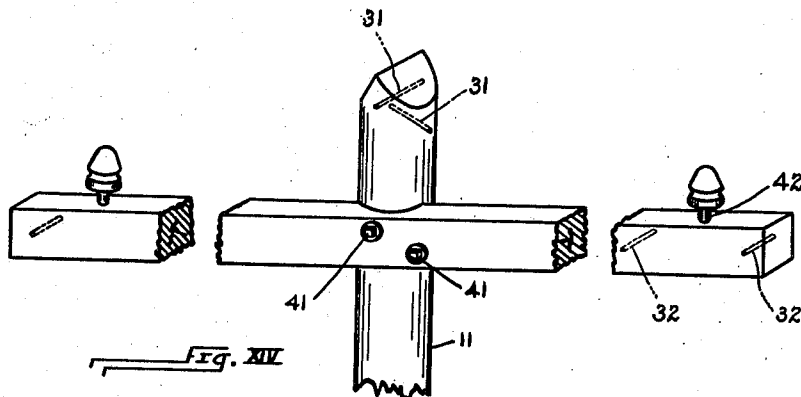
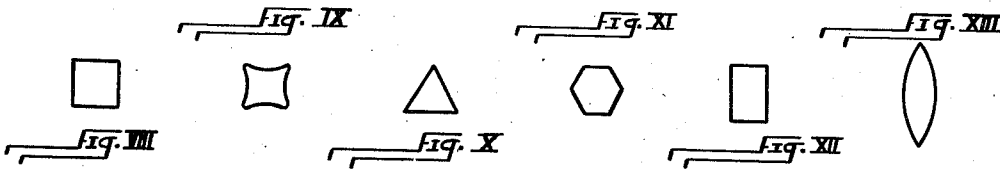
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2 Sheets-Sheet 2



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2,014,892

REENFORCEMENT OF TIMBER

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Application March 6, 1935, Serial No. 9,600

8 Claims. (Cl. 238—29)

This invention relates to timber and consists in the reenforcement of timber, to prolong its life and to render it more serviceable. Timber, round and square, and in widely varying uses—in uses including railway ties, telephone, telegraph, and electric light and power line poles, the cross-arms upon such poles, the piles and the planks of docks and piers, the timbers of trestles and bridges, of the derricks and equipment of oil and gas wells, of the false work for building, and of buildings themselves, etc.—being subject to changing conditions of moisture and of temperature, and to various strains of service, checks and splits and deteriorates. This invention has as its object the prevention of such checking, splitting, and deterioration. The invention is one that is adapted in economy of manufacture and of installation to the rigorous limitations under which, in uses such as those named, it must prove serviceable.

The invention is illustrated in the accompanying drawings, in which Fig. I is a view in end elevation of a wooden cross-tie for a railway, and it shows splits in the tie or checks (as they are commonly styled), such as are likely to develop and not infrequently do develop incidentally in the curing of the tie and before it goes into service. Fig. II is a similar view of the end of a tie, together with diagrammatic indication of instrumentality for compressing the tie and closing splits and checks, preliminarily to the application of the strengthening means of this invention; and the figure further shows diagrammatically such strengthening means in place. Fig. III is a view in perspective of a strengthened tie of the invention. Fig. IV is a fragmentary view, in plan from above, of a railway track, including in its structure a strengthened tie of this invention. Fig. V is a fragmentary view of the tie in plan from above, with diagrammatic illustration of a feature of utility. Fig. VI is a view in side elevation and to larger scale of a strengthening element. Fig. VII is a view of a tie in end elevation, with diagrammatic showing of a variation attending the practice of the invention, when resort is had to it after the tie has been installed in service. Figs. VIII–XIII afford diagrammatic indication of variety in the cross-sectional shape of the strengthening element. Fig. XIV is a fragmentary view in perspective of the upper end of a telegraph or telephone pole with a cross-arm in place upon it, to which pole and to the cross-arm as well the strengthening means of the invention have been applied. Fig. XV is a fragmentary view in perspective of a trestle structure including timbers to which the invention has been applied.

The invention will first be described in its application to railway ties. A railway tie formed of timber, whether hewn or sawn, is (with relation to its position in service) relatively wider

(in horizontal direction) than it is thick (in vertical direction). Ordinarily, the heart of the log from which it is cut lies within its periphery, and in any case the natural planes of minimum strength, which are radial with respect to the heart of the log, extend (many of them) in planes that are, when the tie is in service position, vertical or are inclined at acute angles to the vertical. A railway tie, after it has been cut and before application to service, is ordinarily cured, and the curing process is essentially a process of drying. The strains incident to drying not uncommonly cause cleavages of greater or less extent in the substance of the tie itself and along radial planes with respect to the heart of the log from which the tie is cut. Inasmuch as the ties are of greater breadth than thickness, these cleavages tend to occur chiefly in planes that are (with respect to the service position of the tie) vertical and approximately vertical planes. Cleavage of such sort is indicated in Fig. I in black areas 6. These cleavages occur chiefly at the ends of the ties (though they may occur at intermediate points) and they extend longitudinally for perhaps a foot, more or less.

When in service a railway tie is subject to crushing strains of great magnitude. As it continues in service the processes of decay, and the conditions of alternate wetting and drying, freezing and thawing, tend to cause the timber to grow yet weaker along its radial planes. When a tie is built into a roadway, and tracks are laid and secured upon it, rail-securing spikes are driven into it in approximately vertical direction from above. These conditions and circumstances all tend and contribute to cause splitting. As ties continue in service they manifest, as a chief feature of deterioration, a splitting in longitudinal planes that are vertical or inclined at acute angles to the vertical, with consequent spreading and sinking of their substance, and loosening of the rail-securing spikes.

The invention is applicable both to new ties and to old; both to ties that are checked, to ties that are split, and to ties in which no rupture as yet has occurred. And since, in the broader view of the invention, it matters not how and when the fissures have developed or may tend to develop in the substance of the tie, the term splits may without further distinction be understood to include all those fissures, springing from the causes and having the characteristics indicated.

Turning to Fig. I of the drawings, and understanding the tie there shown to be a new tie in which terminal splits have in the course of curing developed, a usual step in the further preparation of the tie for service is to coat the tie (the coating is attended with some penetration and saturation in portions adjacent the surface) with a suitable preservative in liquid form,—typically 60

creosote. Such coating and saturation extends to and includes the cleavage surfaces of the splits, if any. The invention consists in sinking in the substance of the tie adjacent the ends thereof transversely extending metal rods of screw configuration. These rods by their presence secure the tie against splitting; they hold closed splits from opening again; they prevent the opening of new splits; and they are effective, more firmly to hold in place the rail-securing spikes that are driven into the substance of the ties. When a tie has been reinforced by sinking transversely into its substance metal rods of the screw configuration described while still the tie is in green condition, the rods will be effective during the ensuing curing period to prevent splits. Treatment with creosote will follow, and the rods will continue to afford their strengthening effect in the finished tie.

In exemplary performance of the invention the tie 1 of Fig. I is clamped in suitable clamping apparatus, conventionally indicated at 2, Fig. II, and by such clamping the splits (if any have occurred) are closed again. Into the substance of the now fissureless tie one or more of the strengthening rods of metal are driven, so as to extend in transverse position in the substance of the tie, as diagrammatically indicated at 3, Fig. II. Even though the tie be not clamped, and even though splits already developed be not closed, still the applied rod or rods will be effective to prevent further splitting.

Typically the rods are rolled steel rods, square in cross-section, three eighths of an inch square. They are twisted, so that the screw formed by each corner of the square has a lead of something more than two inches. They are cut to length suited to tie thickness,—ten inches. And they are of the essential helical shape shown, substantially to their ends. They need not be, and ordinarily will not be, headed, but they are preferably tapered or bluntly pointed at one end, as indicated at 31, Fig. VI. These rods may be driven into the tie by means of a sledge, as a nail is driven by a hammer. As they advance into the substance of the wood, their screw shape causes them to rotate. Thus, with spontaneous turning, they embed themselves, and when in place the tenacity of the union between wood and metal, and the tensile strength of the rods, are such that the tie is stronger to resist splitting strains at the points where the rods lie than at any other point in its extent. Splits closed before the driving-in of the rods, and then bridged by rods, will not, when clamping pressure is relieved, reopen. Furthermore, when the substance of a tie has so been strengthened at two remote points, the portion of the tie that lies between those points possesses increased capacity to hold secure a driven-in spike. The rods may be, and ordinarily will be, driven in until their ends are flush with the surface through which they are sunk. When the rods have been driven in, the clamping pressure may be relieved and the tie may be removed from the clamping apparatus. It is then ready to be applied to service, with realization of the advantages of the invention.

A rod of the dimensions specified may be driven by a sledge into the solid substance of an oak tie. Alternatively, a bore may be drilled (of substantially less diameter than the over-all diameter of the rod) and the rod may then (and with less effort) be driven into the bore. Even so, the rod will be found effective as a strengthening element, in the manner described.

Ordinarily the rod which by twisting is devel-

oped to screw configuration will be of simple, square cross-section. For the purposes of the invention, however, all that is requisite is that it be angular in cross-section,—that is to say, possessed of an edge or ridge which, when the rod is twisted, will develop into screw form. In Figs. VIII-XIII a variety of possible shapes is presented,—not as an exhaustive, but rather as an exemplary, showing. It will be perceived that the cross-sectional shape is typically polygonal—regular or irregular; that the number of corners or ridges—typically four, in the square—may be reduced to three in a triangle, or to two in a lens-shaped section, or increased to six, in the case of the hexagon; and that the sides of the polygon (and the faces of the rod), typically straight, may be concave or even convex.

Further, it is not requisite that the essential screw shape be developed by twisting, although because of economy such will be the usual mode of formation. Manifestly in known manner a rod may be rolled from a round blank with such a thread upon it.

It is, however, requisite of the screw configuration that it be such in pitch that under the longitudinally directed driving stress (ordinarily the blow of a sledge) the rod will turn as it sinks into the wood.

The proportions of the rod may be varied. In the case specified, of a three-eighths inch rod, twisted so that the developed screw has a lead of something more than two inches, the angle of pitch will be found to be about 54°. This, manifestly, is a very different pitch from that of a screw-spike,—an article that has some acceptance for securing rails to ties. The pitch of thread of a screw-spike is of such relatively small angle that it is removable by turning, and is serviceable by virtue of that capability. The rod of this invention cannot be turned to place. If the attempt were made, when the rod had advanced for an inch or two into the substance of the wood, by turning to advance it further, the resistance to progress would be greater than the rigidity of the rod itself, and access of turning force would then be effective only to twist the rod, to the point of tearing it apart. Nor can the rod of the invention, when once it is sunk to place, be removed by opposite turning. It is effective and serves its purpose by virtue of the fact that it cannot be turned. If such a rod be grasped at separate points in its extent in the fingers of the two hands, it will be discovered that outward pull by either hand tends to effect rotation in the support afforded by the fingers of the other hand, and that the directions of rotation are in the two cases opposite. This is a demonstration of the fact that when such a rod is in service, a tendency of the tie to split expresses itself in oppositely effective tendencies to rotation, and these opposite tendencies are counteractive and mutually cancelling. It will be perceived that, by virtue of the fact that the dowel is spiraled throughout its length and sunk transversely to the grain throughout the thickness of the tie, it is immovably embedded in the tie with respect to any substantial portion of the thickness thereof.

This distinction between the strengthening rod of the invention and the screw-spike alluded to—the distinction that renders them different articles, different in character and effect,—lies in this matter of the angle of pitch of the screw-thread. It is characteristic of the rod of the invention (and herein its unlikeness to the screw-spike lies) that the angle of pitch of the screw-thread

is so great that, permitting rotation in response to the thrust of the longitudinally directed blow of a sledge, it forbids retraction by rotation. Beginning with a straight and untwisted rod, any degree of twist up to a critical angle of pitch will, manifestly, afford a rod having the characteristic here dwelt upon. And the critical angle, manifestly, is not susceptible to sharpest definition, because ties vary in quality; and different ties, of different kinds and qualities of wood and of different conditions and ages, afford resistance to turning that varies within certain limits. It will, however, be apparent that in structure as well as in principle of operation the strengthening rod described stands remote from the screw-spike.

The rod of the invention may be formed of rolled stock, without machining; such roughness and minute irregularity as it may possess are conducive to, not unfavorable to, utility; it requires for making application no special appliances; to the contrary, it is applicable with dispatch. And these characteristics render it practicable.

We have mentioned rolled steel as the typical material for the rods of the invention; and while, manifestly, rolled steel is the material most readily available, manifestly also rods of wrought-iron would serve, and metallic rods generally. The invention is realized in the integration of the wooden body and the correction of its tendency to split by means of these transverse rods of the high tensile strength that metal affords, and of shape such as to permit driving under longitudinal stress and to insure firm anchorage in position in the wood.

Particularly it is to be remarked of this dowel that, formed of metal and of high tensile strength, its diameter is, relatively to the size of the tie, relatively small. (The tie has a diameter of, say, ten inches; the dowel is formed of a rod three eighths of an inch square.) In such case, manifestly, the weakening of the tie by the dowel is negligible in amount, while the resistance to splitting is greatly increased. And it is further to be remarked that the invention is realized, not in the nailing or pinning together of two articles, but in the reenforcement of a unitary article and rendering it better fitted for service.

In Fig. III a typical pattern for the placement of the strengthening rods in the substance of a tie is indicated. Five rods in all are employed. One is centrally placed and the others are disposed in pairs and in symmetrical arrangement, near the two ends. The rods of each pair conveniently extend in a common vertical plane, and they are spaced above and below the horizontal mid-plane of the tie. It will be manifest that in such case the tendency of the tie to split will be resisted and an incipient split in the end of the tie arrested while still the split is narrower and its penetration less in depth than would be the case were there a single rod at each end of the tie placed in the mid-plane of the tie.

Fig. IV shows the track assembly from above, and (understanding the arrangement of the strengthening rods to be that of Fig. III) it will be perceived that the spikes 4, by which the rails 5 are secured to the tie, are sunk vertically (or substantially so) into the substance of the tie, at points intermediate the central and terminal lines of strengthening.

Fig. V serves to indicate how the strengthening rods serve, both to check splitting tendencies incident to the sinking of a rail-securing spike

to place, and actually to increase the holding power of the tie upon the driven-in spike. Fig. V is a fragmentary view in plan from above. The spike 4 is sunk into the substance of the tie between two lines of strengthening rods, 3, 3. The fissure opened by the sinking of the spike is diagrammatically indicated in black. Such a fissure is limited in its possible extent longitudinally of the tie by the rods 3 on one side and the other; furthermore, the practical impossibility of spread of the substance of the tie at the points where the rods 3 are situated has the effect (when a spike is driven in, as at 4) of bringing into play the elasticity of the wood, causing it more firmly to engage the spike and hold it secure.

If the invention is to be realized in the ties of a track already laid, the rods will conveniently be sunk in obliquely transverse lines, as indicated in Fig. VII, from the upper corners of the tie obliquely downward, toward the opposite lower corners. Before sinking the rods, the tie may be subjected to transverse clamping pressure and pre-existing splits closed. And fresh application of liquid preservative may have been made before such closure of splits.

Other metal reenforcements for railway ties have been proposed and used. Among them S-shaped cramp-irons of substantial breadth, sunk edgewise into the end of the tie; but these cramp-irons have been found inadequate. It is only their rigidity against the straightening of the S that is resistant to splitting strains; and, in point of fact, these S-shaped cramp-irons do straighten out, and ties do split, in spite of their presence. Furthermore, they are not, in the nature of the case, very secure, and the stresses that tend to straighten, tend often to dislodge them so that presently they lose much of their split-resisting power. In the reenforcement of this invention there is no reliance on resistance of bent steel to straightening; it is the tensile strength of the rod itself; and that, even in a slender rod secured in the manner described, is so great that no tendency to split can be so great as to overcome it and tear the rod in two.

Turning to Fig. XIV and to the telephone pole there illustrated, it is to be remarked that the pole itself 11 is by the dowels 31 of the nature and character illustrated in Fig. VI, and, applied in the manner already described, reenforced at its exposed upper end against splitting; and that the cross-arm 12 is in like manner reenforced by the similar dowels 32, in like manner applied. We have shown the dowels extending horizontally through the timber; manifestly they may be inserted to extend vertically; and manifestly both horizontal and vertical dowels may be inserted; and they may be set obliquely. The reenforcing dowels may be inserted not at the end of the timber only, but in distributed succession throughout the length of the timber. The practice of the invention thus lends itself to the varying circumstances or conditions of the material employed.

It will immediately be perceived of this installation that, like the railway tie, the pole and the cross-arm are weakened by the setting of the assembling bolts 41; and that the cross-arm is additionally weakened by the setting of the insulator-carrying pins 42. And it will further be realized that as in the case of the railway tie there are service strains, tending to rack the assembly, and to cause splitting and insecurity.

These strains are due to heat and cold, to moisture and dryness, and to storm and wind, to thermal expansion and contraction of the supported wires, and to the loading of the wires with rain and snow and ice. The tendencies to splitting are resisted and integrity in high degree is imparted to these members by the dowels of this invention.

Two dowels 32, sunk on opposite sides of pin 42, are effective to maintain the integrity of the cross-arm under service strains that, exerted upon the pin, might otherwise split the cross-arm and cause it to fail. The cross-arms have ordinarily a thickness of four inches; and in such case the dowels may be formed of quarter-inch rolled stock. And again, as in the case of the railway tie, the dowel is of such relatively small size as not appreciably to cut the fibre of the wood and to weaken the cross-arm, but rather to make way by compressing the fibre to one side and the other; while the strengthening effect of the dowel is such as to prevent splitting. The wood will be crushed and broken before it will split.

In Fig. XV a fragment of a trestle is shown in which the timbers 13 and 14, secured together by bolts 43, are severally reenforced by the dowels 33, 34 of the character, and applied in the manner, described. Here, again, the timbers that in service are exposed, not to the elements merely, but to strains that tend to rack and that make for splitting, are reenforced and their integrity insured, so that the life of the structure is prolonged, by the dowels of the invention.

It will be perceived that the invention permits some latitude in dimensions. The timber subject to strengthening in the practice of the invention may be of an order of thickness ranging from four to twenty-four inches; and, in correspondence, the thickness of the steel rod will be of an order ranging from a quarter to three quarters of an inch.

In all cases the sinking of the relatively slender, metal dowel into the timber has negligible effect in severing the fibres of the wood, but has substantial and valuable effect in lateral compression of the fibres, for the elasticity of the wood is thus brought to bear with intensified effect in holding and securing the dowel against displacement, and, consequently, in preventing the opening of splits in the wood itself.

It is manifest that the reenforcement herein described, being applied to the upper end of a wooden pile, the pile will be strengthened to resist splitting.

We claim as our invention:

1. In combination, a timber adapted to be included in a load-sustaining structure and in exposed situation, and secure against splitting under the varying weather conditions, and a dowel of metal sunk within the substance of the timber transversely of the grain of the timber and adjacent the end thereof, said dowel being of a length substantially equal to the transverse thickness of the timber and of a thickness that is uniform, unenlarged by any head, and being finned spirally throughout its length, said dowel being sunk throughout its length within and being embedded and secured in the substance of the timber with lateral compression of the wood fibre, the pitch of the spiral of the fin being such as to permit rotation under sinking-in stress and so as to be immovably embedded in said timber with respect to any substantial portion of the thickness thereof.

2. The combination of claim 1 in which the timber is a railway tie.

3. A wooden railway tie, reenforced against splitting and of prolonged serviceability, such reenforcement consisting of a plurality of dowels of metal helically finned throughout their length driven transversely of and extending through substantially the breadth of the tie, two such dowels being driven adjacent each of the ends thereof, and by engagement with the substance of the tie being immovably embedded with respect to any substantial portion of the thickness thereof.

4. A wooden railway tie, reenforced against splitting and of prolonged serviceability, such reenforcement consisting of a plurality of dowels of metal helically finned at both ends driven transversely of and extending through substantially the breadth of the tie, two such dowels being driven adjacent each of the ends thereof, and by engagement with the substance of the tie being immovably embedded with respect to any substantial portion of the thickness thereof.

5. A wooden railway tie, reenforced against splitting and of prolonged serviceability, such reenforcement consisting of dowels of metal helically finned at both ends driven transversely of and extending through substantially the breadth of the tie, and being immovably embedded with respect to any substantial portion of the thickness thereof, the dowels being arranged in pairs adjacent the ends of the tie and the dowels of each pair being arranged one above the other.

6. The method herein described of consolidating a split wooden railway tie and increasing its serviceability, which consists in closing under compression a split in its substance, and, while the tie is held under compression, sinking and rotating into its substance under longitudinally directed stress and transversely of the tie and at points adjacent its ends a plurality of metal rods screw-shaped at their ends, extending through substantially the breadth of the tie, and by engagement with the substance of the tie being immovably embedded with respect to any substantial portion of the thickness thereof.

7. The method herein described of preparing a timber for service which consists in sinking into the green timber transversely across a plane of potential cleavage, under longitudinal stress and with rotative motion, a dowel of metal spiraled throughout its length and having a steepness of spiral effective to produce rotation while so entering the wood and by engagement with the substance of the wood being immovably embedded with respect to any substantial portion of the thickness thereof, allowing the doweled timber to cure, and impregnating the cured timber with a preserving liquid.

8. The method herein described of consolidating a split wooden railway tie in situ and increasing its serviceability, which consists in closing under compression a split in its substance, and, while the tie is held under compression, sinking and rotating into its substance under longitudinal stress and diagonally from one of the upper corners of the tie transversely toward the opposite lower corner and with lateral compression of the wood fibre, a screw-shaped metal rod which when sunk to place extends through substantially the breadth of the tie and by engagement with the substance of the tie is immovably embedded with respect to any substantial portion of the thickness thereof.

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