From *Notes on Track. Construction and Maintenance*, by W. M. Camp (Auburn Park, Chicago: Published by the author, 1903.), pages 126-135. Camp was the editor of *The Railway and Engineering Review*.

10. Ties.—The selection of cross ties for track on roads of considerable length is a large and important undertaking. In this, much dependence may lie in the situation respecting the supply of timber in the locality. In timberless regions far removed from sources of supply there will usually a wide range for selection among timbers brought from a distance; while, on the other hand, where timber is abundant it is usually found to be more economical, all things considered, to use the best that can be obtained near at hand. It is between these two extreme situations, perhaps, that the most study is required in order to determine what particular kind of timber will be the most satisfactory. The cost of transportation, time required for delivery, and kindred questions increase the scope of investigation when ties are purchased at points off the railroad company's lines. The principal desideratum with ties is, of course, length of service at economical cost.

Conditions Affecting the Life of Ties.—The life of ties depends upon so many things that it is difficult of close estimation from knowing only the kind and quality of the timber. A good deal depends upon the season of the year in which the timber is felled. It is generally conceded that the proper time to fell timber is while it is free from sap. When timber is cut in the sap it will season leaving the sugar and albumen of the sap in the solid state, which will ferment and hasten decay when left to the action of water and variable heat, as is the case with timber used for ties. Also, when sap is in the timber the fibers are more open or porous than otherwise, which makes it more receptive of water from the outside than when the sap has declined naturally; and it is thought that when seasoned in this condition the pores do not close so tightly as with timber seasoned after the sap has declined. For this reason the holding power of spikes may depend to some extent upon the condition of the timber with respect to the presence or absence of the sap when it is felled. At all events it is commonly supposed that a mechanical change takes place in the condition of the fiber during the time the sap is out, which leaves the timber in a condition best suited to endure the action of the elements; and that at some particular time this condition is most favorable. On this time the opinions of good authorities vary all the way between the time just after the sap has declined until immediately preceding the time it starts again. Where some special use is to be made of the timber the determination of this particular time for the locality with some degree of exactness may be worthy of close study; but with ties it is hardly a practicable proposition to attempt to realize the desired condition so nearly as to specify a period as brief as a month or six weeks. It usually occurs, that, within reasonable limits, the time must be arranged to suit the convenience of the parties cutting the timber. In many localities a large portion of the ties are got out by farmers

who own patches of wooded lands, and thus employ themselves during their spare time in winter. And then, too, the best time to cut probably varies with the kind of timber, and certainly with the climate or region. For the north half of the United States the time between late October and early March will include the tie-cutting season of perhaps all localities, and January is probably the proper time in most cases.

Ties cut during any month should be allowed time to season before they are put into the track. This rule is often repeated, but in practice it seems to be but little heeded. Those who profess to be authorities on the subject claim that at least six months is required to season timber well in the open air, and that a year is all the better. So far as ties used in renewals are concerned the most favorable time for cutting the timber and the most desirable time for placing the ties in the track are rather too close to admit of thorough seasoning of the timber, unless it is held over until another year; and such an alternative is, of course, out of accord with penny-wise policies regarding the investment of money. To let timber stand a year to season involves an interest charge of two to three cents per tie, which falls, of course, on the railroad company, the matter being of no interest to the tie men. The tie-renewing season begins but a few weeks after the tie-cutting season ends and, as a matter of fact, a large amount of green timber is used in renewing ties. In building a new road it frequently occurs that any and all sources of supply are called upon, on short notice, and consequently much green timber and sometimes summer-cut timber, is used for ties. To aid the seasoning process the timber should be worked up into ties and peeled soon after felling. The hewing or sawing of the timber hastens evaporation of the moisture and the stripping of the bark prevents "souring" or fermentation. Timber experts say that bark should not be left on timber longer than two months after felling. The decomposition induced by leaving the bark on timber too long after felling, before the tie is made, is what the Germans call "suffocation."

In no case should ties be placed in the track before the bark has been removed. If they are not purchased with the bark peeled it will pay to have it taken off at the expense of the company. For such work a drawshave is a convenient tool, and track shovels and bark-peelers' spuds are also used. Ties peel easiest after being taken out of water, as when they have been floated in streams, or after a rain. The cost of peeling is 1 to 1½ cents per tie. With certain kinds of wood the presence of the bark after cutting favors worm eating; and with all kinds it is an absorbent of moisture, and will keep the sapwood of the tie damp as long as there is the least moisture in the ballast, thus hastening rot. Bark when dry is more inflammable than the timber in the tie and therefore renders the tie much more liable to take fire from sparks. After the tie becomes old the bark will loosen and mix with the ballast, much to its deterioration. It makes weed cutting between the ties more difficult, and, in short, it is so much of a nuisance that it should never be permitted in the track.

According to the general understanding the most durable timber is obtained

from matured trees, being superior to that cut from either young or very old trees. The disparity with the young timber is due to the relatively large amount of sapwood which it contains. It is also pointed out by authorities on timber that the location of the forest and the rapidity of growth have much to do with durability; that coniferous wood of slow growth (as indicated by narrow rings) on comparatively poor soil on high land, in dense forests, and hard or deciduous woods of rapid growth, from rich, deep, warm soil in the lowlands, but sparsely grown, yield the most durable timber of either class. The heavier and denser wood in the same species is the more durable. However much importance attaches to such conditions respecting the growth of timber, and even to the age of timber, for that matter, they have always been largely, if not entirely, overlooked in the selection of ties in this country. So far as age is concerned the "pole" tie or one faced on only two sides and made from a tree no larger than will yield one tie from a single cut, takes the preference. One reason for this is that the heart is in the interior of the tie and the sapwood on the faces occurs only at the edges of the same. Another reason is found with the advantages in the shape of the pole tie. The cheeks or rounded sides of the tie, from the center line downward, afford some bearing upon the ballast between the ties, and the weight of the filling material or ballast bearing upon these cheeks from above assists in holding the tie in position, making it more secure against being moved out of line or "churned" in the ballast than is possible with a tie sawed four-square. With some roads (one of which is the Buffalo, Rochester & Pittsburg Ry.) nothing but pole ties are standard, ties sawed on four faces, of whatever size or quality, being received only as second class.

Ties of any kind of timber resist decay longer in the colder countries, where the ground is frozen during several months of the year. For example, the average life of winter-cut white oak ties grown on high ground in Kentucky, Tennessee and Mississippi, and used on the Illinois Central R. R., is, by official statement, 7½ years on high ground in the states where it is grown, 10 years in lllinois and 11½ years in Northern Iowa. White oak ties grown and used in southern Arkansas last but 4 years, on the average, while ties of the same timber grown in the same locality, when used in northern Illinois and Wisconsin, have an average life of 8 years. In the warm climate of southern Arkansas the timber is filled with sap at all seasons of the year, and ties cut therefrom are necessarily in sap. Under the continual action of the heat and moisture of the southern climate the process of decay is rapid, while in the northern states referred to, where the ground is frozen three or four months of the year, chemical change is entirely arrested during that time, and more or less retarded during other of the cooler months. Prolonged wet seasons shorten the life of ties, especially where the climate is hot. The life of ties varies with the kind of ballast used, to a large extent, being longer, for a usual thing, in those kinds of ballast which dry out most thoroughly and quickly. In loose material, like sand, gravel, broken stone or cinder, the exterior of the tie decays sooner than it does in

compact material like clay, which is probably due to the condition respecting the exclusion of air. The chemical properties of the soil or ballast also have an influence on the life of ties. It is commonly understood that the effect of cinders is to shorten the life of ties. On the other hand, in 1901 there were ties in the track of the Central Pacific road, in salt and potash soils, in parts of Nevada and Utah, not the least bit decayed, which were laid when the road was built, in 1868. Ties of the same kind of timber in light, sandy loam roadbeds rot out in 3 to 4 years.

Hard ties in stone ballast are hammered by the rail, and soft ties are rail cut, either action shortening the life irrespective of the destruction of the fiber by rot. The driving of many spikes into a tie, or a single spike redriven several times, mutilates and destroys the material of the tie just where it is put to the most severe service; so also does the grinding action of sand where it is habitually used, as on grades, near stations, etc. Ties of some kinds of timber check on the upper face from the heat of the sun and such open cracks get filled with sand or dust. Then when the tie gets wet the water gets in and is held by the earthy material to start decay in the interior sooner than otherwise. All these conditions, where they obtain, have to do with the life of ties. Good drainage lengthens their life.

A great deal of misleading data has been published on the life of ties. As a rule, the average number of ties placed in renewals per mile of track per year, reported by the railroad companies without qualification, is not a reliable basis for estimating the average life of the ties removed, because account is seldom taken of new road and sidetracks built within a back period corresponding to the life of the ties. When estimated on such figures the apparent life of the tie is too long, for it is clear that new track increases the mileage without increasing the renewals for a number of years. In estimating the life of ties from the renewals no track should be included on which renewals have not been started, and, properly, no track on which the ties have not been renewed during at least three consecutive years, because during the first two or three years after the ties begin to fail the renewals are unusually heavy. On such grounds it would seem, therefore, that no track less than 7 to 12 years old, according to the quality of the ties should be considered. As it is usually desired to know the average life of ties for main-track service, separate account should be kept of those used in side-tracks, where the timber is allowed to reach a more advanced state of decay before removal than would be safe for main track. In a general estimate on the life of ties, including all kinds of timber used for that purpose in this country, in its natural state, the average duration is usually taken at about 6½ years.

Manner of Cutting.—The advantages inhering with the pole tie have already been explained, and the same may be claimed for ties of any regular shape which conduces to anchor them in the ballast. In some of the European countries it is the practice to chamfer the upper corners of the tie, so as to narrow the face and reduce the supposed rocking motion claimed to be set up by the undulations in the rail. Such practice is badly advised, because under rolling loads the roadbed

undulates with the rail and the rocking of the ties in the ballast is inappreciable; and besides, reduction in the width of the upper face without the use of tie plates removes fiber needed to resist rail cutting. Ties made from small trees are usually hewed, while from large trees they are sometimes split, but most frequently sawed. It is widely claimed that hewed ties last at least a year longer than sawed ties of the same quality of timber. One explanation for the inferiority of the sawed tie is that the faces are cut obliquely to the grain, exposing the ends of a great many fibers, which are roughened and started to a considerable depth, so that water is readily absorbed in wet weather. A hewn face is smooth, usually follows the grain, and is supposed to shed water to more or less extent for at least a year or two. For the purpose of smoothing the faces and making all ties exactly the same thickness (an unnecessary refinement), it is the practice in some mills to take the ties as they come from the saw and run them though a planer, surfacing two sides. Another objection to sawing, and one which is not overcome by planing, is that ties sawed out of crooked logs may be so crossgrained as to easily break in two under load or split in spiking. On split ties the faces naturally follow the grain of the timber, but some hewing is usually necessary to take out the wind at the rail seats. A sawed face affords an even bearing for both rails, which is not so liable to be the case with a hewed or split face. In ties sawed or split out of large trees it is not an easy matter to detect old timber, timber felled out of season, or even timber which was dead at the time of felling. In point of fact the timber worked up at saw mills, unless felled under contract at a specified time, is usually felled at any and all seasons of the year.

Fig. 25.

There are various conventional terms to denote the different ways of splitting up large timber into ties. When a log is sawed or split into four pieces, so that the heart is divided, each tie will have a piece of the heart at or near one of its corners, and is known as a "quarter" tie. When a log is sawed or split into two pieces (each piece is known as a "slab" tie, if the heart comes in either top or bottom face, and a "half" tie if it comes in a side face. In Fig. 25, A is a quarter tie, B a slab tie, C a half tie and D a pole tie. Tie C is shown faced only three sides; if faced four sides it would still be called a half tie. The half tie is more liable to split in spiking than is a slab tie, for the reason that the spike enters the wood tangentially to the rings. Ties made from large timber should be laid heart side down, thus disposing the rings of the timber to shed water. The heartwood of most kinds of timber offers more resistance to rail cutting and holds the spike better than the sapwood, but it checks worse when turned up to the sun and the sapwood does not last so long in the ground. When the heart side is up the rings

of the timber dip or open out, like troughs, and hold water. With pole ties the wider face should usually be laid downward. In cutting up large trees there is economy of lumber in sawing or splitting ties to rectangular section, and as an article of freight ties of that shape weigh less and occupy less space than pole ties having the same width of face. Under other considerations, however, it is inadvisable to face small timber four sides for ties, not alone because of the advantages already pointed out for the pole tie, but for the further reason that weight is a desirable property in track material, on account of the increased stability it gives.

Crooked timber should not be hewed into belly-shaped ties. With such timber it is better to make the faces straight, even though somewhat across the grain and though the tie be narrow-faced in the middle or at the ends. There is no particular objection to a crook in the tie horizontally, if not too much so. Ties, however made, should not be put into the track belly up, for a tie bulging upward in the middle of the track presents an ugly appearance and forms an obstruction to tear loose dragging brake rigging and pieces of car trucks; and such a tie is difficult of removal when it must be taken out. When a tie is put belly downward in dirt ballast its bed forms a sort of receptacle from which the water does not run freely after a rain.

Tie Dimensions.—The most common length of tie for standard gage track is 8 ft., but since heavier rolling stock and heavier rails with wider bases have come into use many railway companies have increased the length to 8½ ft. For a tie of given thickness there is some certain length which conduces to a uniform distribution of rail pressure over the whole length of the tie. The experiments of Mr. A. Wasiutynski, permanent way engineer of the Warsaw-Vienna Ry., described under "Rail Deflection" (§181, Chap. XI.), show that such a length for white oak ties 6 ins. thick lies somewhere between 8 ft. and 8 ft. 10 ins. One of the general improvements carried out on the Prussian State and Imperial roads during recent years is an increase in the standard length for ties, both wood and metal, from 8 ft. 2½ ins. to 8 ft. 10¼ ins. (2.5 to 2.7 meters). In dirt ballast, where the ends of the ties must be exposed to insure proper drainage, a tie 9 ft. long seems to answer better than one of shorter length, since more support can then be given the track outside the rail and lessen the tendency to center binding, which is more pronounced with track in dirt ballast than in other kinds of ballast. Ties of such length are standard on a number of roads. Whatever the standard length, the specifications should be closely enforced. A variation of more than an inch either way ought not to be allowed, as there is no necessity for it. Where the ties are of uniform length the track is more evenly supported than is the case where the lengths vary. To give both rails equal support the middle of the tie should be at the center of the track, and if the lengths be not the same, or nearly so, either this condition cannot obtain or the ends will be out of line and cause a bad appearance. Still, where the ties are of irregular lengths it hardly improves the appearance of things to line one side, because then the track looks one-sided. The

care usually taken to put the ends of ties to line on one side would, if the ties were approximately of equal length, secure fair line on the other side also, without extra trouble or expense. The habit of cutting ties to vary from 3 to 6 ins. from a standard length is slovenly and inexcusable, and the party who should pay for the consequences should be the individual who makes the ties, and not the railway company. The specifications of some roads require that ties more than 1 in. shorter than standard shall be rejected, on the first-class scale, and those more than 1 in. longer than standard length shall be cut off before they are received. The ends of ties should be cut with a saw, and reasonably square.

Besides being of equal length ties should be of uniform thickness, or nearly so. Ties varying much in thickness make an uneven rail surface for the outfit train to run upon during construction, unless considerable shimming or surfacing be done at a time when there is little opportunity to do it; and when not done there is danger of damaging the rails. The right thickness is about 6½ ins., and a variation of more than ½ in., at the most, should not be allowed. A tie much less than 6 ins. thick will be lacking in stiffness, and it is liable to be split when the spikes are driven, because the spike reaches so near to the under face. On the other hand a thickness of more than 7 ins., with ordinary tie spacing, interferes with facility in the use of the tamping bar. In pole ties extra depth narrows the faces, a difference of 1 in. in depth making a considerable difference [in the] width of face. To allow for strength in the case of ties longer than 8 ft. and for both strength and for rail cutting in the case of soft wood ties, it is well to give such ties the benefit of the maximum allowable thickness. On a few roads soft wood ties are made as thick as 8 ins., but on a great majority of the roads the standard thickness of ties of all kinds of timber is either 6 or 7 ins., perhaps more oftener 7 ins. than 6 ins. As touching the matter of strength a slight variation in the thickness of the tie makes a large difference. Since beam strength varies as the cube of the depth or thickness the relative strength of a 7-in. tie to that of a 6-in. tie of the same width, is as 343 to 216, or 59 per cent greater.

While there is neither difficulty nor reason why all ties should not be of the same length and thickness, it is not always so with regard to the width of face; neither is it so necessary that it should be. There is much said concerning the arrangement of ties in track with reference to uniformity of width of face that is to no great purpose. As long as there is no tie with a face narrower than a minimum acceptable, and the variation in width of face among all the ties is not greater than 50 per cent, it is hardly worth while to waste words with the tie maker or to consume time trying to arrange ties of the same width of face to go into the track together. Ordinarily about 40 per cent of the surface of the rail base rests upon tie face, and of course the same proportion of the surface of the ballast can be covered by tie face, be the ties large or small, so long as they are properly spaced. By spacing ties a certain distance apart in the clear (as they should be), and not a certain distance apart center to center, and increasing the width of the spaces next the largest ties, in case they are abnormally large, the

bearing surface of the ties will be about equally distributed along the rail. A rough estimate in adjusting the spaces, by the eye, even where a considerable variation in width of face exists, will not appreciably depart from the proper proportion of bearing surface. Where the ties are small there are more, and where large, less of them for a given length of rail, and consequently about the same amount of bearing surface in either case.

A 6-in. face for pole ties and an 8-in. face for ties of rectangular section is the minimum allowable for main track. Smaller ties, bought at a reduction in price, may answer in side-tracks; but enough for this purpose may usually be had in culls from the whole lot offered for sale, because quite frequently a small tie must be made from the top of the tree in order to avoid undue waste of timber. But there is also such a thing as a tie too wide to give good results. Wide ties are seldom tamped as firmly as they should be; and it is somewhat difficult, also, to do it properly without using time much out of proportion to the size of the face. A tie having a face exceeding 10 ins. in width is too large for main track. The width of face giving best results all around is 8 ins. for pole ties, and 9 ins. for ties of rectangular section.

Kinds of Timber.—Oak, pine and cedar are now the timbers principally used for ties. White oak, rock or bur oak, post oak, chestnut oak and red oak are the varieties used. White oak is the timber which gives the best all-around results. Of the durable woods, when seasoned, it holds a spike the firmest, and, except under very heavy traffic, it supports the rail without being cut into until after it is well along in decay. Its life, stated in a general way, is from 5 to 10 years, depending upon circumstances, some of which have already been noted. A general average of the average life of white oak ties reported by 22 well-known railroads of the northern states. located both east and west of the Allegheny mountains, is 8¼ years. The figures taken into account in this average were supposed to represent the life of ties which had failed by natural decay and not by rail cutting. In the southern states the life of white oak ties seems to average 5 to 6 years. The weight of a 7x9-in. seasoned white oak tie 8 ft. long, sawed on four sides, is about 185 lbs.; of a 6x8-in. tie of the same length and sawed in the same manner, about 140 lbs.; of a white oak pole tie 8 ft. long, 6½ ins. thick, with 8-in. faces, about 175 lbs. The toughest and best quality of white oak, when green, takes on an inky blue color when cut across the grain. The other kinds of oak are not so good. Rock oak comes next best. It is hard, but not quite as tough as white oak, and its life is about the same. Red oak is more brittle and softer, not holding a spike nearly so well as either white or red oak, and its life is not more than half that of white oak, sometimes lasting not more than three years. It makes excellent material for shims on account of its straight grain and ease of being split without shattering. It is subject to worm eating. Oak ties are used throughout the Allegheny mountains, in the middle Atlantic states, in the lake states, and in the Ohio and Mississippi Valley states. In 1900 it was estimated by

good authorities that the different varieties of oak ties comprised about 50 per cent of all ties in service in this country; ten years earlier the estimate was 60 per cent.

In the south Atlantic and gulf states southern yellow pine ties are used extensively, and late years large numbers of them have been shipped into the middle Atlantic and New England states. The life in the South is 4 to 6 years and in the North 8 to 12 years. In the white sand ballast of some of the roads in Florida these ties last but 4 years and on the Isthmus of Panama but 1 to 2 years. In western Texas, New Mexico and Arizona a mountain pine is largely used for ties, but it is inferior to the southern yellow pine, lasting only 4 or 5 years when laid in the natural condition; when treated with zinc chloride such ties last 8 to 12 years or longer, as witnessed by the experience of the Atchison, Topeka & Santa Fe Ry. (§168, Chap. XI). California mountain pine is of better quality. In the gulf states black and red cypress are used to a considerable extent. It is a soft timber requiring tie plates for best results. The natural life, as reported by some roads, is 10 to 12 years.

The most durable timber for ties, so far as resistance to decay is concerned, is cedar. Both red and white cedar are the varieties available but the supply of the latter is much the more abundant. It is a very soft timber and is cut into by the rail so rapidly that it is sometimes taken out, turned over, and put back long before there is any sign of decay. It is used to best advantage on straight-line track under light traffic. Under heavy traffic it does well on tangents if tie plates are used, the life of cedar ties, when so protected, being 15 to 20 years, and even longer. ln fact the natural life of cedar ties seems not to be widely known, if known at all, because in nearly every case where such ties have failed the cause has been either rail cutting or spike killing. On the Saginaw division of the Michigan Central R. R. there are large numbers of cedar ties, which have been in service more than 19 years, and the ties are still in sound condition and expected to last 10 years longer. Tie plates were not used on these ties until after they had been in service 18 years. On the Buffalo division of the Buffalo, Rochester & Pittsburg Ry. there are cedar ties in the track which have seen service for 17 years and are in condition for further use. There is on record the case of a red cedar tie which did service in the track of the Boston & Providence (now New York, New Haven & Hartford) R. R. from 1834 to 1876 or 42 years. Sound, dead cedar gives just as satisfactory service as live, green cedar, which is a fortunate circumstance, for the bark of cedar trees is thin and over large areas of cedar forests which have been swept by fires the trees have been killed. The supply of cedar ties in this country is obtained largely from Canada and from states along the Canadian border, such as Maine, Michigan, Wisconsin, and Washington. Cedar is light in weight and is carried farther for ties than any other timber. When used with tie plates it is considered to be a very economical tie timber. On the behavior of cedar ties under traffic, and the use of tie plates with the same, the reader is referred to a comprehensive article entitled “Cedar Ties in Service,”

written by Mr. Moses Burpee, chief engineer of the Bangor & Aroostook R. R., and published in the Railway Review of March 13, 1897. Spikes hold best in cedar ties when driven in the sap, or as close to the edges of the tie face as good practice will permit.

The average life of chestnut ties is about 7 to 9 years. Chestnut timber is medium in hardness and holds a spike quite well. It is found quite abundantly in the middle Atlantic and New England states and is there much used for ties, telegraph poles, and fence posts. It is disposed to check badly in the sun. In the northern states east of the Mississippi river hemlock is used to a considerable extent for tie timber. It is soft, but holds a spike tolerably well. It usually rots from the outside in, and it will hold the spike quite firmly, sometimes, when so rotten on the outside as to be of no further use. The life of native hemlock ties is 4 or 5 years, but hemlock ties brought from Canada and used in New England last a year or two longer.

In California, redwood is extensively used for ties. It is soft but durable, and when green it is heavy. Redwood ties are usually split out of large timber. On the Southern California Ry. (Santa Fe System) redwood ties, used with tie plates, have been found in good condition after a service of 14 years. Without tie plates the life of this timber is measured by the traffic carried rather than by time. There are records of redwood ties in side-tracks on the Southern Pacific road, perfectly sound after 40 years of service. Farther up the coast in Oregon and Washington, fir and white cedar are used. Fir, if first allowed to season, holds a spike well, and lasts 6 to 13 years in gravel ballast. In Montana ties are principally tamarack and cedar. In the Ohio Valley wild cherry, honey locust and black walnut are used to a small extent for tie timber, and each lasts about 8 years. In Canada cedar, oak, tamarack, hemlock spruce and fir are the tie timbers largely used, the average life of all except cedar and hemlock being about 8 years. Tamarack is a variety of larch (American or black larch) and in some localities is called hackmatack. Its durability is quite variable, for in some parts of Canada and the United States the average life is only about 4 years. On the Duluth, Missabe &. Northern Ry. it lasts 6 years. In Canada the average life of hemlock ties is 6 years.

It is an easy matter, and useful as well as interesting, to so mark a tie when it is put into the track that at any time its length of service may be known. This can be done by simply cutting a notch in the edge of the tie face, in a certain position fixed for each year of a decade. Say the road runs north and south: then let the odd numbered years be marked on the north edge of the face and even numbered years on the south edge. Starting at the east end of the tie, let successive notches toward the west end thereof indicate years increasing upwards to ten. As distinct positions for the notches points can be taken outside the rail, just inside the rail, and at the middle of the tie, making positions for five notches on each edge of the tie face. With ties thus marked the foreman is able to take note of the ages of the ties removed when making his report on renewals. A system of

notching something similar to that above described has been used on the Allegheny Valley Ry. On some roads, including the Southern Pacific and the Lake Shore & Michigan Southern, the ties are stamped when put into the track with a cast iron hammer having a raised figure on the striking face denoting the year. The figure is quite large and is raised about 1/8 in. The usual practice is to stamp the tie in the end, on the line side, and sometimes also on the top. At the end of each year all the hammers bearing dies for that year are called in and scrapped and new ones are cast for the new year and issued to the section foremen. To preserve a record of the life of treated ties the Chicago Tie Preserving Co. uses a galvanized iron nail with the last two figures of the year of treatment stamped on the head. The nail is ¼ in. in diam. and 2½ ins. long and the head is 5/8 in. in diam.