in keeping the track to gauge and line on curves and places where there is a tendency of the rails to spread. By fulfilling these requirements the tie plate has the great advantage that it enables a comparatively soft tie to be used to advantage in places where the traffic is heavy, and in addition to this it will also prolong the life of a hardwood tie. A sub-committee of the American Railway Engineering Association devoted a great deal of time to the special study of this subject and took measurements of the actual abrasion of ties in service with and without tie plates. The opinion formed by this sub-committee was that flanged tie plates of suitable design, width and thickness, and properly applied on

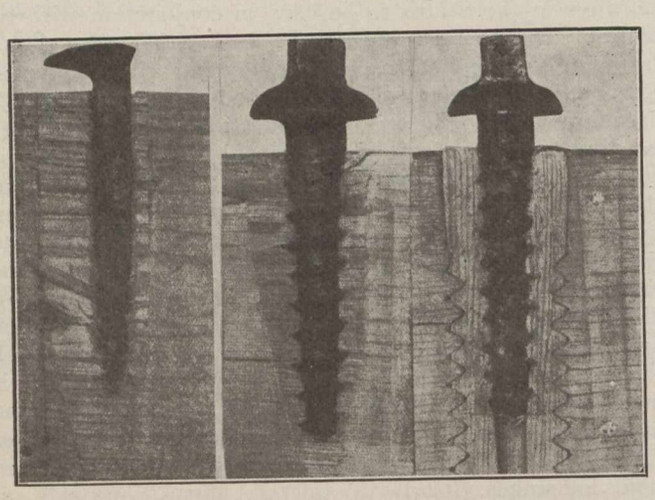

Fig. 4.—Cut Spike in Bored Tie. **Fig. 5.—Screw Spike in Bored tie (left) and With Dowel (right).**

tangents as well as on curved track will lengthen the life of cross-ties to 2 or even 3 years, and in the meantime the track will have been maintained in better surface and line and at less cost than could have been done without the plates. The averages of the results obtained of measurements of the abrasion of ties by rail-cutting are given in Table IV.

Table IV.—(White Oak Used for Ties Throughout) Abrasion of Ties by 85-lb. A.S.C.E. Rail, Without Tie Plates.

Alignment.	Traffic.	Age.	Outside edge of base of rail.	Inside edge of base of rail.	Remarks.
Tangent	Heavy	7 to 8 yrs	3/4 in.	3/8 in.	Single track
,,	,,	8 yrs.	1/4 in.	3/8 in.	East Bd. track
Curve (slag ballast)	Light	—	3/8 in.	3/8 in.	Inner rail, yard track, outer rail tie plated, no abrasion.
Tangent	Heavy	5 yrs.	1/2 in.	1/4 in.	East Bd. track
,, (gravel ballast)	,,	6 yrs.	1-1/16	5/8 in.	——
5 deg. curve	Heavy	—	3/4 in.	3/16 in.	Inner rail, outer rail tie plated, no abrasion.
2 ,, ,,	Light	—	5/8 in.	1/2 in.	Fast Pass. trains
1 ,, ,,	,,	—	1/2 in.	3/8 in.	,, ,,
Tangent	,,	—	1/4 in.	1/8 in.	,, ,,
8 deg. curve	,,	—	3/8 in.	1/4 in.	Tie plate on opposite ends of ties, no abrasion.

The requirements of a tie plate in general are as follows: The plate must be rigid enough to equally distribute the rail load over that part of the tie which it covers. If the plate is too thin it will buckle and the load will be transferred to the tie through a thin strip of metal the same width as the base of the rail, and the value of the plate for distributing the load will thus become nil. The tie plate must be rigidly held to the tie so as to prevent dirt and water collecting between it and the tie, and a great many railways favor the plate being so well embedded into the tie by means of flanges or claws so as to assist in the lateral displacement of the rail. In the case of flanges being used they should be deep enough to grip the wood but they should not be so deep as to damage the wood fibres, and when the flanges are placed longitudinally they help very considerably to make the plate rigid and the thickness can consequently be reduced.

In Table V. reports to the American Railway Engineering Association have been compiled to give a general idea of the different standards adopted in 1913 by the larger railways of the continent. A great deal of the variation is in the minor details and it must be borne in mind that what is suitable for one purpose would be absolutely unsuitable under different conditions. It is probable, however, that more universal standards will be adopted in the near future.

Table V.

Railway	Type of plate	No. of holes	Outside dimens. of plate
			Ins.
A. T. & S. F	Pronged or corrug'd, transverse flange*	4	9x7½
Al. Cent. & Hud. Bay.	Sellers patent	4	8½x6–80-lb.
B. & O.	Various	3	9x7–100-lb.
Bangor & Aroostock.	Claws	2	8½x5½–80-lb.
Boston & Maine	Longitudinal flange	5	8¾x5–85-lb. 9x5–100-lb.
B. R. & P.	Claws	4	9x7.
C. C. C. & St. L.	Longitudinal flange	4	8½x6–90-lb.
Chicago & Gt. West'n.	Longitudinal flange	4	8¾x6⅜.
Chicago & Alton	Corrugated and Sellers	3	6½x6–80-lb.
C. & N. W.	Corrugated Sellers pat. bottom	2	9x6–100-lb.
C. B. & Q.	Sellers pat., also transverse flange	2	9x6–100-lb.
Can. Pac. Ry.	Sellers pat., also corrugated	4	8½x6½–80-lb.
Denver & Rio Grande.	All types	4	8½x5–80-lb.
Frisco Lines	Longitudinal flange*	4	8¾x6½–80-lb.
Gt. Northern	Transverse flange	4	8½x6½–90-lb.
Grand Trunk	Longitudinal flange	4	9x6–100-lb. 8¾x5–80-lb.
Ill. Cent.	Flat bottomed	4	8¾x5⅜.
Lehigh Valley	Transverse flange	3	9x7–100-lb.
L. & N.	Claw	2	8x6–90-lb. 7½x6–80-lb.
Long Island	Longitudinal flange	4	9x6–100-lb. 8x6–80-lb.
Miss. Pac.	Flat, and corrugated	4	
Mich. Central	Transverse flange*	3	9x6–100-lb 9x5–100-lb
Northern Pac.	Longitudinal, for tans. and curves less than 3 deg.	3	8½x6–90-lb.
Northern Pac.	Pronged for curves over 3 deg.	2	8½x6–90-lb.
Norfolk & West'n	Longitudinal flange	4	9½x6–100-lb.
New York Cent.	One Longitudinal flange	4	9x6–100-lb. 8½x6–80-lb.
National of Mex.	Flat bottomed	4	
Pennsylvania, East	Transverse flange	6	13½x7–100-lb.
Pennsylvania, West	Pronged	4	9x7–100-lb.
Philadelphia & Read'g.	Flat bottom	4	10x7.
Pittsburgh & Lake E.	Flat bottom*	4	8½x7.
Rock Island Lines	Flat with screw spikes, trans. flange, with cut spikes*	4	9¼x6¼–100-lb
T. & North Ont.	Sellers patent	4	8½x6.

*Cut spike and screw. In all other cases cut spikes only.