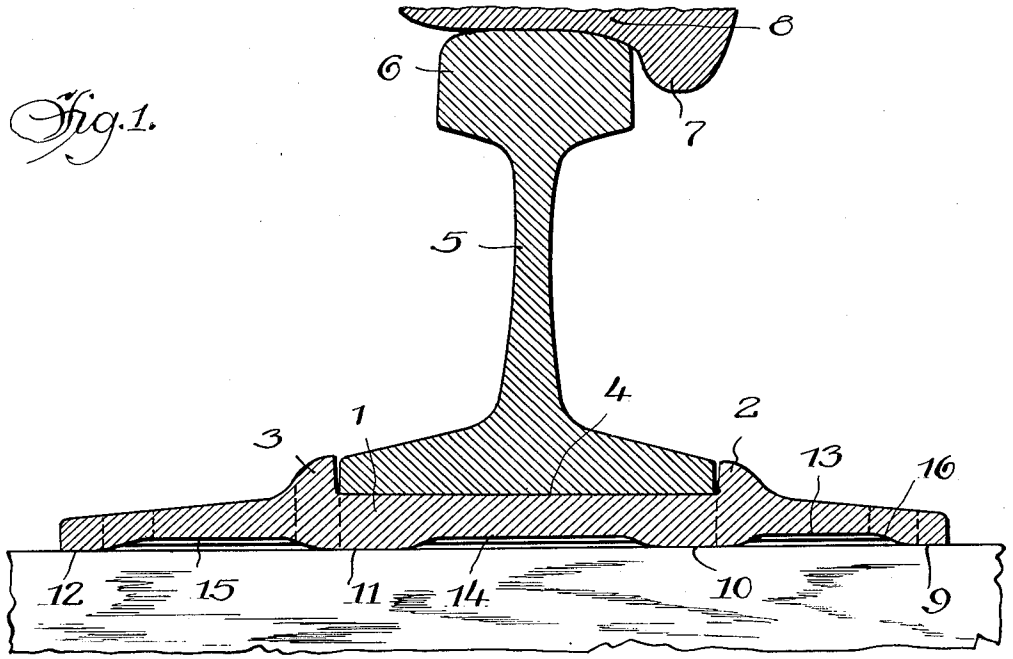
Oct. 14, 1952 W. S. BOYCE 2,613,876

TIE PLATE

Filed Dec. 6, 1946 2 SHEETS—SHEET 1

Fig. 1.



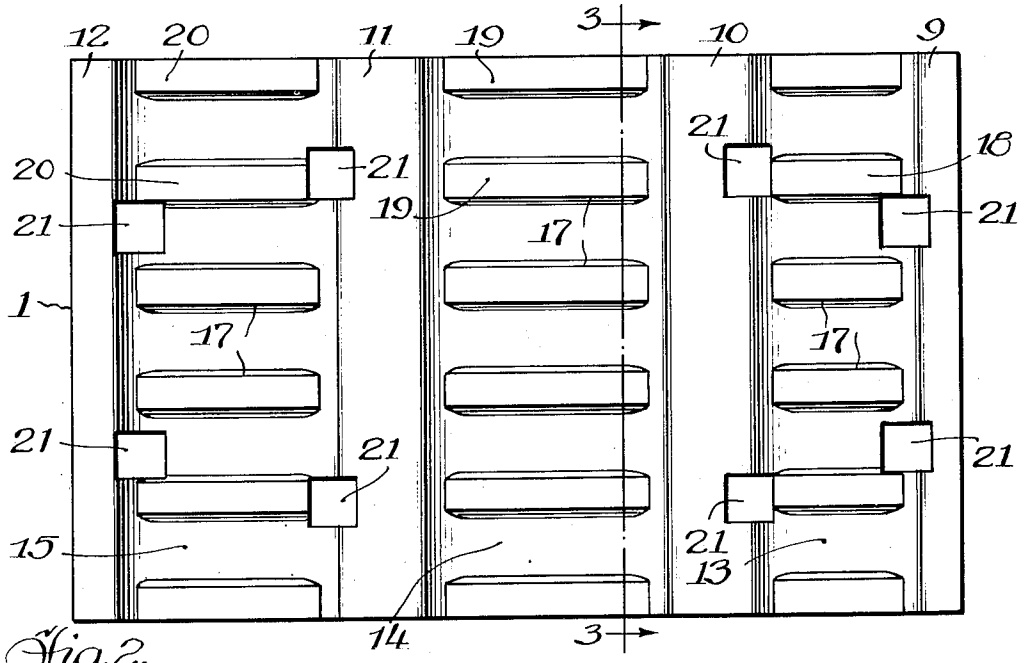
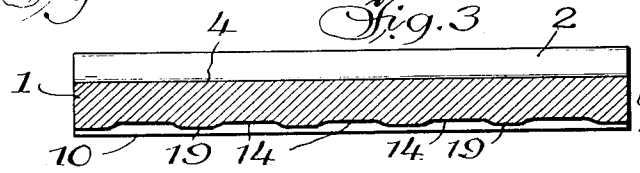


Fig. 2.

Fig. 3



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Filed Dec. 6, 1946 2 SHEETS—SHEET 2

Fig. 4.

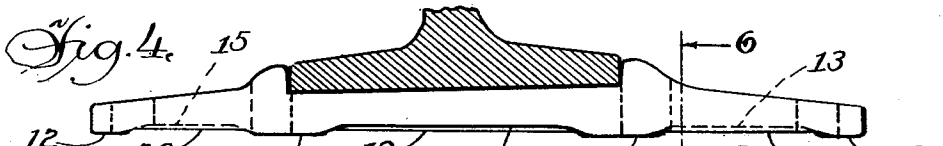


Fig. 5.

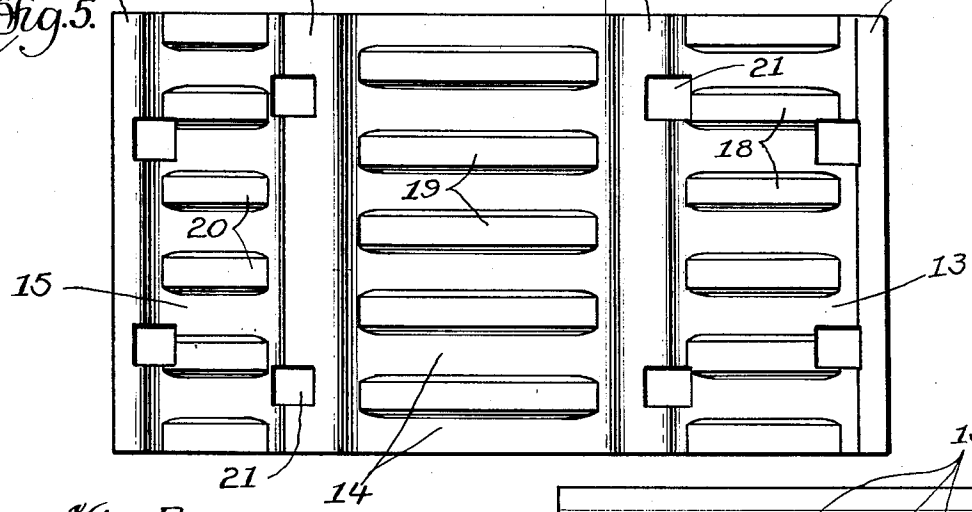
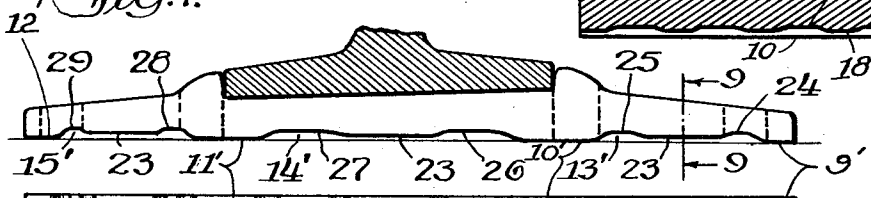


Fig. 6.

Fig. 7.



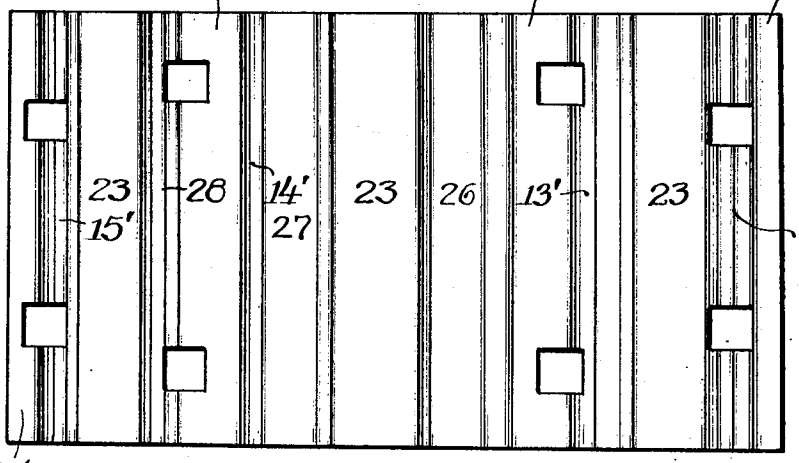


Fig. 8.

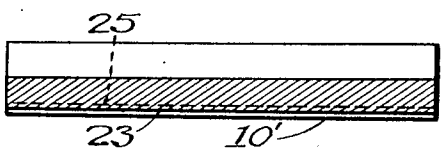


Fig. 9.

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UNITED STATES PATENT OFFICE

2,613,876

TIE PLATE

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Application December 6, 1946, Serial No. 714,544

12 Claims. (Cl. 238—306)

1

This invention relates to a tie plate of the type used in railroad track construction, and more particularly to a tie plate structure having vertically separated primary, secondary and tertiary bearing areas that are individually coplanar and that will successively adjust themselves to initially flat tie surfaces, to firmly anchor the rail to the ties and prevent any possibility of gage misalinement.

The present invention is an improvement on those shown in United States Letters Patent 1,583,773 and 2,018,658 granted to me May 11, 1926, and October 29, 1935, respectively. While the tie plates of said prior patents were efficient for the purpose then intended, railroad operations have, with the additional requirements of speed and safety, made necessary a more effective tie plate that will meet the increased requirements and effectively minimize the possibility of misalinement of the track gage as result of operation of trains. The tie plate of the present invention is so constructed as to meet all of the present rigid requirements of increased speed of rolling stock and more effectively and safely secure the rails to the ties.

Among the objects of my invention are: to provide a novel and improved railroad tie plate; to provide a tie plate structure which will successfully adjust itself to initially flat tie surfaces and by means of vertically separated surfaces that are individually coplanar will provide adequate immediate anchorage for rails on ties by means of properly distributed bearing areas providing fractional embedment of such bearing areas in the ties, particularly ties of soft woods or similarly compressible material; to provide a tie plate that will expeditiously grip and retain its initially positioned tie seat and minimize subsequent movement thereon; to provide a tie plate of adequate strength and in which the metal in the plate is so distributed as to attain the maximum strength consistent with the weight of the plate and computed load requirements; to provide a tie plate having primary, secondary and tertiary tie bearing surfaces or areas that are individually in a common plane, they aggregating substantially the total potential bearing of the plate on the tie and so arranged as to materially facilitate the mechanical rolling of the tie plates during the recognized conventional method of production; to provide a novel construction and arrangement of the bottom surfaces of the tie plate to embody a plurality of parallel transversely extending primary tie bearing areas spaced apart in a direction longitudinally of the tie, with a laterally extending recess between each two adjacent primary areas to provide tertiary bearing areas, and a plurality of secondary bearing areas in said recess; to provide vertically spaced apart primary, secondary, and tertiary tie bearing areas the spacing between each thereof being substantially equal in a vertical direction; to provide a plurality of primary tie bearing areas constituting approximately 25% of the total plate bearing area, and secondary tie bearing areas constituting approximately 25% of the total plate bearing area; and such further objects, advantages and capabilities inherently possessed by my invention, as will later more fully appear.

2

My invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings, and while I have shown therein for illustrated purposes, preferred embodiments of my invention, I wish it understood that the same are susceptible of modification and change without departing from the spirit of my invention.

In the drawings:

Fig. 1 is a vertical section through a fragmentary transverse portion of a car or locomotive wheel, a transverse section through the rail, and a section through the tie plate longitudinally of one of the ties, which latter is shown fragmentarily in elevation.

Fig. 2 is a bottom plan view of the tie plate shown in Fig. 1.

Fig. 3 is a vertical transverse section through the tie plate on the line 3—3 of Fig. 2.

Fig. 4 is a side elevation of a modified form of tie plate and showing in section a fragment of the rail seated in the rail seat.

Fig. 5 is a bottom plan view of the tie plate of Fig. 4, showing the secondary bearing areas of each transverse row staggered with relation to those in the next adjacent rows.

Fig. 6 is a vertical transverse section on the line 6—6 of Fig. 4 but omitting the rail.

Fig. 7 is a side elevation of a further modified form, and showing in section a fragment of rail positioned on the rail seat.

Fig. 8 is a bottom plan view of the tie plate of Fig. 7 but omitting the rail.

Fig. 9 is a vertically transverse section through the tie plate on the line 9—9 of Fig. 7.

With the advent of mechanical adzing machines for preparing a tie plate seat on the ties, and plate-cut ties in the track in connection with rail renewals and on new ties before their insertion, it is important to provide the charac-

teristically smooth tie plate bottom which will promptly seat on the tie and remain in its initially applied gage holding position. Projections extending below the bottom plane of the tie plate, or longitudinally disposed configurations on the tie plate bottom or merging into the bottom plane of the tie plate, are deficient adjuncts for effectively accomplishing under heavy traffic the important functions required of an efficient tie plate structure. The ends of the spaced pockets 16, 17, and 18 of my Patent 2,018,658, it will be noted, merge into the plane of the transverse members of the plate bottom. These recesses are produced in the rolling process by correspondingly formed projections on the periphery of the rolls. In rolling operations while forming the required shapes in the tie plates, water is used as a coolant for the rolls. With the forcing of these recesses in the hot bars passing between the rolls to form the desired tie plate section, trapped steam causes minor yet severe explosions at the recess ends resulting in ragged, objectionable, more or less rough surfaces and rapid deterioration as well as cracking of the roll surface requiring frequent and expensive redressing of the rolls. I have overcome these disadvantages in the present invention by the formation of the novel arrangement of the primary, secondary and tertiary bearing areas.

Immediate and positive gripping of, or adhesion to, the tie is an essential operative function of the tie plate. Projections and bottom configurations of varying depths indiscriminately disposed necessitate full penetration in the tie surface to become effective. I have provided in the present invention a novel design and structure of a tie plate embodying primary, secondary and tertiary tie bearing areas in vertically spaced relationship to each other, their respective areas aggregating the potential ultimate maximum bearing of the plate on the tie, these areas being so arranged as to apportion unit load distribution to insure uniform and stable gripping of the tie. Uniform seating of a tie plate on the tie is a function of uniform applied load and proper distribution of unit pressure transmitted to the tie. In the present construction I have provided for the initial concentration of load through the coplanar surfaces at the tie plate ends and under the margin of the rail flanges, these surfaces constituting in effect the primary tie gripping portions transverse to the tie fibers provided by recessing the plate bottom portions intermediate such bearing surfaces or areas.

It will also be noted that in the bottom structure of the tie plate disclosed in my Patent 2,018,658, the longitudinally extending plane surfaces 20 retard the desired gripping action of the initial bearing areas transverse of the grain of the tie. This delayed gripping action incident to lateral load thrusts transmitted from the wheels through the rail to the plate induces longitudinal displacement of the plates affecting the important uniformity and accuracy of the track gage, a deficiency which practical performance has demonstrated. By providing the secondary tie bearing surface areas in vertically spaced relation to the primary transverse tie bearing surface areas, said secondary areas being comprised of a plurality of laterally spaced bearing units situated in the median and end portions of the tie plate as contemplated in the present invention, improved advantage in positive structure is accomplished. In the recessed portions of my present tie plate are positioned a plurality of members constituting secondary bearing areas laterally spaced with relation to each other and in vertically spaced relationship to the primary tie bearing areas. I have also provided tertiary tie bearing areas which are in vertically spaced relation to both the primary and secondary bearing areas and are composed of the main body portion of the plate intermediate the primary and secondary bearing areas. While I am referring to the primary, secondary and tertiary bearing areas as being respectively coplanar, as they preferably are, I wish it understood that in some instances they may depart from being strictly flat if desired.

In the form of my invention shown for illustrative purposes in the drawings, my improved tie plate comprises a body portion 1 having on its upper surface spaced apart transversely extending rail abutting shoulders 2 and 3 defining a rail seat 4 within which is seated the rail 5 having the head portion 6 to receive on its gage side the flange 7 of the wheel 8. Predominantly in railroad tie plates the rail seat 4 is slightly inclined so as to throw the upper portion of the vertical center line of the rail slightly to the inside to enable the rail to better maintain the proper gage of the track, by reason of being better able to resist the outward thrust of the wheel flange 7 and/or the horizontal component of the vertically applied wheel load. The bottom surface portion of my improved tie plate comprises a plurality of transversely extending coplanar primary tie bearing surfaces or areas 9, 10, 11, and 12. These primary tie bearing surfaces or areas are parallel to each other and spaced apart longitudinally of the tie plate by the plurality of transversely extending recesses, the upper preferably flat surfaces of which constitute the tertiary tie bearing areas 13, 14 and 15. These tertiary bearing areas like the primary bearing areas are likewise preferably flat throughout the greater portion of their width except that they may be slightly arcuate and beveled or tapered downwardly at their ends at 16 to merge into the sides of the primary bearing areas. Positioned in each of the recesses 13, 14 and 15 are a plurality of cross units or members 17 constituting secondary tie bearing areas 18, 19 and 20. These members are transverse of said recesses but owing to their reduced vertical depth stop a little bit short at their respective ends of the extreme sides of the recesses. The faces of said secondary bearing areas may be parallel with the planes of the primary and tertiary areas, and are positioned substantially midway between the primary and tertiary areas in a vertical direction. As seen in Fig. 2 these cross members extend in a direction longitudinally of the tie plate, that is, in a direction longitudinally of the tie, but may assume other directions as desired. This construction provides for the release of steam formed by the heating of the cooling water during the rolling and thus minimizes explosions at the ends of the cross members and sides of the recesses to eliminate the formation of ragged, unsmooth surfaces, deterioration and cracking of the roll surfaces, which in turn eliminates the necessity for frequent, expensive redressing of the rolls.

As shown in Figs. 1 and 2, the tie plate is formed at suitable locations with any desired number of openings 21 to receive conventional fastening means for securing the rail to the tie plate and the tie plate to the tie. In the form shown in Figs. 1 and 2 the cross members 17 of

each row are arranged in non-staggered relationship with those of the other rows, but in longitudinal alinement.

In the form shown in Figs. 4 and 5, the tie plate is of similar construction to that shown in Figs. 1 and 2 except that in Figs. 4 and 5 the cross members in each recess or trough are staggered with relation to the cross members in the next adjacent recess or trough. In the form shown in Figs. 1, 2, 4, and 5 the cross members in the central recess or median plate bottom portion may be somewhat longer than those shown in the outside troughs. Their proportions, dimension and arrangement may be varied as desired to meet track requirements but without departing from the general proportions in area of the primary, secondary and tertiary tie bearing areas. For reasons pointed out hereinafter, it is desired that the initial tie bearing area of the combined primary bearing surfaces be approximately 25% of the plate area, and the initial tie bearing area of the combined secondary bearing surfaces likewise be approximately 25% of the plate area.

In the form shown in Figs. 7 and 8, the cross members **17** are omitted and in their place is substituted a transversely extending member **23** centrally positioned in each of the recessed troughs **13'**, **14'** and **15'**, it being understood that these recesses or troughs, as in Fig. 2, extend transversely through the entire width of the bottom face of the tie plate. These transverse coplanar members **23** constitute the secondary tie bearing surfaces and are in vertically spaced relation to the primary surfaces **9'**, **10'**, **11'** and **12'**. The inner faces of troughs **13'**, **14'** and **15'** on each side of the transverse members **23** may be substantially flat as shown at **24**, **25**, **26**, **27**, **28**, and **29**, or slightly arcuate in such a manner that their respective ends merge into the adjacent primary and secondary tie bearing surfaces. In this form the primary, secondary, and tertiary areas are also preferably arranged so that the primary surfaces constitute approximately 25% of the plate area and the secondary surfaces constitute approximately 25% of said plate area. The remainder of the plate area is constituted of the tertiary tie bearing surfaces and the adjoining surfaces therefrom to the adjacent tie bearing surfaces.

A conventional tie plate for 131 lb. rails is 8 inches wide and 14 inches long, affording 112 square inches bearing area. Thirty thousand pounds rail load is a common load applied, which results in a unit load of 268 lbs. per square inch. The allowable working stress in compression perpendicular to the grain as given by the Forest Products Laboratory of the U. S. Department of Agriculture for the following timber used for ties is:

	Pounds per square inch
Fir, Pacific Coast	325
Fir, Rocky Mountain	275
Western pine	250
Southern pine	325
Average	294

In the bottom arrangement of the tie plate of the present invention, the applied 30,000 lb. load is initially distributed on the tie through the primary bearing surfaces constituting approximately 25% of the plate bearing area, to wit: 28 square inches, or approximately 1100 lbs. per square inch unit load. This load being considerably in excess of the recognized working stress of tie timber results in quick initial compressive embedment into the tie surface and desired interlocked relation therewith of the primary bearing surfaces and supplemental contact of the secondary bearing surfaces is effected. Preferably the coplanar bearing area of the members constituting the secondary bearing surfaces is likewise approximately 25% of the plate area and with these secondary surfaces in contact with the tie, the unit load is reduced to 550 lbs. per square inch, which is still in excess of the allowable working stress above set forth, hence further penetration though slightly retarded, occurs and further interlocked reaction between the tie plate both longitudinally and transversely is accomplished. Upon the ultimate embedment of the secondary surfaces into the tie surface, contact between the tertiary bearing surfaces of the plate and the tie occurs, and the unit load of 268 lbs. per square inch is distributed uniformly over the tie plate—tie engaging surface. The term "approximately 25%" is used herein to apply generally to the types of woods of such softness as those listed above for working stresses as given by the Forest Product Laboratory of the U. S. Department of Agriculture. As will be obvious, if the ties are made of harder woods, the percentages could be somewhat less than said 25%.

It will be observed that the vertically spaced relationship between the primary and secondary bearing surfaces permits the reduced depth of the members providing the secondary bearing areas, and the fact that their ends merge into an angular instead of flat surface minimizes or precludes entirely the objectionable results of steam pockets forming which would cause rolling difficulties referred to above, owing to the reduced draft necessary to form them.

The elimination of another objectionable feature of the structure of my Patent 2,018,658 is made possible by the vertically separated bearing areas that are individually coplanar as described in the present invention. The recesses 16, 17 and 18 of my prior Patent 2,018,658 are formed by corrugations on the rolls producing the plate. The metal in these rolls is subjected to heavy draft or compressive action of the rolls, the effect of which is transmitted to the rail seat on the top of the tie plate, producing an objectionable irregular surface or rail seat. The reduced depth of the plurality of the plate portions comprising the coplanar secondary bearing areas is such that their formation does not affect the rail seat of the tie plate. The manifest advantages of the flat bottom tie plate structure of my Patent 2,018,658 are retained, but the improved structure arrangement herein described greatly improves the effectiveness of the structure both from a productional as well as functional standpoint, as has been found by practical demonstration. Another important objective provided in the present graduation of plate adjustment to the tie seat lies in the improved shearing of the tie plates from the long rolled strips in which they are produced.

In my prior Patent 1,853,773 the ends 6 and median portion 7 of the tie plate were recessed, permitting the concentration of initial wheel transmitted load on transverse members 3, but due to the outwardly turning action of the rail incident to the lateral effect of the horizontal component of the wheel-load on the rail head, the unsupported recessed end portions 6 permit-

ted, or actually induced the rotary movement or tilting of the plate, thus affecting track gage. For example, a 131 lb. rail 7⅛ inches high (a section generally adopted by class I railroads for main line use) subjected to an outward or inward lateral ⅛ inch turning of the rail head results in a difference of ¼ inch in track gage either tight or wide, which is detrimental to track structure in that the irregularity of the track gauge intensifies the hunting action of the wheels in passing over the rail and amplifies the lateral nosing action of the wheel flanges against the rail head, increasing the tendency toward further distortion of the gage and alinement—both important factors in smoothly riding track.

In my present construction this condition is obviated by the presence of secondary bearing areas in the end and median portions of the tie plate since following the embedment into the tie of the primary or transverse portions, these secondary bearing areas coacting with the primary transverse portions prevent this tilting of plate and development of gauge inequality, resulting in a more uniform distribution of applied load through the plate to the tie without shifting of the plate incident to the initial seating action of the primary bearing areas. This improved construction, therefore, eliminates the structural deficiencies developed in the use of both structures of my prior Patents 1,853,773 and 2,018,658.

I claim:

1. A rolled steel tie plate comprising, a body portion, having a top surface and a bottom surface, a rail seat on said top surface, said bottom surface having a plurality of parallel primary tie bearing areas extending in spaced apart relation across said bottom surface in a direction transversely of the tie, a plurality of secondary tie bearing areas extending at right angles to said primary areas and vertically spaced a distance upwardly from said primary areas, and a plurality of tertiary tie bearing areas vertically spaced a distance upwardly from said secondary areas, said primary bearing areas all having flat faces falling in the same plane and being the first to contact a flat tie top surface when the tie plate is first applied to the tie, said primary bearing areas constituting approximately 25% of the plate bearing area.

2. A rolled steel tie plate comprising, a body portion having a top surface and a bottom surface, a rail seat on said top surface, said bottom surface having a plurality of parallel primary tie bearing areas extending in longitudinally spaced relation transversely across the width of the tie plate, a recess extending between each two adjacent primary areas and parallel therewith and of substantial depth in a vertical direction, and a plurality of flat faced members in each of said recesses, the faces of said members forming secondary tie bearing areas, and the deepest surfaces of said recesses forming tertiary tie bearing areas, said primary, secondary and tertiary areas each being vertically spaced with relation to each other and in parallel planes, said primary bearing areas all having flat faces falling in the same plane and being the first to contact a flat tie top surface when the tie plate is first applied to the tie, said primary bearing areas constituting approximately 25% of the plate bearing area.

3. A tie plate as claimed in claim 2, in which each of said members extends longitudinally of the tie plate and is less in length than the overall width of its respective recess in the direction of the length of the tie plate, the flat faces of said members jointly constituting approximately 25% of the plate bearing area.

4. A rolled steel tie plate having a top surface provided with a rail seat, and a bottom surface having end portions and formed transversely across each of its end portions with a primary tie bearing surface, another primary tie bearing surface extending transversely across the bottom of the plate and spaced from said end primary surfaces, all of said primary surfaces having flat faces and being in a common plane, a trough extending transversely across the width of the tie plate between each two spaced apart primary surfaces, and constituting tertiary bearing surfaces, and a plurality of flat faced raised members extending crosswise in each of said troughs constituting secondary bearing surfaces, the flat faces of the cross members all falling in a common plane and the flat depressed faces of said troughs all falling in a common plane, the plane of said primary surfaces and the plane of said secondary surfaces and the plane of said tertiary surfaces all being vertically spaced with relation to each other, the flat faces of the primary bearing surfaces constituting a substantial portion of the entire plate bearing area.

5. A tie plate as claimed in claim 4, in which the cross members extend longitudinally of the tie plate, and each end of each cross member stops short respectively of the adjacent edge of the adjacent primary bearing surface.

6. A tie plate as claimed in claim 4, in which the primary surfaces are four in number, said troughs are three in number, said raised cross members are more than six in number, and said three planes are vertically spaced apart equal distances one from the other.

7. A tie plate as claimed in claim 4, in which the primary bearing surfaces constitute approximately 25% of the plate bearing area, the secondary bearing surfaces constitute approximately 25% of the plate bearing area, and the tertiary bearing surfaces constiuting nearly the remainder of the plate bearing area.

8. A rolled steel tie plate having a top surface provided with a rail seat, and a bottom formed transversely across the plate with a plurality of flat primary bearing surfaces in a common plane, a plurality of troughs extending transversely across the plate between the primary bearing surfaces and having tertiary bearing surfaces, and a plurality of laterally spaced members in each of said troughs extending longitudinally of the plate and providing areas forming secondary bearing surfaces, said secondary bearing surfaces being coplanar in a plane vertically spaced from the plane of the primary bearing surfaces, and the tertiary bearing surfaces being coplanar in a plane vertically spaced from the plane of the secondary bearing surfaces, said flat primary surfaces constituting more than one-sixth of the entire plate bearing area.

9. A tie plate as claimed in claim 8 in which the ends of said laterally spaced members merge into angular surfaces to substantially eliminate objectionable steam pockets when the tie plates are being hot-rolled, and a primary bearing surface is located at each end of said tie plate bottom.

10. A tie plate comprising, a body portion hav-

ing an upper surface provided with a rail seat and an essentially flat bottom surface formed with a plurality of respective primary, secondary and tertiary tie bearing surfaces in vertically spaced relation to each other, each of said bearing surfaces being formed of a series of flat coplanar tie bearing sections laterally spaced with relation to each other, the area of the primary bearing surfaces constituting more than ten percent of, and the area of the secondary bearing surfaces constituting more than fifteen percent of, the entire plate bottom area, so that the initial square inch load on the primary bearing surfaces exceeds the recognized working stress of tie timbers to which they are to be applied and is relatively greater than that transmitted to the secondary bearing surfaces, the primary and secondary bearing surfaces together being of such aggregate area as to materially reduce the unit of pressure and yet provide a retarded seating action as the secondary series of bearing surfaces engage the tie surfaces, whereby to provide uniform unit seating of the plate incident to the application of the rail load and prevent tilting of the tie plate.

11. A tie plate as claimed in claim 10, in which the flat coplanar primary bearing sections in the aggregate constitute more than 15% of the entire plate bearing area.

12. A tie plate as claimed in claim 11, in which the primary bearing sections are four in number laterally spaced apart, the two outer ones extending to the opposite end edges of the plate, and the two inner ones are each wider than each of the outer ones in a direction longitudinally of the plate.

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