Oct. 29, 1935. W. S. BOYCE 2,018,658

TIE PLATE

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FIG. 1

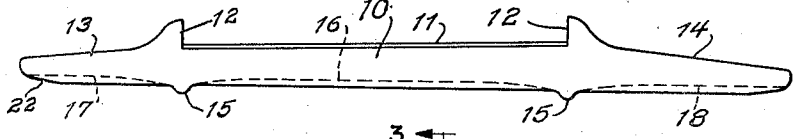


FIG. 2

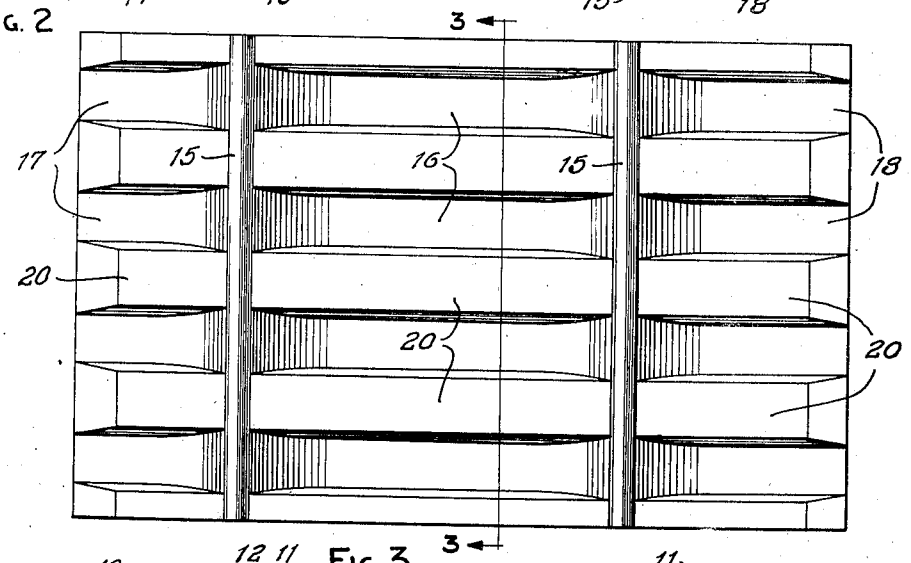


FIG. 4

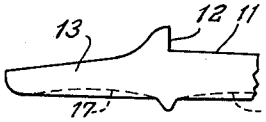


FIG. 3

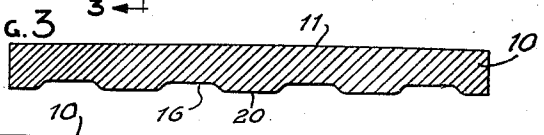


FIG. 5

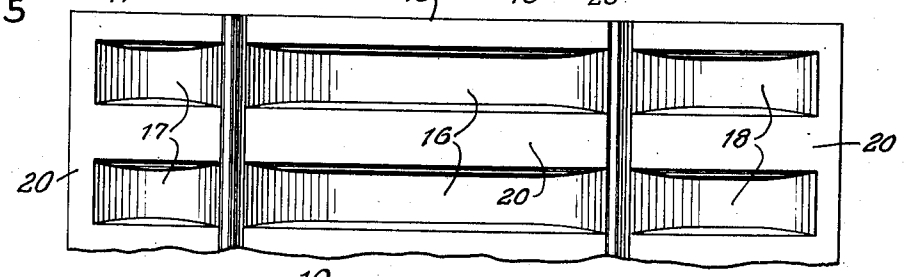


FIG. 6

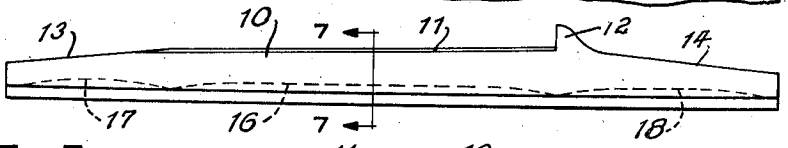


FIG. 7

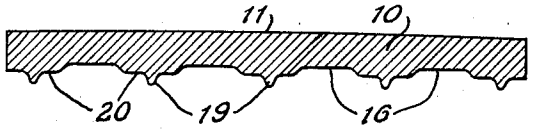
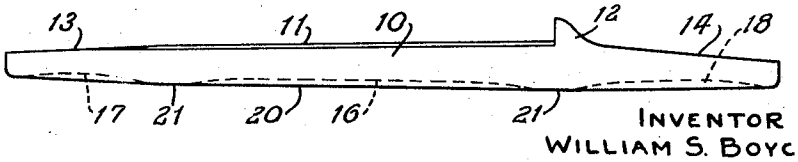


FIG. 8



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FIG. 9

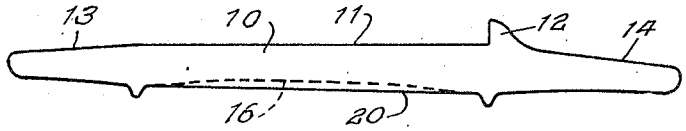


FIG. 10

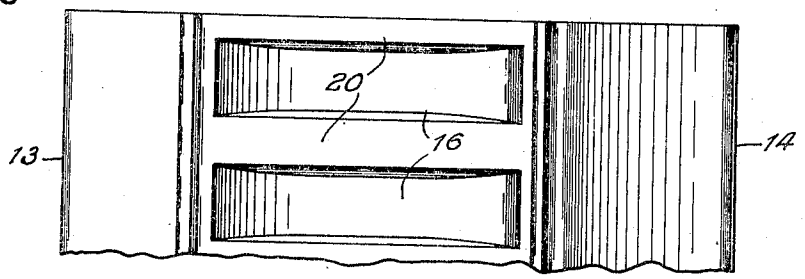


FIG. 11

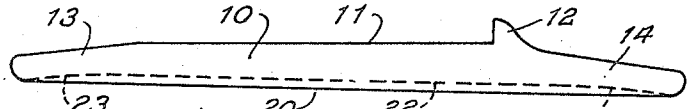


FIG. 12

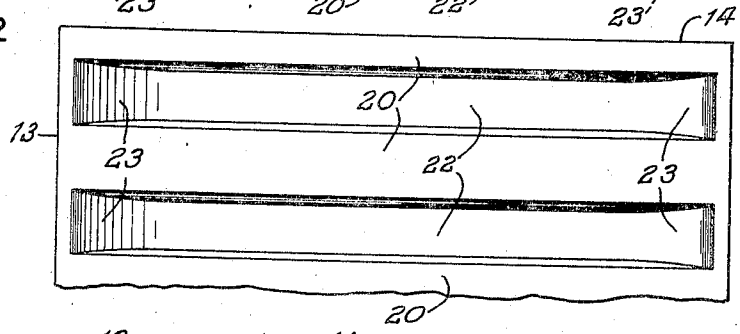


FIG. 13

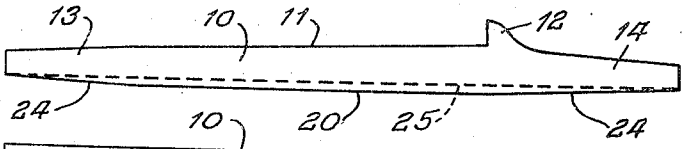
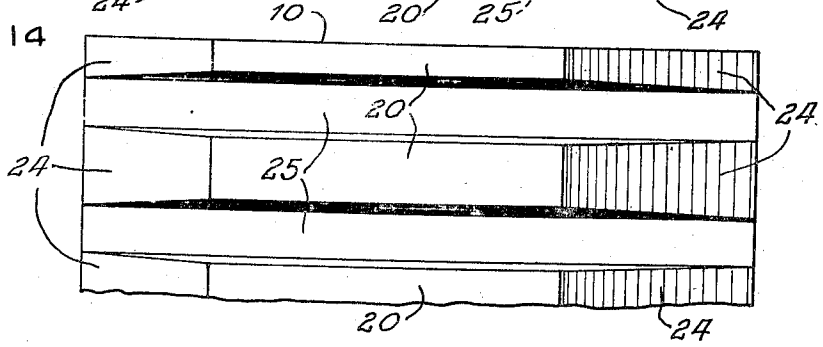


FIG. 14



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UNITED STATES PATENT OFFICE

2,018,658

TIE PLATE

William S. Boyce, Chicago, Ill.

Application February 3, 1933, Serial No. 655,035

13 Claims. (Cl. 238—298)

This invention relates to an improvement in the design of tie plates such as are used in railroad track construction. Such tie plates are used for numerous reasons, chief of which are the attainment of stability of the rail, and especially the prevention of rail spreading. Another reason for the use of tie plates is found in the fact that tie plates reduce wear and cutting of the tie by the rail and thereby serve to prolong tie life. The maintenance of proper gauge in the track is, of course, a matter of necessity and the prolonging of tie life is a matter of economy since the cost of ties is a very considerable item in track upkeep.

The cost of tie plates is also a very material element in the cost of railroad track construction and maintenance, and it depends largely on the weight of the plates which in turn is dependent upon the size and strength of plate required.

Applicant is aware that tie plates have heretofore been provided with many varied forms and patterns designed to effect metal saving—weight reduction with minimum strength impairment. The tops and bottoms of tie plates have both been the subject of many forms of treatment. However, so far as known to applicant, no one has heretofore devised a plate having essentially a flat bottom surface with its desirable advantages in which provision is made within the body of the plate for effectively anchoring the plate to a tie against shifting movement longitudinally of the tie to thereby prevent rail spreading, or in which as high a degree of strength is attained, weight for weight, as is attained in plates made in accordance with applicant's present invention.

As already indicated, the objects of applicant's invention are to provide a tie plate structure which will effectively grip the tie and hold a rail against sidewise displacement; to provide a tie plate which will not objectionably cut or crush tie fibre, nor effect mortising of sections from the tie, thereby to prolong tie life; to provide a tie plate structure in which maximum strength for the weight of metal used is also attained; and to provide a tie plate having the above indicated desirable qualities but which may be commercially produced by the customary rolling operation and sold at a cost which is lower than the cost of conventional tie plates of like strength.

This application is directed to subject matter analogous to that disclosed in my co-pending application, Serial No. 563,207, filed September 16, 1931.

Other objects and advantages of the invention will be understood by reference to the following specification and the accompanying drawings in which I have illustrated tie plates embodying several forms of my present invention.

In the drawings:—

Fig. 1 is a side elevation.

Fig. 2 is a bottom plan.

Fig. 3 is a section on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary side elevation similar to a portion of Fig. 1 but showing a modified structure.

Fig. 5 is a fragmentary bottom plan further illustrating the form contemplated in Fig. 4.

Fig. 6 is a side elevation, similar to Fig. 1 but illustrating another modification.

Fig. 7 is a section on the line 7—7 of Fig. 6.

Fig. 8 is a side elevation similar to Fig. 1 but illustrating still another modification.

Figs. 9, 11 and 13 are side elevations illustrating various further modifications, and

Figs. 10, 12 and 14 are fragmentary bottom plans of the forms illustrated respectively in Figs. 9, 11, and 13.

Referring now to the drawings, the tie plate illustrated in Figs. 1, 2, and 3 includes a median portion 10 which is provided with a rail seat 11 on its top surface, the rail seat being flat, or cambered as indicated. The rail seat is also usually canted as indicated. Upstanding shoulders 12—12 are provided at the opposite sides of the rail seat, these shoulders being formed as a part of the end portions 13 and 14 respectively of the plate. The camber of the rail seat may be rolled in the plate or it may be formed by bending the plate.

The bottom of the plate is provided with a pair of transversely extending ribs 15—15 which extend from side to side of the plate. These ribs are preferably rounded so as to avoid cutting of tie fibre, and they are preferably located approximately under or inside of the edges of the rail seat 11.

The bottom of the median portion of the plate is provided with a series of spaced recesses or pockets 16 which may be of substantially uniform depth throughout their lengths except that at their ends, they are gradually tapered so that the bottom surfaces of the recesses at their ends merge gently into the sides of the transverse ribs 15. As illustrated, the bottoms of the recesses 16 at their ends constitute, in effect, continuations of the sides of the respective ribs.

The bottoms of the respective end portions of the plates 13 and 14 are similarly provided with a series of recesses 17 and 18 respectively, the

bottoms of these recesses at their respective inner ends, merging into the transverse ribs 15—15. At their outer ends, the recesses may continue to the ends of the plate as shown in Figs. 1 and 2.

In the modified structure shown in Figs. 4 and 5, the arrangement is, in general, the same as that shown in Figs. 1 to 3 inclusive, but the outer ends of the recesses 17 and 18 in the ends of the plate terminate short of the plate ends, leaving a portion of the flat bottom surface between the plate ends and the ends of the recesses. In both Figs. 2 and 5, the recesses 16, 17, and 18 are shown in the preferred longitudinally aligned relation but, if desired, the end recesses 17 and 18 may be staggered with reference to the median recesses 16. It will be observed that the recesses in the median and end portions of the plate extend substantially the full length of the respective plate portions in which they are located.

Various details in the structure thus far described may be made to suit any particular requirements. For example, the transverse shape of the recesses 16, 17, and 18 may be substantially as illustrated in Fig. 3. Also, the bottoms of the plate end portions may be co-planar with the bottom of the intermediate portion or they may be offset, or inclined relatively thereto substantially as illustrated in Figs. 8, 9 and 13. The ends of the plate may be cut square as shown in Figs. 6 and 13, or the bottoms of the end edges may be chamfered or rounded as indicated in Figs. 1, 4, 9, and 11. The plate may also be made with either one or two rail abutting shoulders such as 12.

In the modification illustrated in Figs. 6 and 7, but one rail abutting shoulder 12 is illustrated, this being in accord with conventional practice under certain conditions and where plates are cross-rolled. Also, instead of providing transversely extending ribs 15, longitudinally extending ribs 19 depend centrally from the flat tie bearing bottom surface portions 20 of the plate which are disposed, as clearly shown in Fig. 7, intermediate the aligned recesses. As illustrated in Fig. 6, the adjacent ends of the bottom recesses 16, 17, and 18 preferably come together in the plane of the bottom surface of the plate, at a point located approximately in vertical alignment with the margins of a rail flange seated on the plate.

In Fig. 8, the top of the plate is provided with only one rail abutting shoulder 12 and the bottom of the plate is illustrated as being provided with recesses 16 in its median bottom portion and recesses 17 and 18 in its end bottoms. The end portions 13 and 14 of the plate are also illustrated as being offset upwardly with reference to the plane of the bottom surface 20 of the median portion of the plate. Because of the effect produced by the upwardly offset arrangement of the plate ends, this section may, in some instances, be utilized without recesses in its bottom.

In some instances, the end recesses 17 and 18 may be omitted in all of the described forms of the plate but more especially in the form illustrated in Fig. 8 in which the upward offset position of the plate ends accomplishes, to some extent, the purposes of the end recesses. As shown in Fig. 8, the recesses may terminate short of each other so as to leave a transversely extending flat bottom surface intermediate such ends substantially as indicated at 21. This latter arrangement may, of course, be utilized in the other forms shown either in connection with, or without, longitudinally or transversely extending ribs.

The form of plate shown in Figs. 9 and 10 is somewhat similar to that shown in Fig. 8. It embodies end portions having their bottom surfaces offset upwardly relative to the plane of the median bottom surface 20 and recesses 16 in its median bottom surface only. The end bottom surfaces are preferably arched upwardly as indicated.

The form shown in Figs. 11 and 12 embodies flat bottom surface area 20 surrounding elongated recesses 22 which extend substantially the entire length of the plate except that they terminate in gently arched portions 23 just short of the plate ends. The pockets 22 are thus completely surrounded by flat bottom area 20 and, with the tie projections formed when the plate is fully seated, serve to produce a desirable and effective interlocking action between the tie and tie plate.

The form shown in Figs. 13 and 14, also embodies end portions having bottom surface area 24 which is inclined upwardly and outwardly with respect to the plane of the main bottom surface area 20. Recesses or pockets 25 extend the entire length of the plate so as to form open-ended channels in the plate bottom. As illustrated, the bottoms of the channels are flat from end to end and hence the depth of the channel, or conversely, the depth of the plate bottom portions projecting below the channel bottoms, gradually decreases towards the plate ends.

Plates embodying the described features will have the desired effect of distributing loads impressed on the plate, uniformly over a large area of the tie upon which the plate is seated, because of the material area of flat bottom surface 20 distributed uniformly over the entire area of the flat bottom. This feature is conducive to prolonged tie life since it causes the plate to be gradually embedded to its ultimate seat in the tie. Gradual embedment and the absence of sharp ribs extending transversely of the direction of the tie fibre, avoids cutting and crushing of tie fibre as is apt to occur when the entire load is impressed on relatively small, localized tie areas.

By provding elongated recesses in the plate bottom, it will, of course, be apparent that comparatively large and elongated tie portions will project upwardly into the body of the plate when the plate becomes fully seated and embedded in the tie. Such interlocking of the plate and tie prevents endwise displacement of the plate relative to the tie. Rail spreading, i. e., sidewise displacement of the rails is thereby effectively prevented. It will be observed that endwise displacement of the tie plate is resisted by the end portions of the bottoms of the recesses which bear against the end grain of the projecting tie portions. When the plate embodying the described design is embedded in a tie, the tie fibre under the flat unrecessed portion of the plate bottom, constituting a substantial bearing contact on the tie surface is in effect by reason of incipient load concentration on such surface, hardened and made more dense, hence less permeable to moisture, so that wearing away of the tie under the plate, and also decay, are greatly retarded. The largeness and consequent sturdiness of the tie projections also aids in reducing mechanical wear on the tie.

While obtaining durability in the large tie projections as just explained, and anchorage for the plate against lateral shifting, tie protection is also attained. It should be observed that the tie fibre is subjected to a practically negligible amount of distortion owing to the gradual shallowing of the depth of the recess end portions, or

of the depth of the depressions formed in the tie. The only tie crushing tendency present in the applicant's designs is incident to the end shallowing of the depths of the recesses formed in the tie, but because it is a gentle, gradual shallowing, the extent of tie fibre distortion is insignificant.

Obviously, the separation of tie fibre longitudinally, incident to the formation of longitudinal recesses in the tie, does not cause a crushing thereof. Instead, the tie fibre is compacted or concreted with the tie fibre toughening or strengthening advantage already referred to.

The provision of recesses distributed uniformly over the entire plate area imparts to the plate the ability to quickly accommodate itself to a somewhat irregular tie surface such as often results from the preparation of a seat by hand adzing. It is understood that it is increasingly becoming the practice of railroads to adze their ties by machine instead of by hand, in a shop before the ties are inserted in track. While such machine adzing results in a more perfect, flat, tie plate seat than is usually obtained by hand adzing, such machine-adzed seats are not always in a horizontal plane, and even though they may initially be so positioned, they do not always remain so because of the effects of weather on the tie and on the road bed. Hence, the ability of a tie plate to quickly and effectively adjust itself to such irregular surfaces, for example, at one side of the plate when, because of unevenness of the tie seat, the normal load is initially applied mainly at such side, is an important advantage obtained by the described arrangement.

It is a recognized fact that the tie plates are generally subjected to their severest strains in areas extending transversely of the plate in line with the side edges of the rail seat. Also, that minor stresses are produced intermediate said side edges and intermediate the opposite ends of the plate and the respectively adjacent rail seat edges. Thus, it will appear that by the described arrangement, the maximum strength of the plate which is, of course, where the plate is thickest, is located in the zones or area where the plate is subjected to the greatest stresses. Also, where the stresses are lightest, the plate is recessed so as to make available, without increase in weight, a corresponding amount of metal for distribution in the desired portions of the plate to thereby secure the maximum of strength in the plate.

It is also a recognized fact that conventional flat bottom plates tend to buckle under load, i. e., to bend transversely so that the top surface of the plate from end to end assumes a concave shape. Likewise, the bottom surface of the plate assumes a more or less convex shape from end to end. This is due to the fact that, with the concentrated load of a rigid rail base, the fibres of the tie beneath the base of the rail give and deteriorate and with constant repeated impact, more of the load on the flat bottomed plate is carried out to the ends of the plate. These load reactions cause a bending moment which curves the plate.

Obviously, under such conditions, the top fibres of the plate are subjected to compression, while those of the base are in tension. It is an indisputable fact borne out by past costly experience that the removal of metal from the top of the plate in whatever manner under the rail seat or otherwise purely for economic reasons, and there are no other, weakens the plate in addition to damaging the rail base and providing a receptacle for accumulation of matter destructive to the plate section itself. Hence a rail seat of uniform bearing on the top of the plate is demanded by railroad engineers as a requisite to safe, economic track practice.

The described tendency to buckle and accompanying dangers and disadvantages are practically eliminated in my improvement by retarding the application of loads to the ends of the plate, this being accomplished by offsetting the bottoms of the plate ends upwardly as indicated in Fig. 8, and further by providing recesses in the plate ends as 17 and 18, when the plate bottom is substantially flat from end to end.

From the foregoing description and explanation, it will be evident that by my improvement, I have provided a tie plate in which metal distribution to the best advantage is accomplished by removal of metal from the zones of least stress to the zones of greatest required strength, providing at the same time component sections of bearing area, such sections being of maximum required depth to provide greatest moment of inertia and extending essentially the full length of the plate and at right angles to the applied load creating such excessive stresses. Disposed between such sections of maximum depth are component sections of varying thickness arranged so as to release surplus metal at the same time providing supplemental holding power within the body of the plate. The arrangement is such that the transmission of load to the tie will be primarily through said flat surfaces and subsequently through the medium of varying longitudinal cross section.

It is a fundamental fact that the horizontal component of the rail load transmitted to the plate is counteracted by friction between the plate and tie, and by resistance of the spikes in proportionate amounts depending on the character of the surface of the plate bottom and location of spikes. In the described arrangement, the pressure is transmitted at right angles to the grain of the tie fibre. Since the modulus of elasticity of wood for bearing pressure is relatively small (less than 1/50 part of that for tension and compression lengthwise of the fibre counting the effect of both detrusion and compression), and since the protection of tie fibre is manifestly a requisite of correct tie plate design, the described arrangement in which the projecting tie portions have their greatest dimension in the direction of thrust against them, is unusually effective to resist displacement of the rail and tie plate with a minimum of tie damaging effect. Also, by the longitudinal distribution of the pressure on the plate supporting fibre, the fibre is subjected to the least amount of distortion and lateral displacement.

By careful computation, I have ascertained that a conventional flat plate measuring $7\frac{1}{2}''$ x $10\frac{1}{2}''$ and $\frac{11}{16}''$ thick at one edge of the rail seat and $\frac{9}{16}''$ thick at the other edge, weighs substantially 12.40 pounds. The cost of such tie plates at current prices is practically $229.40 per thousand plates.

By utilizing the structure illustrated in Fig. 4, a plate of the same dimensions will weigh substantially 11.70 pounds and would cost $216.45 per thousand plates, a saving over conventional plates of $12.95 per thousand plates. Stress diagrams which I have prepared indicate that in the zones where greatest strength is required, the structure shown in Fig. 4 is for practical purposes equivalent to that of conventional flat bottom plates. Hence, my improved structure is such

that a material saving in cost of the plates to the railroads may be secured.

However, many railroads have come to the conclusion that it is better policy and greater economy to use stronger tie plates which are more durable and offer a greater factor of safety than it is to lighten the weight of the plates and be faced with the necessity of greater expenditure for track inspection and maintenance. This attitude on the part of railroads is becoming more and more general and for such railroads, I am enabled, by my above described invention to offer at the same cost, a thicker and hence stronger plate. Such a plate, instead of being $\frac{11}{16}$'' and $\frac{9}{16}$'' in thickness at the rail seat edges may be $\frac{3}{4}$'' and $\frac{5}{8}$'' in thickness at the respective edges, and the weight thereof will be substantially the same (12.40 pounds) as the weight of a conventional flat bottom plate of $\frac{11}{16}$'' and $\frac{9}{16}$'' thickness. Stress diagrams which I have heretofore prepared indicate that a plate of the increased thickness mentioned will be approximately 16% stronger than the corresponding conventional flat bottom plate referred to. By "corresponding plate", a plate of like weight and like length and width is contemplated.

While weight saving is an important advantage resulting from my invention, the fact that superior strength, weight for weight, is made possible, is a more important advantage. In many prior tie plate designs, the only feature of importance has been the reduction of weight but without any thought of an arrangement whereby the metal in the plate is so distributed as to materially increase the strength of the plate without increasing its weight. Likewise, in many prior designs, tie protection has not been duly provided for.

In the event that the plate is cambered, especially by bending, the flat bottom surface portions of the plate, may not, in a strict sense, be flat nor in a flat plane common to all. They probably would be slightly curved. However, for practical purposes, and for the purpose of interpreting the appended claims, the slight curvature of the bottom surface of a cambered plate is disregarded.

Although I have obtained extensive knowledge of both the patented art and the practical art as a result of many years of association with the railroad tie plate business, I am not aware that any one has heretofore developed a tie plate wherein features have been combined and arranged in an essentially flat bottom plate, to secure all of the advantages above indicated. Another arrangement of an essentially flat bottom plate, in some important regards preferable to the herein described structure, and the broad aspects herein disclosed, are disclosed and claimed in a related, copending application filed by me. Various other re-arrangements and modifications of my structure may also be made without departing from the spirit of the invention, the scope of which should be determined by reference to the following claims, the same being construed as broadly as possible, consistent with the state of the art.

I claim as my invention:—

1. A tie plate having on its top surface, an unbroken rail seat and having its main bottom surface formed of a plurality of transversely spaced, relatively narrow and elongated, coplanar, flat, tie-bearing surfaces, and bottom portions of the plate intermediate said narrow elongated surfaces being provided with relatively narrow and elongated recesses to receive, when the plate is embedded in a tie, elongated tie projections adapted to interlock the plate and tie against movement of the plate longitudinally of the tie, the width of said tie bearing surfaces approximating that of said recesses and being such as to enable the initially engaged tie portions to resist and retard embedment of the plate.

2. A tie plate having on its top surface, an unbroken rail seat and having its main bottom surface formed of a plurality of transversely spaced, longitudinally extending, coplanar, flat, tie-bearing surfaces, and bottom portions of the plate intermediate said longitudinally extending flat surfaces being provided with longitudinally extending recesses to receive, when the plate is embedded in a tie, elongated tie projections adapted to interlock the plate and tie against movement of the plate longitudinally of the tie, the depth of the end portions of some of said recesses being gradually reduced as said recess end portions approach the vertical plane of the side edges of the rail seat to thereby provide, under said rail seat edges, substantially uninterrupted, transversely extending portions of full thickness.

3. A tie plate having a substantially flat, main bottom surface and a rail seat on its top surface, the bottoms of the end portions, outwardly of the edges of said rail seat, and the bottom median portion, intermediate said rail seat edges being provided with transversely spaced, elongated pockets extending substantially the full length of the end and median bottom portions respectively and being of greater depth intermediate the width of said end and median portions than at the junctures thereof.

4. A tie plate having a substantially flat, main bottom surface provided with a pair of relatively independent, longitudinally spaced ribs depending therefrom and extending transversely of the plate, said bottom being formed with a plurality of relatively independent, elongated pockets in the portion intermediate said ribs, and said bottom being also formed with a plurality of pockets in its end portions intermediate the opposite ends of the plate and the respectively adjacent ribs, said pockets being transversely separated from each other by tie-bearing areas of the flat bottom surface of the plate.

5. A tie plate comprising, in effect, a plurality of conjoined, relatively long but narrow sections, said sections having substantially flat top surfaces combining to form an even, unbroken rail seat, alternately disposed sections having tie bearing bottom surfaces of material width which are substantially flat both longitudinally and transversely thereof and disposed in a plane substantially common to all, and the sections intermediate said alternately disposed sections having relatively narrow elongated, upwardly offset bottom surface portions extending lengthwise of the respective sections.

6. A tie plate comprising, in effect, a plurality of conjoined sections extending longitudinally of the plate, alternately disposed sections having tie bearing bottom surfaces which are substantially flat both longitudinally and transversely of the plate and disposed in a plane common to all, the intermediate sections each having a plurality of elongated, longitudinally extending, upwardly arched bottom surfaces having adjacent ends located adjacent an edge of said rail seat so as to form thickened portions providing maximum strength in a zone adjacent said edge.

7. A tie plate having a substantially flat main bottom surface adapted to support the plate on a

tie, the bottom of the plate having a plurality of relatively independent, elongated pockets in the portion thereof which underlies the rail seat area of the top surface of the plate, and a plurality of relatively independent elongated pockets in the bottoms of the end portions of the plate outwardly of said rail seat area, said pockets being transversely separated from each other by tie bearing areas of the flat bottom surface of the plate, said median and end pockets being disposed in longitudinally aligned relation and having the depths of their adjacent end portions gradually decreased so as to retain adequate strength in the plate under the edges of the rail seat.

8. A tie plate having on its top surface, an unbroken rail seat, and having in its median bottom portion a plurality of longitudinally extending, coplanar, flat, tie bearing surfaces, bottom portions intermediate said longitudinally extending flat surfaces being recessed to receive, when the plate is embedded in a tie, elongated tie projections adapted to interlock the plate and tie against movement of the plate longitudinally of the tie, the end portions of the plate beyond said median portion having their bottoms offset upwardly relative to the bottom plane of the median portion.

9. A tie plate having on its top surface, an unbroken rail seat, and having in its median bottom portion a plurality of longitudinally extending coplanar, flat, tie bearing surfaces, bottom portions intermediate said longitudinally extending flat surfaces being recessed to receive, when the plate is embedded in a tie, elongated tie projections adapted to interlock the plate and tie against movement of the plate longitudinally of the tie, the end portions of the plate beyond said median portion having their bottoms offset upwardly relative to the bottom plane of the median portion, and provided with recesses also adapted to receive tie projections for interlocking the plate and tie.

10. A tie plate having on its top surface, an unbroken rail seat and having its main bottom surface formed of a plurality of transversely spaced, longitudinally extending, coplanar, flat, tie-bearing surfaces, and bottom portions of the plate intermediate said longitudinally extending flat surfaces being recessed to receive, when the plate is embedded in a tie, elongated tie projections adapted to interlock the plate and tie against movement of the plate longitudinally of the tie, and longitudinally extending, tie penetrating ribs depending from some of said longitudinally extending tie bearing surfaces.

11. A tie plate comprising, in effect, a plurality of conjoined, relatively long but narrow sections, said sections having substantially flat top surfaces combining to form an even, unbroken rail seat, alternately disposed sections having tie bearing bottom surfaces of material width which are substantially flat both longitudinally and transversely thereof and disposed in a plane substantially common to all, and the sections intermediate said alternately disposed sections having elongated, upwardly offset bottom surface portions extending approximately the entire length of the respective sections.

12. A tie plate comprising, in effect, a plurality of conjoined, relatively long but narrow sections, said sections having substantially flat top surfaces combining to form an even, unbroken rail seat, alternately disposed sections having tie bearing bottom surfaces of material width which are substantially flat both longitudinally and transversely thereof and disposed in a plane substantially common to all, and the sections intermediate said alternately disposed sections having elongated, upwardly offset bottom surface portions extending from end to end of the plate so as to provide, in effect, open ended channels in said plate bottom.

13. A tie plate comprising, in effect, a plurality of conjoined, relatively long but narrow sections, said sections having substantially flat top surfaces combining to form an even, unbroken rail seat, alternately disposed sections having, under said rail seat, tie bearing bottom surfaces of material width which are substantially flat both longitudinally and transversely thereof and disposed in a plane substantially common to all, the end portions of said sections, outwardly of said rail seat, having upwardly offset bottom surfaces, and the sections intermediate said alternately disposed sections having elongated, upwardly offset bottom surface portions extending from end to end of the plate so as to provide, in effect, open ended channels in said plate bottom.

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