May 26, 1931. G. LANGFORD 1,807,219

RAIL

Filed June 5, 1930 2 Sheets-Sheet 1

Fig. 1.

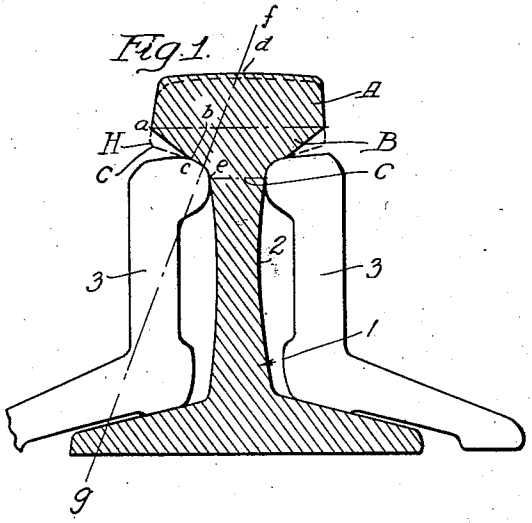


Fig. 3.

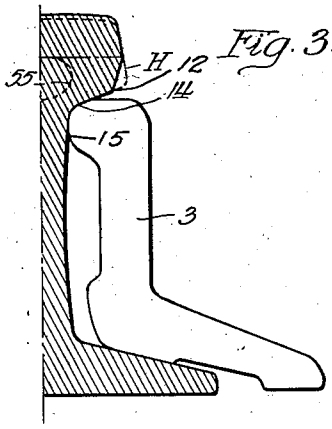


Fig. 2.

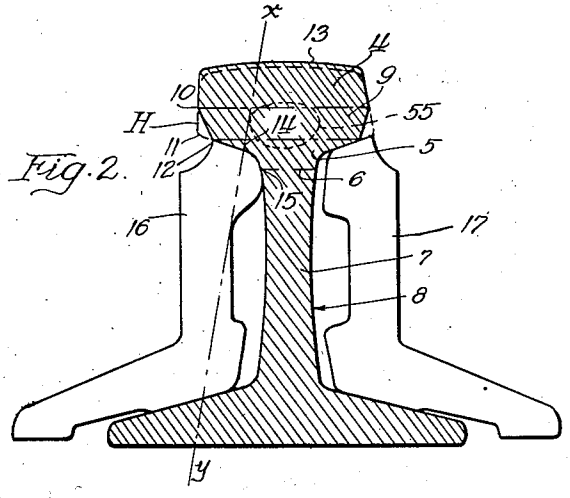


Fig. 4.

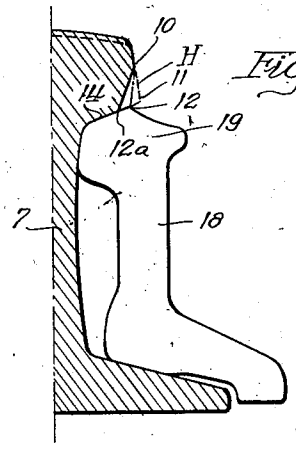
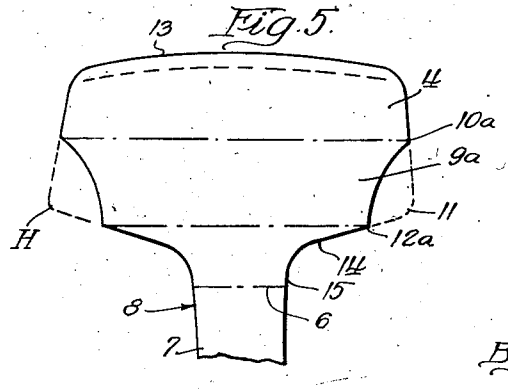


Fig. 5.



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RAIL

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Fig. 6

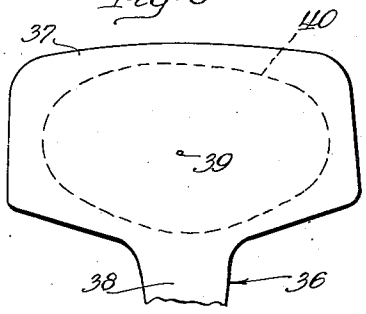


Fig. 7

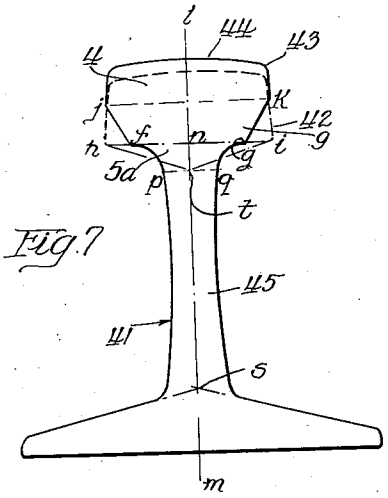


Fig. 8

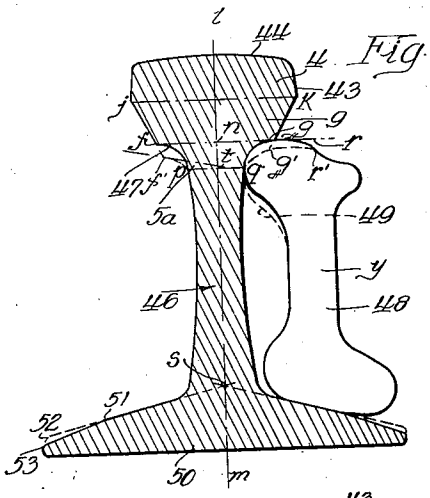


Fig. 9

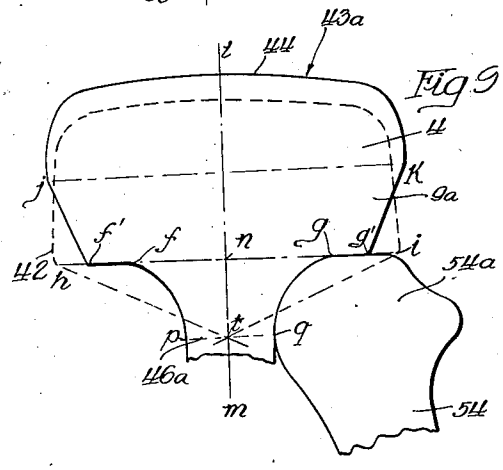
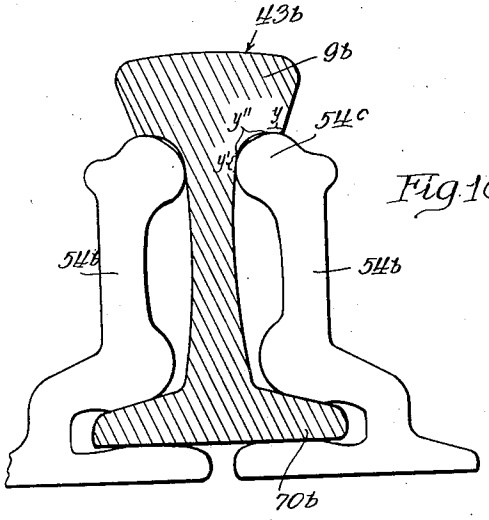


Fig. 10



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Patented May 26, 1931 1,807,219

UNITED STATES PATENT OFFICE

GEORGE LANGFORD, OF JOLIET, ILLINOIS, ASSIGNOR TO McKENNA PROCESS CO. OF ILLINOIS, OF JOLIET, ILLINOIS, A CORPORATION OF ILLINOIS

RAIL

Application filed June 5, 1930. Serial No. 459,312.

This invention relates to rails for use in railroads, and has to do more particularly with the section of the rail and the method of rolling the same.

In T-rail of ordinary type, such as is now in common use and considered as standard, great difficulty is frequently encountered due to fissures in the rail. This is particularly true of heavy rail which is now coming into extensive use. Transverse fissure of the rail is particularly objectionable, as, when the rail breaks, it is thrown out of alignment and is apt to cause derailment of the train with resulting serious damage. Such a fissure starts in the head of the rail at a central point or area and gradually spreads into an irregular oval shape area which provides a distinct plane of weakness or crevice which, when this area becomes sufficiently large, results in breakage of the rail. A rail is subject also to longitudinal fissures and to flange fissures, but the transverse fissure of the head is the one of most vital importance and one of the main objects of my invention is to provide a rail head so constructed as to eliminate transverse fissure.

This I accomplish, by so constructing the head as to obtain more uniform rate of cooling between the web of the rail and the portion of the head adjacent thereto, thereby reducing objectionable stresses at the juncture between the head and the web and also obtaining more uniform cooling of the head as a whole. A further object of my invention is to provide rail of such cross section that it may readily be rolled from worn rail without objectionable reduction in the cross section of the reformed rail relative to the original unworn rail.

The rail of my invention, in its broader aspect, is analogous to the head free rail disclosed in the patent to William T. Thompson, Patent No. 1,507,870, dated September 19, 1924. The head free rail is particularly adapted for use with head free rail joint bars, which have contact with the head of the rail at the lower inner fillet thereof, but do not have fishing contact with the rail in the ordinary manner. In the head free rail, the contact between the bar and the rail head does not extend beyond the web-head fillet of the rail and the bearing of the bar head against the under side of the rail head is quite slight. As a result, there is a tendency of the bar to move upwardly relative to the rail, this tendency being particularly noticeable after the rail and bar have been in service for sometime and wear has occurred. A further objection to the head free rail is that it is capable of being used with the head free rail joint bar only. A further and important object of my invention is to provide a rail capable of being used with any type of rail joint bar now in use, this rail being adapted for fishing contact with the bar beyond the web-head fillet so as to give a desirable increase in contact area between the bar and the rail head.

Another object of my invention is to provide a rail of the character referred to which can readily be produced by rerolling worn rail. Further objects and advantages of my invention will appear from the detailed description.

In the drawings:

Figure 1 is a sectional view of a head free rail of known type with head free joint bars applied thereto;

Figure 2 is a sectional view of the rail in accordance with my invention, showing different types of joint bars applied;

Figure 3 is a sectional view of one-half of a rail in accordance with my invention with a head free bar applied thereto;

Figure 4 is a sectional view of one-half of a rail in accordance with my invention with a full contact bar applied thereto.

Figure 5 is an end view of a rail head an a portion of the web, illustrating a modified form of my invention;

Figure 6 is an end view of the head and a portion of the web of a T-rail of standard type;

Figure 7 is an end view of a second modified form of rail in accordance with my invention.

Figure 8 is a sectional view of a third modified form of rail in accordance with my

invention, with a head free bar applied thereto;

Figure 9 is an end view of the head and a portion of the web of a fourth modified form of rail in accordance with my invention, with a head free bar applied thereto;

Figure 10 is a sectional view of a rail and a brace member applied thereto, illustrating a modification of the rail of Figure 9;

My invention is particularly adapted to be applied to heavy T-rails commonly used on railroads, as distinguished from lighter industrial rails and the tall girder rails commonly used by street railways.

In Figure 1 of the drawings I have illustrated a head free rail 1 of known type such as that previously referred to. This rail is of standard section except as to the head thereof. This head comprises an upper portion or zone A and a lower zone B, the upper zone being of approximately oblong shape and the lower zone being of approximately inverted pyramidal shape and having a truncated juncture at C with web 2 of the rail. The head of a standard T-rail is indicated by dotted lines at H for purposes of comparison with the head of the free rail. It will be noted that, in the head free rail, segments *a*—*b*—*c* of the standard rail head have been omitted and this metal has been applied to the tread of the head at *d* to increase the height thereof. The dotted lines *b*—*c* represent the fishing surface of the standard rail head and the line *a*—*b* represents the under side of the head of the head free bar, this line being at a much greater angle to the horizontal than the head fishing surface of the standard rail head. This head free rail is adapted for use with head free bars 3 of known type. The heads of these bars have contact with the rail at the web-head fillet *b*—*e* only thereof. This is objectionable for several reasons. The head of the bar tends to move upwardly relative to the rail head, when the joint is subjected to pressure upon the rail head, since there is no contact between the head of the bar and the head of the rail beyond the fillet *b*—*e*. This necessitates the provision of means for counteracting this tendency of the bar to slide upwardly. Also, in a joint constructed in this manner, the line of pressure between the bar and the rail, indicated by the line *f*—*g*, is inclined downwardly and outwardly at a considerable angle to the rail so that the bars are subjected to severe stresses tending to move them outwardly away from the rail. A further objection to the head free rail is that it is adapted for use with the head free bar only, and cannot be used with any other type of bar. A still further objection to the head-free rail referred to is, that the metal removed from the lower and outer sides of the rail head is added to the top of the head in such amount as to greatly increase the depth of the central portion of the head, thereby greatly increasing the mass and offsetting to a large extent the metallurgical advantages which would otherwise be gained by eliminating the useless metal at the lower portion of the head.

In Figure 2 I have illustrated a rail constructed in accordance with my invention, and have shown two joint bars of different types applied thereto. The head of the rail of my invention comprises an upper portion 4 of approximately oblong shape, a lower portion 5 of approximately inverted pyramidal shape and truncated at its juncture 6 with web 7 of the rail 8, and an intermediate portion 9 of approximately trapezoidal shape and tapering downwardly to its line of juncture with the lower portion 5. By reference to the head H of a standard rail, indicated in dotted lines, it will be noted that, in my rail, segments 10—11—12 have, in effect, been removed from the lower corner portions of the head H, this metal being placed upon the tread of the head at 13 to increase the height and resistance thereof to vertical pressure, in a shallow head, or eliminated entirely in a deep head. It will also be noted that the surface 12—14 extending from the top of the web-head fillet 14—15 is at the same angle as the head fishing surface of the standard rail head H which is indicated by the line 11—12—14. I thus provide, in my rail, a fishing surface of appreciable width disposed at the same angle as the fishing surface of a standard rail head and extending from the upper end of the web-head fillet of the rail. The lower outer corner of the standard rail head is ordinarily a small fillet, made larger in some cases. This is also true of the rail of my invention, corner 12 ordinarily being a comparatively small fillet, though it may be large. A small fillet shortens the head fishing contact but slightly, this shortening increasing as the size of fillet increases. By constructing the rail in this manner, I adapt it for use with various types of bars. I have shown, at one side of the rail, a bar 16 applied thereto, the head of this bar having contact with the web and head of the rail from a point somewhat below point 15 throughout the length of the fillet and the width of fishing surface 14—12. This provides an area of contact between the head of the bar and the head of the rail which is several times the area of contact between the bar head and the rail head of the head free bar illustrated in Figure 1, and serves to effectively brace the rail head while eliminating all tendency of the bar to move upwardly relative to the head since the bearing surface of the bar head seats flatly against

the fishing surface 12—14 of the rail head. The bar 16 is similar to the bar disclosed in my patent for rail joint and bar, No. 1,759,458, dated May 20, 1930. I term this bar a full head contact bar, since it has contact with the rail head throughout the full width of the web-head fillet and the fishing surface at the head of the bar. At the other side of the rail I have illustrated a bar 17 of known type, as applied. This bar is the ordinary head contact bar, and has fishing contact with the fishing surface 12—14 of the rail head. When this bar is initially applied to the rail, the head of the bar projects outwardly somewhat beyond the intermediate portion 9 of the rail head, but not appreciably beyond the top portion 4 of the rail head, so that the bar is not disposed to be struck by the wheel flanges.

The width of fishing contact between the bar head and the rail head is limited by the width of the fishing surface 12—14 of the rail head. As wear progresses, the bar is moved inwardly towards the web of the rail, by bolt tension, and the area of fishing contact between the bar head and the rail head is correspondingly increased.

In Figure 3 I have shown a head free bar 3 applied to my rail. This bar contacts the web-head fillet of the rail but does not have fishing contact with the rail head. It will be noted, however, that the fishing surface 12—14 of the rail head extends an appreciable distance outwardly beyond the web-head fillet and serves as an abutment element for limiting tendency of the bar head to slide upwardly out of the fillet 14—15.

In Figure 4 I have illustrated a bar 18 applied to my rail. This bar is of full head contact type plus web contact at a point below the lower end of the web-head fillet, head 19 being also provided with a relatively wide fishing surface which contacts the fishing surface 12—14 of the rail head. The width of the fishing surface of the bar head is appreciably greater than the width of the fishing surface of the rail head, indicated by the line 12*a*—14. It will be noted that the width of this surface is somewhat less than the width of the surface 12—14 of the bar of Figure 2. If the width of the bar head fishing surface be increased to the width 12—14, as indicated by the dotted line 10—12, head 19 of bar 18 will have full head fishing contact with the head of the rail. In Figure 4, the area of fishing contact between the bar head and the rail head is determined by the width of the fishing surface of the rail head, whereas, in bar 17 of Figure 2, the width of the fishing contact between the bar head and the rail head is determined, in part at least, by the width of the fishing surface of the bar head since the bar head moves inwardly to the web of the rail as wear progresses.

The modified form of rail illustrated in Figure 5 is the same as that of Figure 2, with the exception that the sides 10ª—12ª of the intermediate zone or portion 9ª of the head are concave instead of straight. Since this rail is essentially the same, in all other respects, as the rail of Figure 2, it is not necessary to describe it in detail. It is to be noted, however, that the concavities at the sides of the intermediate zone or portion 9ª of the head are of advantage from a metallurgical standpoint as promoting more nearly uniform cooling of the head, particularly the lower portion thereof, and facilitating more thorough working of the head during the rolling operation.

In Figure 6 I have illustrated the head portion of a standard T-rail 36. The head 37 of this rail constitutes a relatively large mass of steel which it is difficult to work thoroughly in the rolling operation and which cools much more slowly than the web 38, this setting up objectionable stresses adjacent the line of juncture of the head and the web. In heavy rails, weighing one hundred pounds or more per yard, serious difficulty is encountered due to the development of fissures, the most serious of which are transverse fissures in the head. A fissure of this character originates at a point disposed centrally of the head, as at 39, and spreads throughout the head into an irregular oval shape as indicated at 40. Such a fissure is highly objectionable since it results in breakage of the rail and disalignment thereof with the adjoining rail, frequently causing derailment of trains. It is possible to avoid the development of faults and resulting fissures in the head by reducing the mass thereof and so shaping the head as to obtain more uniform cooling of the same and eliminate objectionable stresses at or adjacent the juncture between the head and the web. In Figure 7 I have illustrated, in end view, a modified form of rail 41 in accordance with my invention, the head of which is constructed particularly with the object of eliminating transverse head fissures. For purposes of comparison, I have indicated in dotted lines head 42 of a standard T-rail. In forming the head 43 of my rail I have, in effect, eliminated the lower corner segments *h—j—f* and *g—k—i* of the standard rail head 42 and have applied this metal to the top or tread of the rail head at 44, in a shallow head, or dispensed with it in the case of a deep head. It will also be noted that the web-head fillets *f—p* and *g—q* of my rail extend upwardly and inwardly toward the center of head 43 thereof a much greater distance than the corresponding fillets of the standard rail head 42. The fillets of my rail head are tangent to the horizontal line *h—i* intersecting the verti-

cal axis of the web 45 at *n*, this axis being indicated by the line *l*—*m*. Each of these fillets, therefore, extends laterally to a line representing the vertical diameter of the fillet. In practice, slight departure from the horizontal is desirable from a rolling point of view, to provide slight taper so that the head portion will deliver from the rolls. However, the few degrees desired for this purpose are a radical departure from the fourteen degrees or more of angle in the ordinary head fishing. The planes of the flange fishing surfaces intersect axis *l*—*m* of the rail at *s*. In the standard T-rail, the fishing height of the rail is *s*—*t*, that is, the vertical distance between the point of intersection *s*, and the point of intersection between axis *l*—*m* and the planes of the head fishing surfaces. In my rail, the fishing height is *s*—*n* and the web-head fillets, instead of being tangent to the planes of the fishing surfaces of the head 42 of the standard rail, are tangent to the horizontal line *h*—*i* and extend upwardly and inwardly into the head a much greater distance than the fillets in the standard rail. By forming the rail head in the manner illustrated, I not only remove the lower corner segments from the standard rail head, as above pointed out, but I also eliminate the areas *g*—*i*—*q* and *f*—*h*—*p* at the under side of the standard rail head. This construction of the head has important advantages metallurgically over the standard rail head illustrated in Figure 6. It permits more thorough working and compacting of the metal of the head from the under side thereof during the rolling operation. Also, by reducing the mass at the lower portion of the head, I enable the thick head mass to cool more uniformly with the thin web in the region where the head and the web join, thus eliminating objectionable stresses with possible resulting faults or fissures in this region. The head 43 of the bar of Figure 7, comprises the upper oblong portion 4, the intermediate trapezoidal portion or zone 9, and the lower zone or portion 5^a of approximately inverted pyramidal shape truncated at its line of juncture *p*—*q* with the web 45.

In Figure 8 I have illustrated a rail 46 similar to the rail of Figure 7, except as to the flange, and have indicated, in dotted lines and at 47, the head of a head free rail, for purposes of comparison. I have shown a head free rail, the area of contact between the bar head and the rail being quite restricted. Also, in the head free rail, the fishing height is *s*—*t*, as in the standard rail. In my rail, each of the web-head fillets *g*—*q* is higher and of considerably greater length than the corresponding fillets of the head free rail. The bar 48 is of correspondingly increased height so as to fit into the fillet *g*—*q* of my rail. This means that the bar which I employ is of greater height than the bar used for the corresponding head free rail so that, in effect, the head 49 is raised from the position *r'* to the position *r*. This is advantageous as increasing the height of the bar and, therefore, its resistance to vertical stresses. The increased contact area between the bar and the web and head of the rail of my invention is advantageous as more effectively bracing the rail while eliminating tendency of the bar to slip outwardly, such as occurs when using rail of ordinary head free type. Preferably, flange 50 is bent or eased at each side thereof, as indicated by the dotted line segments 51, 52—53. In all other respects, the rail of Figure 8 is constructed similarly to the rail of Figure 7.

In Figure 9 I have illustrated a modification of the head of the rail illustrated in Figures 7 and 8. Referring to Figure 9 it will be noted that the lines *j*—*f'* and *k*—*g'*, defining the sides of the intermediate trapezoidal portion or zone of the head, are inclined inwardly toward the web 46^a at a less angle than the lines *j*—*f* and *k*—*g* of Figure 8. This provides a horizontal bearing surface *g*—*g'* and *f*—*f'* extending from the upper end of each of the web-head fillets *q*—*g* and *p*—*f*. The provision of the additional bearing surface is advantageous as materially increasing the contact area between head 43^a of the rail and head 54^a of bar 54. This increase in contact area is desirable as assuring more effective bracing of the rail head while also eliminating all possibility of upward movement of the bar relative to the head of the rail.

In Figure 10 I have illustrated a modification of the rail of Figure 9. Head 9^b of rail 43^b has it lower side portions inclined downwardly and inwardly, as in Figure 9, but the head web fillets are curved so as to extend well up into the under portion of the head. I have shown a bar or brace member 54^b, of the continuous type applied to this rail. It will be noted, that head 54^c of member 54^b contacts the head-web fillet of the rail for a distance *y'*, and the under outer portion of the rail head for a distance *y*, head 54^c of the brace member being out of contact with the head-web fillet of the rail for the greater portion of the length thereof, indicated by *y''*.

In the form of my rail illustrated in Figure 2 and the modifications thereof illustrated in Figures 5, 8, 9 and 10, the line of pressure *x*—*y* between the bar and the rail is such as to tend to compress the core 55 of the rail head, indicated by dotted lines in Figures 2 and 3, which is advantageous as tending to prevent the development of fissures at the core of the head while contributing to support the chord of the tread

of the rail head. It will also be noted that the line of pressure x—y in Figure 2 is disposed at an appreciably less angle of inclination than the line of pressure of a head free bar applied to head free rail of ordinary type. This is advantageous as relieving the bolts and the bars of a joint of excessive lateral stresses when the joint is under load.

In all of the forms of my invention illustrated, each of the fishing surfaces at the under sides of the head extends outwardly and laterally of the head a distance at least equal to the distance from the web to the point of tangency between the head-web fillet and a line perpendicular to the vertical axis of the rail. This is advantageous as permitting the use of various types of joint bars, while eliminating tendency of the bars to slip upwardly under load and securing improved distribution of stresses and more effective bracing of the rail, as above pointed out.

My invention is best adapted for heavy railroad rail weighing over 100 pounds per yard. In this country there are now two generally accepted standards of moderately heavy rail. One is known as ARA—A and the other ARA—B. The ARA—A sections are high in total height with high web and shallow head. The ARA—B sections are comparatively low with low web and deep head. The ARA—A sections are more generally used than the ARA—B sections, in that they afford greater beam strength of rail and of the joint. The great mass of metal in the head of the ARA—B sections prevents as complete draughting in manufacture as the ARA—A sections, and cooling after rolling is retarded, two circumstances contributing to imperfect rails. While my invention may be applied to rails of ARA—A type, it is particularly adapted to rails of ARA—B type whose massive heads are reduced by the removal of metal from the under portion, thus reducing the surfaces available for fishing contact in the case of the ordinary head contact bar but providing ample fishing surface for head-free and full head contact bars, while still permitting some contact in the case of ordinary head contact bars.

Some of our larger railroads use heavy rails of their own design, these being of two types similar to the ARA—A and ARA—B types. These rails weigh from 127 to 130 pounds per yard, and still heavier rails, 150 pounds per yard, now designed will soon be manufactured and in use. These heavy and very heavy rails with their great head mass afford opportunity for reduction of the head mass to save metal, to afford more thorough draughting in rolling and to insure more uniform cooling of the head as compared with the flange. Each outer lower corner of the head is not needed except for ordinary head contact fishing, and can be removed to use head-free or full head contact joint bars. The under side of the rail head thus substantially narrowed in width and width of fishing contact may retain the usual angle; also this angle may be decreased or made almost horizontal, thereby removing metal from the under side of the head as well as the corners, resulting in a higher rail web and stiffer joint and greater head fillet contact for head free and full head contact bars.

It can be thus seen that while my invention may effect in some cases a better distribution of metal by removing it from the lower portion of the head and applying it to the top of the rail head, its main purpose is to dispense entirely with useless metal by narrowing the rail head or decreasing its depth in the lower portion, so that, for example, a 125 pound rail so reduced from a 130 pound rail would be sounder physically and more efficient than the original heavier design. My invention may therefore be considered broadly as comprehending a rail whose head is narrowed horizontally or thinned vertically from the under side, this necessitating narrowing of the head fishing surfaces, leaving the flange fishing surfaces angled and providing means for take-up necessitated by wear. In the case of new rails, my invention comprehends a rail section with reduced head resulting from redesign of a standard section. As applied to the re-rolling of worn rails, it comprehends a rail with a reduced head resulting from actual removal of metal, which in the case of badly worn rails may sometimes result in a symmetry of the rail head, although having symmetry in fishing height and head fillet fishing contact.

What I claim is:

1. A heavy railroad T-rail including a head and web joined on each side by a fillet, said head consisting of a top and side wheel bearing portion with sides sloping outward and downward, an intermediate inverted trapezoidal portion with sides sloping inward and downward, and a bottom portion with under sides sloping downward and inward and tangent to the tops of said web fillets, the under sides of said bottom portion providing head contact fishings throughout their widths.

2. A heavy railroad T-rail including a head and web joined on each side by a fillet, said head consisting of a top and side wheel bearing portion with non-inward and downward sloping sides, an intermediate inverted trapezoidal portion with sides sloping downward and inward, and a bottom portion with under sides sloping downward and inward tangent to the tops of said web fillets, the lower outer corners of the rail

head being provided with fillets, and the under sides of said rail head providing fishing contacts from the bottoms of said lower outer head corner fillets to the bottoms of said web fillets.

3. A heavy railroad T-rail including a head and web joined on each side by a fillet, the under sides of said head providing approximately horizontal fishing contacts each of sub-normal width.

4. A heavy railroad T-rail including a head and a web joined on each side by a fillet, the width of the head at the bottom being less than the width of the head at the top and providing approximately horizontal fishing surfaces from the outer lower corner of each side of the rail head to the top of each web fillet.

5. A heavy railroad T-rail including a head and web joined on each side by a fillet, said head being narrower at the bottom than at the top and providing for head fillet fishing contact only, said head fillet providing contact from the bottom of said fillet to where the top of said fillet meets an approximately horizontal line tangent to the top of said fillet.

6. A heavy railroad T-rail including a head and web joined on each side by a fillet, said head being narrower at the bottom than at the top and each of its lower surfaces of subnormal fishing width, said lower surfaces and said fillets on each side and in combination providing full fillet fishing contact and partial head fishing contact.

7. A heavy railroad T-rail including a head and web joined on each side by a fillet, said head being narrower at the bottom than at the top and providing maximum contact on each of said fillets only by having the top of each of said fillets extending laterally to the line representing its vertical diameter.

8. A reformed railroad T-rail produced from a standard T-rail by removing metal from each of the lower outer corners of the head of the standard rail in substantial amounts, the reformed rail having only partial fishing contact on each lower under surface of the rail head in combination with head fillet contact.

9. A reformed heavy railroad T-rail produced from a standard T-rail by removing metal from the lower outer corners of the head of the standard rail in proper amount only to provide in the reformed rail head-fillet and under head fishing contacts for a full head contact rail joint bar.

10. A reformed railroad T-rail produced from a standard T-rail by removing metal from each of the lower outer corners and each of the under surfaces of the head of the standard rail, the reformed rail having only partial fishing contact and head fillet contact at each under surface of the rail head.

11. A full head contact T-rail including a head and web joined on each side by a fillet, said head consisting of a top and side wheel bearing portion with non-inward and downward sloping sides, an intermediate inverted trapezoidal portion with sides sloping inward and downward, and a bottom portion with under sides sloping downward and inward and tangent to the tops of said fillets, said under sides and said fillets providing in combination full fishing contact for a full head contact bar.

12. A heavy railroad T-rail including a head and a web joined on each side by a fillet, the width of the head at the bottom being less than the width of the head at the top, the under sides of the head providing fishing surfaces each disposed at an angle to the horizontal materially less than the normal fishing angle of standard T-rail.

In witness whereof, I hereunto subscribe my name this 29th day of May 1930.

GEORGE LANGFORD.