Nov. 11, 1930. B. G. BRAINE 1,781,432

STRESS BALANCED SPLICE BAR

Filed April 11, 1930 2 Sheets-Sheet 1

Fig. 1.

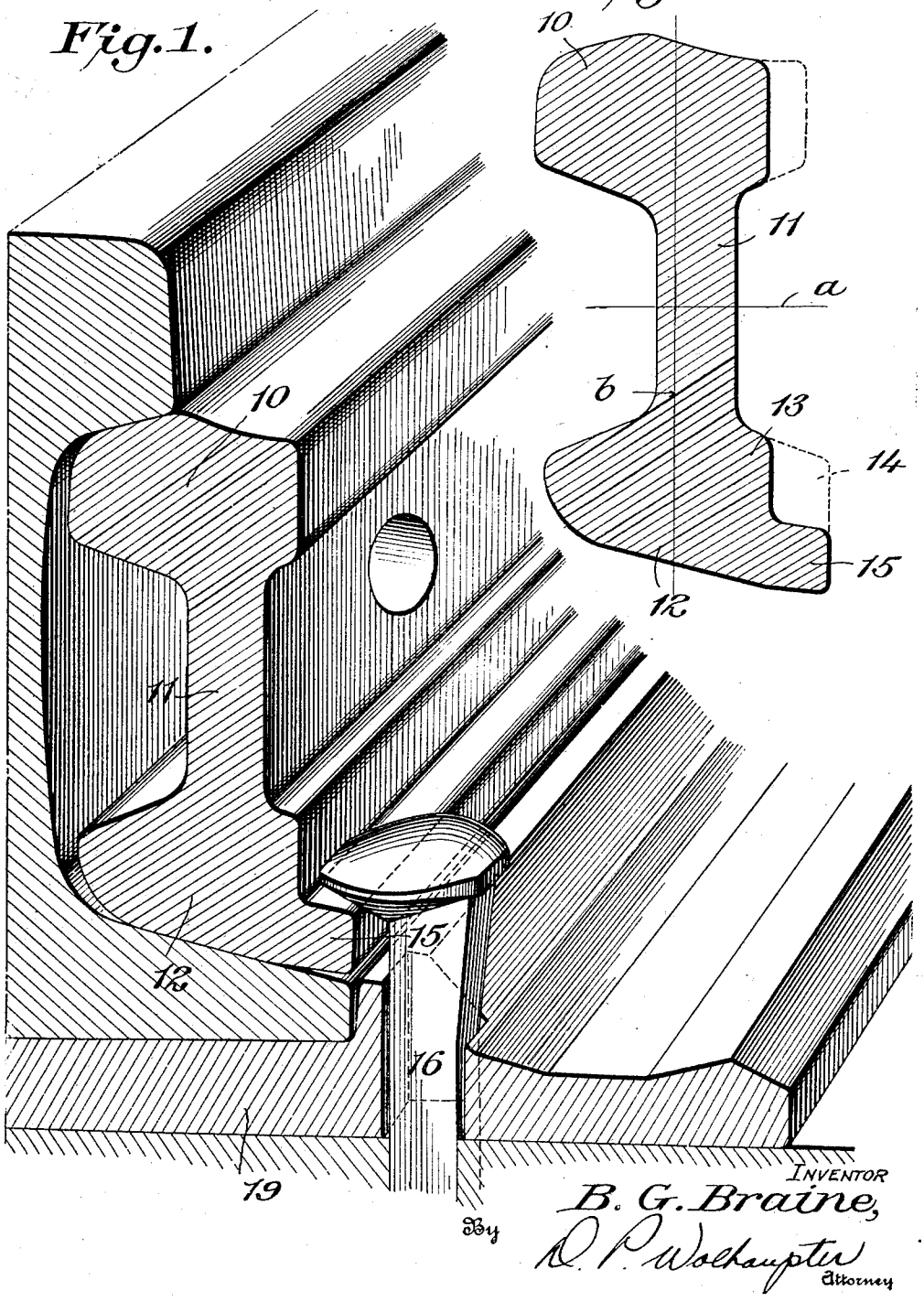


Fig. 2.

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Filed April 11, 1930 2 Sheets-Sheet 2

Fig. 4.

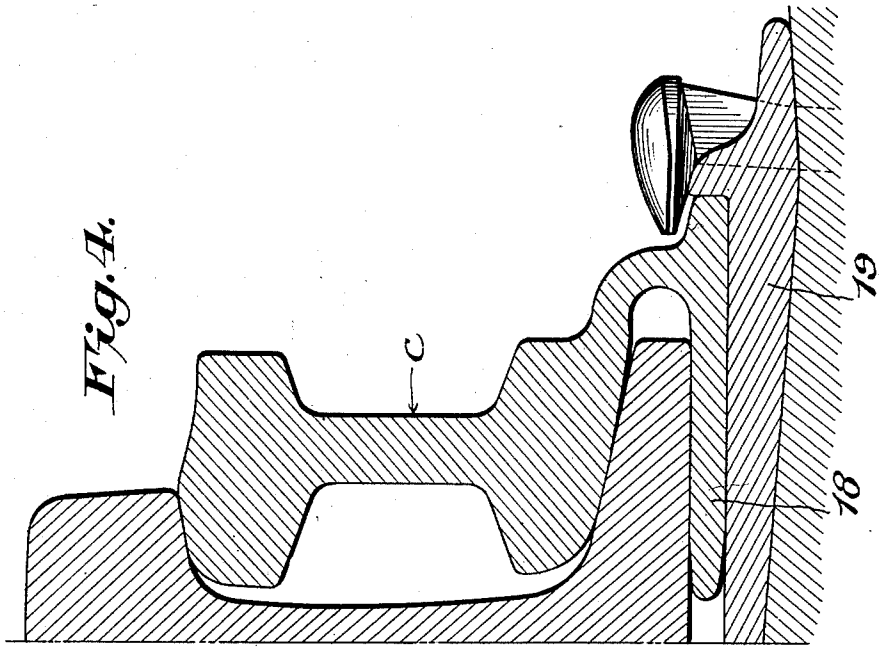
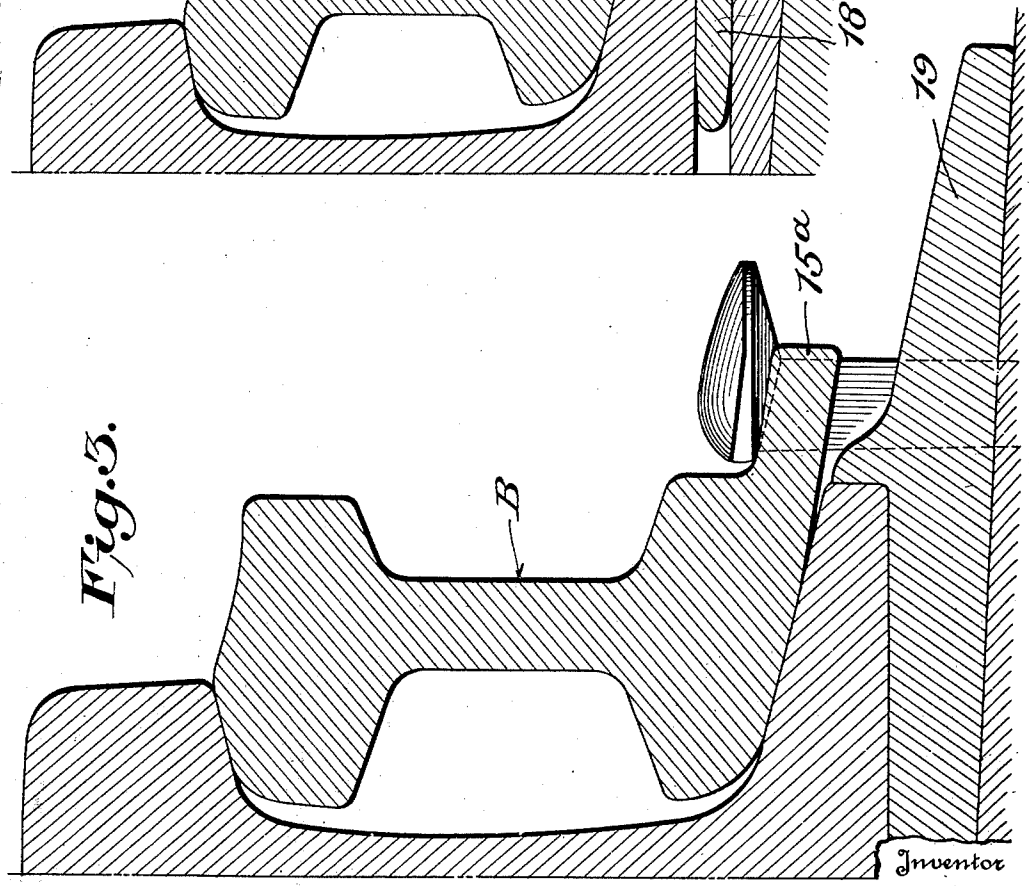


Fig. 3.



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UNITED STATES PATENT OFFICE

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STRESS-BALANCED SPLICE BAR

Application filed April 11, 1930. Serial No. 443,538.

This invention relates to splice bars for rail joints, and has in view to provide certain desirable improvements in the distribution of the metal of such bars to the end of enabling an economical use of metal in producing splice bars of requisite strength, especially adapted for connecting rails which are high in the fishing space.

More particularly, the invention has in view to amplify the principles underlying the distribution of the metal of splice bars in accordance with the teachings of my Reissue Patents Nos. 16,311 and 16,506, and the coordination of these principles to more than a single axis.

A splice bar designed in accordance with the principles set forth in my prior patents mentioned may be balanced, or substantially balanced, as to the areas of certain zones, and as to certain of its physical properties and ratios of metal distribution above and below its horizontal gravity axis or a middle line which may be other than horizontal. In cross sectional shape, however, the head and base portions of a splice bar that is so balanced may differ widely from one another, and as a matter of fact, due to the cross-sectional shape of a railway rail and the relative disposition of its fishing surfaces, most balanced splice bars heretofore produced have been of unsymmetrical shape, some of them being inclusive of a foot flange extending outwardly beyond the edge of the rail flange, and the metal constituting the base of others being disposed entirely inwardly of the edge of the rail flange.

Heretofore, in the instance of a bar having a slotted foot flange extending beyond the edge of the rail flange, it has been the custom, as in the case of my prior patents referred to, to calculate the bar as a whole assuming that the maximum strains did not come as far away from the middle of the bar as the slots, whereas the present bar is calculated within the slots.

In instances where a splice bar is inclusive of a foot flange extending outwardly beyond the edge of the rail flange it has been the usual practice heretofore to provide spike slots at spaced points along the foot flange, while on the other hand, in instances where all or substantially all of the metal constituting the base portion of a balanced splice bar is disposed inwardly of the edge of the rail flange, the foot flange of the bar usually has been of considerable depth.

Accordingly, a particular object of the present invention is to so distribute the metal of a splice bar of the foot flange type, that the bar will be balanced, or substantially balanced, as to the area of certain zones and as to its effective physical properties above and below its horizontal gravity axis or middle line for that portion of the bar located inwardly of the spike slots, and which will be of greater strength or at least of equal strength where slotted, to the unslotted portions of a bar of the same type and of equal weight and area as heretofore produced.

Another particular object of the invention is to effect, in the case of a splice bar of the type including a foot flange disposed inwardly of the edge of the rail flange, a novel distribution of the metal thereof to maintain the bar balanced, or substantially balanced, as to the area of certain zones and as to its effective physical properties above and below its horizontal gravity axis, and to preserve the strength thereof, and at the same time to afford a spiking rib of materially less depth than the standard foot flange of prior bars of this type to give greater penetration and holding power of the spikes.

With the foregoing and other objects in view, which will be apparent to those skilled in the art as the nature of the present improvements are better understood, the invention consists in the novel combination and arrangement of features as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claims.

In the drawings, wherein like characters of reference denote corresponding parts in related views:—

Figure 1 is a sectional, perspective view of a portion of a rail joint illustrating a splice bar of the type having a foot flange disposed inwardly of the edge of the rail

flange, and having a distribution of the metal thereof in accordance with the present invention.

Figure 2 is a view illustrating by full and dotted lines, respectively, the difference in cross sectional shape of the splice bar shown in Fig. 1, as compared with a splice bar of the same type as heretofore produced.

Figure 3 is a cross-section of a rail joint illustrating a splice bar of the type which is inclusive of a foot flange extending outwardly beyond the edge of the rail flange and which has a distribution of metal in accordance with the present invention; and

Figure 4 is a cross section of a rail joint illustrating an embodiment of the invention in which a bar of the type shown in either of Figs. 1 or 3 is provided with an integral base formation adapted to underlie the base of the rail.

It is characteristic of each of the present splice bars that the portions thereof disposed respectively above and below a horizontal gravity axis or middle line are balanced, or substantially balanced, as to their essential physical properties, and ratios of metal distribution, but, as distinguished from prior splice bars of the extended, spike-slotted foot-flange type, a bar of that type constructed in accordance with the present invention involves a distribution of metal affording greater strength, where same is slotted to the prior bar at the slotted point. Further, as distinguished from a prior splice bar of the type which is inclusive of a foot flange disposed inwardly of the edge of the rail flange, a bar of that type constructed in accordance with the present invention involves a distribution of metal possessed of at least equal strength to a prior bar of the same weight and area and which affords in addition a spiking rib of a depth enabling substantially full penetration and holding power of the spikes.

For a better understanding of the invention reference first is made to Fig. 2 of the drawings, wherein is illustrated, by full lines, a splice bar, designated generally as A, of the type having a foot flange disposed inwardly of the edge of the rail flange and constructed in accordance with the present invention, and, by dotted lines, the essential difference in the distribution of the metal of a present bar of this type as compared with a prior bar of the same type, the dotted line bar being calculated for example in accordance with the principles set forth in my prior patents. From the illustration in this figure it will be observed that the present splice bar is inclusive, as usual, of a head 10, a web 11 and a base 12, and that the latter is inclusive of an outwardly directed foot flange 13 disposed, as shown in Fig. 1, inwardly of the edge of the rail flange. It will further be noted, however, that as distinguished from the foot flange of substantially uniform and relatively great depth of the prior bar, illustrated by the dotted lines 14, the foot flange of the present bar is stepped so as to terminate at its bottom in an outwardly directed, relatively thin spiking rib 15, thereby to enable substantially full penetration and holding power of the spikes 16 as indicated in Fig. 1.

The metal constituting the spiking rib 15 may or may not enter into the calculations of the present bar for area and physical properties, and in the latter instance said rib will constitute what may be termed an additional reinforcement for the foot flange. In either event, however, it is desirable that the head and base portions of the bar disposed respectively above and below the neutral horizontal axis of the bar and designated in Fig. 2 as a shall be substantially balanced, as to their physical properties or ratios of metal distribution, particularly as regards the moment of inertia, the static moment, and the location of the center lines of stress

$$\left(\frac{I}{S}\right)$$

and the center of gravity of the respective sections

$$\left(\frac{S}{A}\right).$$

Moreover, it is desirable that the present bar shall have a low product of inertia value and a high polar moment of inertia, and that the same shall approach geometrical as well as analytical symmetry, to which end the head 10 of the present bar is formed to extend only a relatively short distance outwardly beyond the outer face of the web 11 and a materially greater distance inwardly beyond the inner face of the web, thereby in relation to the particular shape of the base of the bar, to preserve an analytical balance or a substantial balance of the physical properties of the portions of the bar above and below the horizontal gravity axis thereof, and inwardly and outwardly of a vertical neutral axis b, as well as to preserve substantial geometrical symmetry between said portions. In explanation of the expressions "product of inertia" and "polar moment of inertia" these may be defined respectively as follows:—

The product of inertia of a plane area with respect to two rectangular axes is the quantity of summation, which is the sum of the products formed by multiplying each elementary area by its coordinates.

The polar moment of inertia in any section is the sum of the moment of inertia about any gravity axis and the moment of inertia about an axis at right angles to the first chosen axis.

That the present bar, as regards its shape, and not considering the rig 15 which, as

heretofore stated, may or may not enter into the calculations of the bar for area and strength, is substantially geometrically symmetrical is evident from Figs. 1 and 2 by a comparison of the shape of the head 10 thereof with the shape of the base 12 thereof, and that a bar having the section of the present bar may be analytically symmetrical or substantially balanced, i. e., balanced in respect to its effective physical properties above and below its horizontal gravity axis, respectively, is evident from the approximately correct dimensions and calculations for the effective physical properties thereof, as follows (disregarding the metal in the rib 15):—

Prior bar (dotted lines)

	Above axis	Below axis
Moment of inertia (I)	7.20	7.07
Stress balancing ratio $\left(\frac{I}{S}\right)$	1.57	1.55
Static moment (S)	4.58	4.57
Centers of gravity ratios $\left(\frac{S}{A}\right)$	1.39	1.40
Area (A)	3.30″	3.27″
Product of inertia minus .91		

Present bar (full lines)

	Above axis	Below axis
Moment of inertia (I)	6.48	6.42
Stress balancing ratio $\left(\frac{I}{S}\right)$	1.60	1.60
Static moment (S)	4.04	4.02
Centers of gravity ratios $\left(\frac{S}{A}\right)$	1.30	1.35
Area (A)	2.98″	2.97″
Product of inertia minus 1.355		

Referring now to Fig. 3 of the drawings, it will be observed that the splice bar illustrated in this instance and designated generally as B is similar to the bar illustrated in Figs. 1 and 2 with the exception that the spiking rib 15ª extends outwardly beyond the edge of the rail flange and is slotted for the reception of the spikes. As in the case of the bar illustrated in Figs. 1 and 2, the metal of the rib 15ª of this bar of the extended foot flange type shown in Fig. 3 may or may not be taken into consideration in the calculations of the bar for physical properties. Also, as in the case of the first mentioned bar, it is evident that the bar of Fig. 3 is substantially geometrically symmetrical. Not considering the rib 15ª, the calculations for physical properties of this latter bar are the same as given in respect to the bar illustrated in Figs. 1 and 2, the essential difference between said bars being that the rib 15 of the bar first mentioned is disposed inwardly of the edge of the rail flange, whereas the rib 15ª of the second mentioned bar extends outwardly beyond the edge of the rail flange. In each instance, however, the bar comprises what may be termed a major portion consisting of the head, the web and the base or foot flange lying inwardly of the edge of the rail flange and which is substantially geometrically and analytically symmetrical, and which is provided with an outwardly directed relatively thin spiking and reinforcing rib.

Now, by a comparison of the calculations of the present bar with the calculations of a prior bar of the same general type, it is evident that by the utilization of substantially an equal amount of metal in each instance, the present bar is possessed of approximately the same effective physical properties as the prior bar and at the same time is possessed of the extremely desirable and important feature of an outwardly extending, relatively thin spiking rib which enables substantially full penetration and holding power of the spikes.

In view of the foregoing it is manifest that the rib 15 or 15ª of either of the present bars, whether same is or is not taken into consideration in the calculations of the respective bars, may be extended without affecting the essential physical properties of the bars, and thus, as illustrated in Fig. 4, a present bar designated generally as C and of either of the types illustrated, is adapted to have the outwardly directed rib thereof extended in the form of a plate 18 to underlie the rail, thereby to reduce the strains on the joint bolts and to maintain the outer face of this joint bar in a vertical position. In this connection it will of course, be understood that if desired the section of this bar may be modified so that no bending strain could come in the much reduced section 18.

In each of the embodiments of the invention herein illustrated it will be noted that the joint is inclusive of an abrasion plate 19 underlying the rail. The use of an abrasion plate, however, is optional.

Without further description it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art, and it will of course be understood that changes in the form, proportion and minor details of construction may be resorted to, without departing from the spirit of the invention and scope of the appended claims.

I claim:—

1. A rail splice bar comprising a substantially geometrically symmetrical major portion inclusive of a foot flange, and a rib forming an outward extension of said foot flange and of materially less depth than the portion of the latter included within the substantially geometrically symmetrical portion of the bar.

2. A rail splice bar comprising a substantially geometrically symmetrical major portion inclusive of a foot flange, lying entirely within the outer edge of the rail flange, and a rib forming an outward extension of said foot flange and of materially less depth than the portion of the latter included within the substantially geometrically symmetrical portion of the bar.

3. A rail splice bar comprising a substantially analytically symmetrical major portion inclusive of a foot flange, and a rib forming an outward extension of said foot flange and

of materially less depth than the portion of the latter included within the substantially analytically symmetrical portion of the bar.

4. A rail splice bar comprising a substantially analytically symmetrical major portion inclusive of a foot flange lying entirely within the outer edge of the rail flange, and a rib forming an outward extension of said foot flange and of materially less depth than the portion of the latter included within the substantially analytically symmetrical portion of the bar.

5. A rail splice bar having a high moment of inertia and a low product of inertia value and inclusive of a foot flange, and a rib of less depth than said foot flange forming an outward extension of the latter.

6. A rail splice bar lying entirely within the outer edge of the rail flange and having a high moment of inertia and a low product of inertia value and inclusive of a foot flange, and a rib of less depth than said foot flange forming an outward extension of the latter.

7. A rail splice bar comprising a major portion having a high polar moment of inertia and a low product of inertia value and inclusive of a foot flange, and a rib of less depth than said foot flange forming an outward extension of the latter.

8. A rail splice bar having a high polar moment of inertia and a low product of inertia value and inclusive of a foot flange and a rib of less depth.

9. A rail splice bar comprising a substantially analytically symmetrical major portion inclusive of a foot flange, and a rib of materially less depth than said foot flange forming an outward extension of the latter, said rib being extended to underlie the rail.

10. A rail splice bar comprising a substantially analytically symmetrical major portion inclusive of a foot flange lying entirely within the outer edge of the rail flange, and a rib of materially less depth than said foot flange forming an outward extension of the portion of said foot flange included within the substantially analytically symmetrical portion of the bar said rib being extended to underlie the rail.

11. A rail splice bar comprising a major portion having a high moment of inertia and a low product of inertia value and inclusive of a foot flange, and a rib of materially less depth than said foot flange forming an outward extension of the portion of said foot flange included within the major portion of the bar and extended to underlie the rail.

In testimony whereof I hereunto affix my signature.

BANCROFT G. BRAINE.