No. 609,101. **R. HINCHLIFFE.** Patented Aug. 16, 1898.

RAIL JOINT.

(Application filed Mar. 9, 1896.)

(No Model.)

Fig. 1.

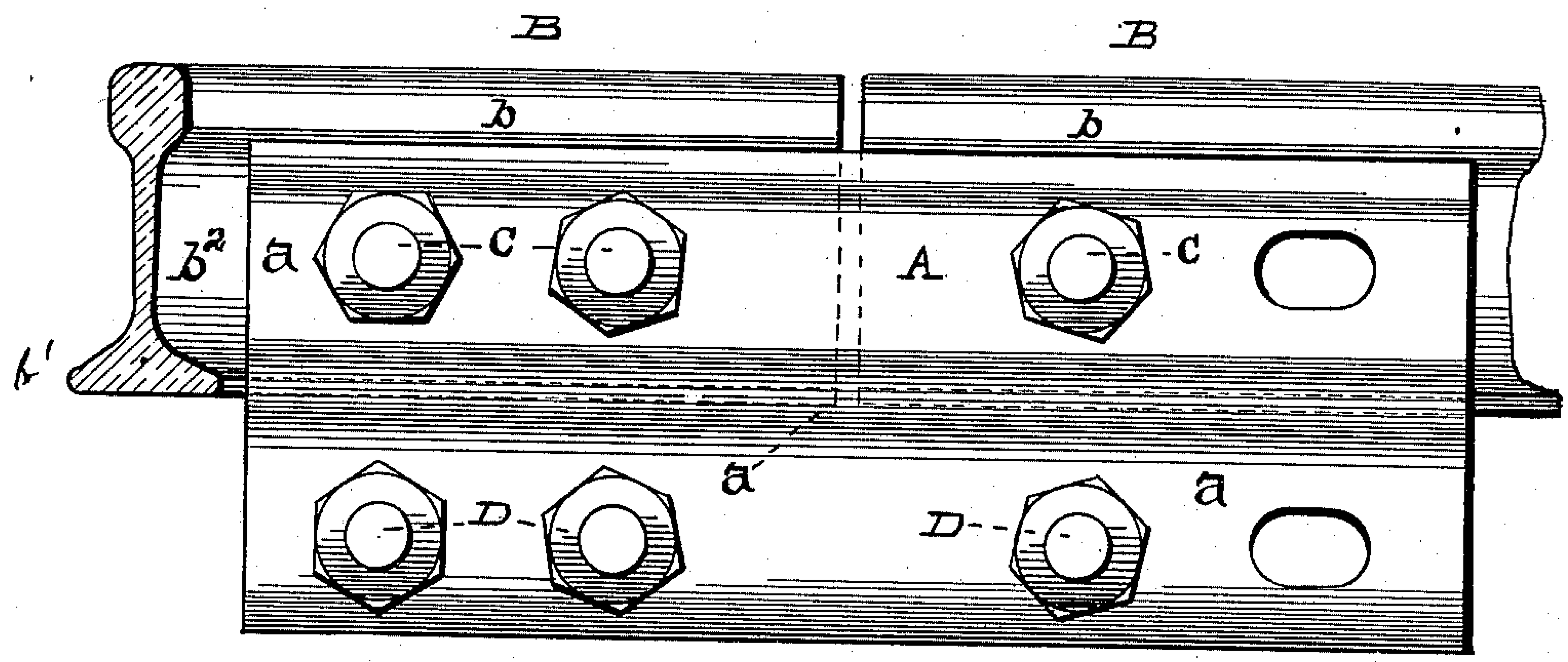
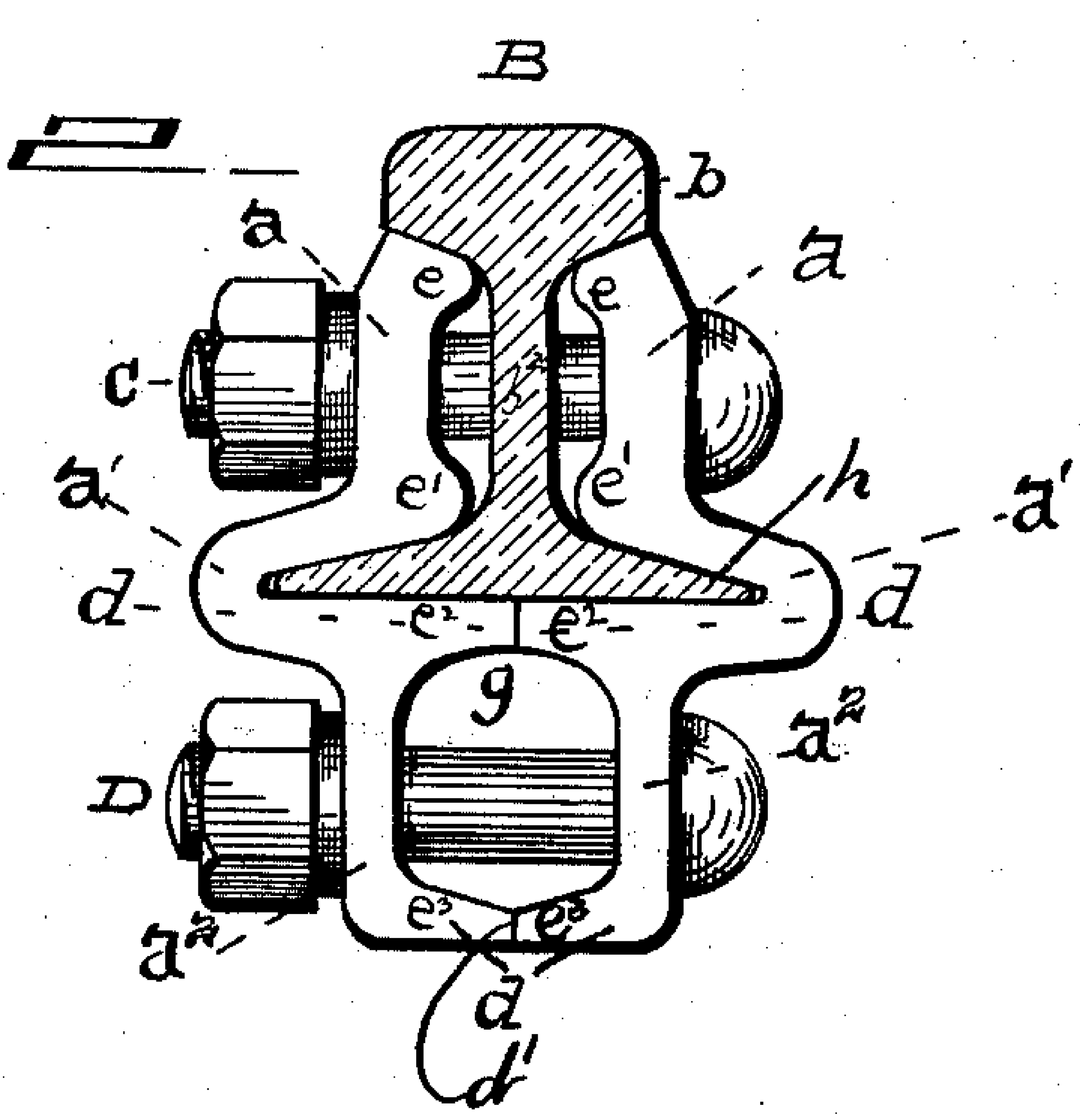


Fig. 2.



WITNESSES

Chas. K. Davies.

W. A. Bartlett

INVENTOR

R. Hinchliffe

By L. B. Coupland & Co

Attorneys

UNITED STATES PATENT OFFICE.

ROBERT HINCHLIFFE, OF CHICAGO, ILLINOIS.

RAIL-JOINT.

SPECIFICATION forming part of Letters Patent No. 609,101, dated August 16, 1898.

Application filed March 9, 1896. Serial No. 582,400. (No model.)

To all whom it may concern:

Be it known that I, ROBERT HINCHLIFFE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rail-Joints; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improved device for connecting the meeting or abutting ends of railway-rails to form a continuous trackway, and has for its object to provide a joint that will be as strong or stronger than the rail, and thereby prevent deflection and secure an even line along the surface of the rail.

On all railways the movement of a train causes a vertical load on the rails, tending to force them downward. In addition to this on a curve there is a lateral force tending to move the outside rail sidewise. The rails are therefore subject to the action of two forces acting at right angles to each other. The vertical only acts on a straight line and both forces together on a curve. The rails, joints, ties, &c., that form the road-bed have to be of such a size as to meet the requirements of weight per car, as well as the number and speed of trains making up the traffic passing over them. The weak points of the track are the joints, which are always found after some use to be depressed below the ordinary level of the rails. To remedy this evil and to maintain the rails at their proper level throughout their entire length the present device was invented. As a means to this end the first thing is to ascertain the strength of the rail in such terms as to represent a known quantity, and, second, to design a joint of equal strength that will safely bear the vertical load and resist the lateral bending action already mentioned. Structurally the larger portion of the material of the rail is in the head or tread. This is to allow for wear, as well as strength. The next largest portion is in the flange or base and the remainder is in the web. In ordinary rails over forty per cent. of the steel forms the head, over thirty per cent. forms the flange, and the balance forms the web. The chief function of the web is to sustain the shear or the crushing effect of the load. All rails are laid on ties spaced a certain distance apart. Between such ties the rail has no support and must be strong enough to resist all bending action. When the wheels of the train are on the rail between the ties, the rail is subject to a shearing strain. When the wheels are over the ties, the strain is a crushing one. For rails of above proportion, and in fact for all rails, the strength to carry a load depends upon the distance between the tread and the bottom of the flange and is in proportion to the cube of this distance within certain limits. The stiffness of the rail sidewise depends, chiefly, on the width of the flange. It will be thus seen that the load that a rail of a given weight will bear in either direction can be greatly modified and is dependent upon the distance between its outer parts, as stated; but this is only within certain limits, for if the rail is made too high the web will be too thin and would bend under the load, just the same as a column is made larger and heavier to carry the same load as its length is increased. Experience has suggested certain proportions for given weights of rails which are recognized among railroadmen as standards.

In searching for data necessary to calculate the strength of a beam or rail there are certain functions, technically called "moments," which are preliminary in all investigations of this nature, which when once ascertained determine the problem to be solved. The first step is to find the neutral axis, which is usually the center of gravity, which in a rail, owing to the usual proportions already stated, is nearer the head and is situated in the web as much farther from the base, measuring from the center of the height, as the head and flange differ in proportion. The line along the web corresponding to this position is called the "neutral axis," because the molecules at this line are not subject to any stress except that of weight when the rail is loaded, as they are exactly between the upper part in compression and the lower part in tension. The same method of reasoning applied to a joint will determine its dimensions to carry a given load with just as much certainty. It being understood that the rail is being treated as a beam, the plates forming the joint, the subject of this invention, are being treated as girders of short span to bridge the gap between the rail ends. The two problems in this connection are the form and dimensions of the plate and the mechanical means of attaching them firmly and readily to the rails. Now the rail is uniform in section and is consequently of the same strength throughout its entire length, and it only remains to construct a joint of the same or greater strength—probably about twenty per cent. more—to allow for punching and possible defects and to properly connect it to the rails to effectually bridge over the gap between them and so make this point as strong as any portion of the rail.

Having found the required depth of the plates forming the joint in the girder form and distributed the material to resist lateral strain, it is only necessary to find the length required, which depends upon the shear of itself and of the flange of rail and the method of connection. The shear of the rail has to be considered, because the deflection at the joint-plates from a load at the middle is resisted by the flange of rail at the end of the joint, which is thus subject to shear or to a punching action. The power of the flange to resist this action depends on the distance from the end of rail or on the length of joint within small limits, just as a lever applied to a load depends upon the position of the fulcrum for the power or weight applied. The stress on the fulcrum depends on its position with reference to the load and the power applied. The nearer to the load the greater the stress. If the fulcrum is moved farther away, a given power will lift less, and in general the load that a given force can move with a lever is proportioned to the length or distance of the fulcrum. From this it will be seen that the load on a joint is concentrated at the gap between the rail ends, tending to bend it at this point downward. This downward tendency is resisted by the joint-plates at the center of their length and at their ends by an upward reaction. They tend to carry the flange of the rail along with them, causing a tendency to shear the flange. From the center of the joint to its end is the fulcrum in the lever, which can be varied at pleasure within certain limits. Calculation shows with regard to the strength of the flange the safe length of the joint. The material in this device is therefore distributed to resist the strains to which it is subject throughout its length and breadth, as well as to resist the bending action around a curve. Its function, therefore, is to unite the rails which it joins into one continuous rail.

So far the joint has been treated as an engineering matter. Its mechanical phases are its manufacture and proper connection to the rails. With reference to its manufacture it can be rolled, like a rail, between suitably-shaped rolls, of steel or any other material that will roll. It is completed in a roll and there is no other process to be gone through except cutting to length and punching, which is common to all joint-plates and is therefore no more expensive. To connect this device to the rails, the plates are fitted to the rail between the head and flange and around and underneath the flange, as shown, and are secured there by bolts. If the function of the bolts was to resist the action of a vertical load only, fewer would answer; but in addition to the vertical load it is subject to a bending strain on a curve, as already stated. These strains are resisted by the bolts, which are the fulcrum of the levers, and their strength is proportioned under these conditions to the strength of the joint, which from the distribution of the material in the plates is stronger laterally than the rail. Its form also gives it a certain elasticity, resulting from the load being conveyed to the vertical portion of the plates through a deflected line. It is a device intended for all rails in ordinary use, of whatever form or section or for whatever purpose, and is entirely independent of the ties, as it lies wholly between them. This device is complete in all its details, and as the result of careful study of the conditions under which it is applicable to resist the strains to which it will be subject will be of great service to railroads in keeping a road in good condition by prolonging the life of the rail and by increasing the safety and comfort of the passengers by minimizing the chances of accidents through the removal of the existing weakness at all joints.

In the construction shown unlimited strength is attainable without making the joint unduly large or bulky. It is a bridge in the fullest sense of the term and is designed, like the rail, on the same principle as a beam or girder for vertical and lateral strains, the latter occurring more especially on curves.

The joint being as strong vertically and as stiff laterally as the body of the rail the weight on the wheels will be equally distributed and unequal loading of the ties adjacent to the joint will be avoided. Weak joints are the cause of the depression always observable at the rail ends. The depression causes hammering on the rails by the moving train, which loosens the earth and lowers the contiguous ties, producing endless expense in maintenance of way, as well as everlasting injury and probable disaster to the rolling-stock. Remove the cause by the introduction of a joint that will hold the rails rigidly in line and yet allow for expansion and contraction and a remedy is at once obtained for the above serious objections.

Figure 1 is a side elevation showing joint-plates applied to a rail-joint, bolts being omitted from two bolt-holes. Fig. 2 is an end view of joint-plates, showing rail in section and bolts as they would appear in such end elevation.

The companion joint-plates A A follow the outline of the rail where they are in contact and when secured in place occupy the relative position shown with reference to the diffent parts of the rail B. The vertical parts a a of the plates fit in between the under side of the head b of the rail and the upper side of the flange or base b', and these parts a a shown have upper and lower ribs e e', such ribs being well known in railway-rail joint-plates. The surfaces in contact of the upper parts of the plates are beveled to fit the corresponding beveled surfaces of the rail-head and flange-base and wedge into place. The plates are secured to the rail by bolts C, passing through the web b^2. From the bases of the upper parts a a the plates extend outwardly around the flange edges of the rail, forming the middle rounded-shoulder parts a' a', then run back closely to and underneath the flange, then turn down vertically, forming the lower parts a^2 a^2, and then turn inwardly, meeting in the vertical plane passing through d' d', forming a chamber g between them. The lower webs a^2 of the plates are shown as about midway of the horizontal width of each plate, measured from end of rib e^2 to rounded shoulder. The webs a a^2 of the plate are therefore in about the same plane, insuring vertical stiffness, and the ribs projecting from said webs a^2 toward each other about in contact under the rail and the bolts holding all firmly in place secure lateral strength and stiffness.

The tongues or shelves ending at d d, on which the base of rail rests, are formed in the process of rolling and may have a space between the points d d to draw the plates in closer contact to rail. The lower parts of the plates a^2 a^2 are held in place by bolts D, passing through from side to side, as shown in Fig. 2. The bolts C and D also resist the action of bending on a curve, as already explained. It will be noted that the in and out bends of the center parts of the plates provide a recess h for the flange of the rail and inclose the surface thereof both above and below. The joint-plates will be proportioned in their dimensions and the material in them will be distributed according to the sizes, shapes, and weights of rails. As the joints will lie between the ties, the depth below the rail is unlimited. There will therefore be no limit to the depth of the joint except that of convenience.

The upper parts a a of the joint-plates between the head and flange of rails are subject to a compressive stress only, like the head of rail, while the lower parts a^2 a^2 below the rail are subject to a tensile stress only, like the flange of rail. The middle portion a' is subject to several strains at the same time. It transmits a part of the load from the upper part a to the lower part a^2 and owing to its Ɔ form undergoes a bending strain and a compressive stress. It is in the line of the neutral axis and is therefore subject to both compressive and tensile stresses. While the middle portion of the Ɔ (as regards length) is undergoing a compressive and bending action from the load, tending to deflect the plates at the center, the ends of the portion tend to open out, owing to the reaction of the flange in resisting the load. The neutral axis by preference passes through that portion of the plate, which facilitates calculation and forms a distinct dividing-line for the compressive and tensile stresses. In calculation the Ɔ portion forms no part except to transmit a part of the load and the opposite lines of stress and to resist bending action.

As already stated, the bolts play an important part in resisting deformation besides the vertical load. This arrangement holds the abutting ends of the rails in a firm grip, prevents any lateral or vertical motion between the rails, gives great stiffness to the joint, and forms practically a continuous rail. Its use, therefore, will remedy the hammering between wheels and rail ends, prevent the loosening of the earth and the consequent depression of the adjacent ties, increase the life of the rail, and materially diminish the wear and tear on rolling-stock and lessen the probabilities of disaster. The manner of investigating the principles governing the action and strength of this joint, together with the deductions determining the form and distribution of the material, are entirely new. In no other specifications involving a similar purpose can analogous reasoning be found.

It will be observed that the parts or webs a a^2 of the joint-plates are substantially in the same vertical plane. The lower parts or webs a^2 of the plates extend the full length of the plates. The bolts D, which extend through the lower parts or webs a^2 of the plates, are below the rails, and the outer pair of such bolts have locations near the ends of the plates, where they have a long leverage from the joint of the rail. The plates are duplicates and reversible and, seen in elevation, are rectangular in outline. The ribs e e' extend toward the web of the rail above the flange. The ribs e^2 e^3 extend into contact when drawn together below the flange.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The rail-joint plate described, consisting of the metallic piece, rectangular in outline, having webs a a^2 in substantially the same plane, and having the inwardly-projecting ribs e e', the rounded-shoulder middle part a', and the ribs e^2 e^3 below said rounded shoulder, the web a^2 joining the under flange of the middle part a' at about midway of its width, said plate having the bolt-holes above and below the middle part, substantially as described and shown.

2. In a railway-joint, in combination with the adjacent rails of a track, a pair of similar joint-plates, each plate having webs a, a^2 in substantially the same vertical plane con-

nected by rounded-shoulder portions, the ribs e, e', extending inward and fitting closely against the rail head and flange, the ribs e^2 extending inwardly nearly to each other under the rail-flange and the ribs e^3 extending toward each other from the lower edge of web a^2, the webs a^2 joining the under flanges of the middle parts a' at about midway of their width, the bolts extending through said plates and the rails, and a pair of bolts extending through the plates near the outer ends and below the rails, all substantially as described.

3. The combination with the abutting rails of a railway, of a pair of joint-plates, similar to each other, rectangular in outline, having upper and lower webs in substantially the same vertical plane, the upper web having upper and lower internal ribs extending inward about to the web of the track at the junction of said track-web with the head and flange respectively, the central portion of said plates curving outward around the flange of the track, the lower webs of the joint-plates having an upper and lower rib extending inward about into contact below the track-flange, and the upper bolts passing through the upper web of the track and of the joint-plates, and the lower bolts passing through the joint-plate webs below the track and between the ribs of the joint-plates, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

ROBERT HINCHLIFFE.

Witnesses:
L. M. FREEMAN,
L. B. COUPLAND.