No. 772,188. PATENTED OCT. 11, 1904.

E. G. THOMAS.

RAIL BOND.

APPLICATION FILED MAR. 26, 1903.

NO MODEL.

FIG. 1

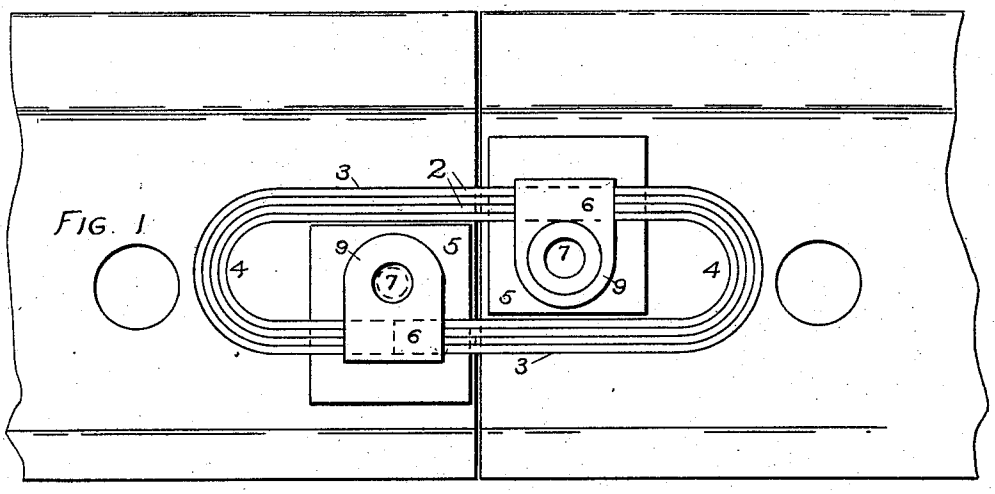
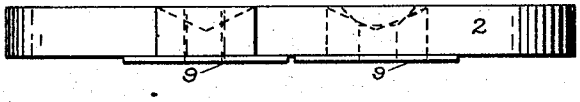


FIG. 2



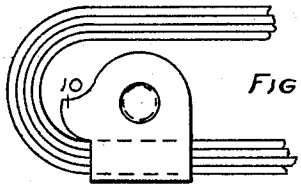


FIG. 3

FIG. 4

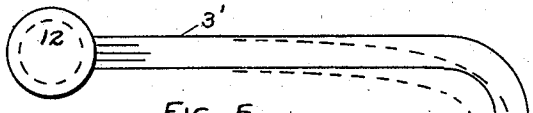


FIG. 5

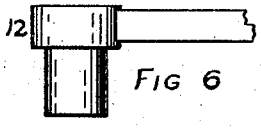
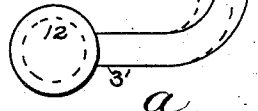


FIG 6



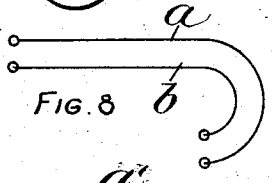


FIG. 8

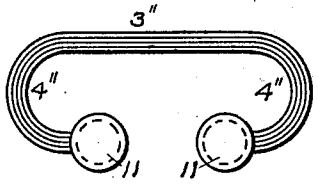


FIG. 7

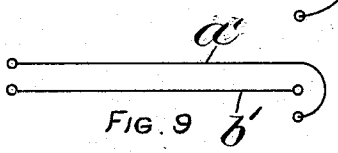


FIG. 9

WITNESSES

Howard Forbes

William H. Boynton

INVENTOR

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No. 772,188. Patented October 11, 1904.

UNITED STATES PATENT OFFICE.

EDWARD G. THOMAS, OF WALTHAM, MASSACHUSETTS.

RAIL-BOND.

SPECIFICATION forming part of Letters Patent No. 772,188, dated October 11, 1904.

Application filed March 26, 1903. Serial No. 149,607. (No model.)

To all whom it may concern:

Be it known that I, EDWARD G. THOMAS, a citizen of the United States, and a resident of Waltham, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Rail-Bonds, of which the following is a specification.

My invention relates to flexible conductors for establishing an electrical connection between relatively moving parts, and is intended more particularly to provide an improved rail-bond for use in connection with the rails of electric railways.

In many instances laminated rail-bonds are preferable to bonds of other types, and, so far as I am aware, all laminated bonds heretofore employed have been so constructed that their laminæ are bent at some point to a **U** shape of more or less perfect character and are so attached to the rails as to maintain the axis of the **U** substantially at right angles to the length of the rails, so that the motion to and fro of the points of attachment of the bond under the alternate elongations and contractions of the rails closes together or spreads apart the sides of the **U**-shaped part. Such a motion necessarily causes the laminæ to separate from one another to a greater or less extent, thus making it possible for dirt, gravel, and the like to get between them when so separated and prevent the bond from returning to its original shape when it contracts.

My present invention provides a simple and inexpensive bond which may be readily located within the space beneath the plate of a rail-joint and is adapted to distribute the bending strains in a novel manner, whereby the life of the bond is increased and the laminæ are always kept in substantial contact with one another. To these ends my bond comprises one or more substantially **U**-shaped portions, the sides of the **U** being substantially parallel with the length of the rails, so that when the bond is elongated or contracted the points where the flexible portion of the bond merges into the sides or arms of the **U** move in opposite substantially parallel directions, thus imparting to the flexible bent portion of the bond a species of rolling motion as distinguished from a motion which tends to close together or spread the sides of the **U**. My bond is preferably made double and is usually composed of two integral **U**-shaped portions, forming a closed loop, the attaching means being applied to the sides of the loop between the flexible ends thereof.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of a preferred form of my bond attached to a pair of rails. Fig. 2 is an edge view of the bond shown in Fig. 1 detached. Figs. 3 and 4, respectively, are a detail elevation and an edge view of a portion of a bond illustrating a slight modification. Fig. 5 is a diagrammatic elevation of another form of my bond, and Fig. 6 is an edge view of one end thereof. Fig. 7 is an elevation of another modification. Figs. 8 and 9 are diagrams illustrating the principles which govern the elongation of my bond.

Referring to Fig. 1 of the drawings, my bond is therein shown as composed of a closed loop formed of a suitable number of superposed laminæ 2 and having two substantially straight parallel portions 3 joined at each end by curved flexible portions 4. This bond is secured to the rails in such manner that the straight portions of the bond are substantially horizontal and parallel with the length of the rails. This arrangement secures the advantages obtained by locating the attaching-points of the bond on opposite sides of the longitudinal axis thereof, which arrangement is described and claimed in another application, Serial No. 148,524, filed by me on the 19th day of March, 1903, and is not broadly claimed herein. For securing the bond to the rails I prefer to employ attaching-plates or strips 5, each soldered on one face to the edges of the laminæ, forming one of the straight portions of the bond, and on its other face to the web or flange of a rail. These strips secure an ample conducting-area of contact between the bond and the rail and also serve to space the laminæ away from the rails sufficiently to prevent their rubbing against the same when the bond is elongated or contracted. On the opposite or outer edges of the laminæ opposite each attaching-strip 5 is

preferably secured a binding-plate 6, which is recessed to receive the laminæ and hold them together and is also extended laterally and provided with a perforation 7, through which an attaching bolt or rivet may be passed. By preference the edges of the laminæ between each binding-plate are recessed to receive said plate, and thus bring its outer face into the plane of the outer edges of the laminæ, thereby preventing the binding-plate from projecting beyond the bond proper and enabling the latter to be made practically as wide as the space beneath the plates of a rail-joint. This recess 8 is shown by dotted lines in Fig. 2 as **V**-shaped, the under side of the binding-plate being correspondingly formed, so that the width of the laminæ diminishes progressively from the edges to the center of the binding-plate. This arrangement leaves the current-carrying capacity of the bond at the points of attachment of the binding-plates practically undiminished, since the electric current, which begins to pass through the attaching-strip 5 as soon as it reaches one edge of the same, is progressively diminished and is not required to pass through a contracted conducting area at any point. The form of attaching means above described is substantially the same as that described and claimed in an application for Letters Patent filed by me on December 4, 1902, Serial No. 136,458, and is not claimed herein. Other attaching means may be employed, however, if preferred. The lateral extensions 9 of the binding-plates are preferably arranged as shown in Fig. 1, thus providing for the location of the attaching bolts or rivets within the loop or bend formed by the bond proper, and therefore economizing space.

In Figs. 3 and 4 I have shown the attaching means as located close to the flexible portions of the bond, in which case I prefer to provide each binding-plate with a projection 10, forming a support for the inner laminæ when the bond is elongated. This construction also is not herein claimed, being described and claimed in my pending application last above referred to. In Figs. 3 and 4 the bond is shown as not recessed to receive the outer face of the binding-plate, so that the latter stands a short distance beyond the outer edge of the bond proper. This construction may be used where there is sufficient room for its installation.

In Fig. 5 I have shown a bond which has but one flexible portion and consists of a number of superposed laminæ bent to form a **U**-shaped connection and having straight parallel portions 3′ of unequal lengths, which are adapted to be secured, respectively, to the adjacent ends of a pair of rails, with the straight portions of the **U** substantially parallel with the length of the rails and in different horizontal lines. I prefer, however, to employ a double or loop-shaped bond, such as shown in Fig. 1, partly because it may be given the same current-carrying capacity with only half the cross-section of the bond shown in Fig. 5 and partly because it may be constructed in a very simple manner by winding a continuous strip of copper into the loop-shaped form shown in Fig. 1.

In Fig. 7 I have shown another form of bond which has two flexible **U**-shaped portions 4″, but does not form a closed loop, the **U**-shaped portions being joined on one side by a straight portion 3″ and terminating at their other ends in suitable attaching means 11. The attaching means for this bond, as well as for the bond shown in Figs. 5 and 6, are illustrated as rivet-terminals of a well-known construction. The bond shown in Fig. 7 is secured to the rails with its axis substantially parallel with the length of the rails and with the terminals 11 in the same straight line. In this case the straight portion 3″ forms practically a fixed point and operates with respect to either of the end portions 4″ as if it were secured rigidly to the opposite rail. The laminæ forming this portion 3″ may, in fact, be rigidly secured together by solder or otherwise without affecting the action of bond in any way.

With any of the constructions illustrated the action of the bond under the strains produced by its elongation and contraction is the same, the effect of such strains being to produce a species of rolling action in the flexible portion of the bond, as indicated in Fig. 5, and I have found that when said flexible portion is substantially semicircular in form this rolling action has no tendency to cause the laminæ to separate from one another, the introduction of dirt or gravel between them being thus prevented and the proper form of the bond being preserved under all conditions. The reason for this result is illustrated diagrammatically in Figs. 8 and 9, the lines *a b* in the former figure representing the outer laminæ of a bond, such as shown in Fig. 5, before its elongation and the lines *a′ b′* in Fig. 9 representing the same laminæ after the bond has been elongated to the greatest extent which is theoretically possible. It will be evident that if the attaching-terminals 12 in Fig. 5 were separated horizontally to a sufficient extent the innermost flexible strip (represented by the lines *b b′* in Figs. 8 and 9) would be straightened out and the outermost strip would be made to assume the shape of the line *a′* in Fig. 9. Although no such extreme result could ever occur in practice, yet it will be evident from these diagrams that in either of the extreme positions, and therefore in any intermediate position, the thickness or cross-section of the bond remains invariable, being equal to the difference between the radii of the circles on which the innermost and outermost laminæ, respectively, are formed.

When my bond is to be applied to the sides

of the rail beneath the plates of the rail-joint, it is preferably made relatively long and narrow, as shown; but where there is room for its installation, as in case it is to be applied to the bottom of the rails, for example, the bond may be considerably shorter and wider, and thus may have the shape of a broad and shallow loop or of a broad and shallow U, as the case may be. In any case, however, it is so secured to the rails that each flexible portion of the bond is located on the same side of both points of attachment to the rails with reference to the length of the rails and is so arranged as to provide for the rolling action above described under the elongation and contraction of the bond. My bond when combined with the rails in the manner described has certain advantages which are independent of the lamination of the bond proper, which advantages result from the fact that my bond may readily be made long and narrow, corresponding with the usual dimensions of the space in which the bond is located when applied beneath the plates of a rail-joint, and from the further fact that the elongations and contractions of my bond do not substantially change the length of the bond as a whole, so that it may be made practically as large as the space which is to contain it, and I therefore consider that bonds other than laminated bonds may embody my invention when otherwise constructed and applied to the rails in the manner above described. A rail-bond having this arrangement and mode of operation is, so far as I am aware, broadly new in the art, and hence I do not consider my invention to be limited to the specific types or constructions herein shown and described.

I claim as my invention—

1. A laminated rail-bond comprising a substantially U-shaped flexible portion, having its arms extending in the same direction from the bend of the U, an attaching means located on said arms respectively, at unequal distances from said bend.

2. A laminated rail-bond comprising a substantially U-shaped flexible portion, having its arms extending in the same direction from the bend of the U, one of the arms of the U being longer than the other, and attaching means secured to said arms respectively at different distances from the bend of the U.

3. A laminated rail-bond comprising two substantially U-shaped portions, the bend of each U being flexible and forming one end of the bond, and attaching means located at different distances from the bend of each U-shaped portion and between the ends of the bond.

4. A laminated rail-bond having substantially semicircular end portions and intermediate straight portions, and attaching means secured to said straight portions between the end portions and at unequal distances from each of the latter.

5. A laminated rail-bond comprising a loop-shaped member having longitudinal side portions and flexible end portions, and attaching means secured to the longitudinal portions of said loop between said end portions and comprising attaching-studs located within the space inclosed by said loop.

6. A rail-bond comprising a strip of flexible conducting material coiled to form a continuous laminated loop having free, flexible end portions, and attaching means secured to the sides of said loop at unequal distances from each end thereof and between said ends.

7. A rail-bond comprising a strip of flexible material coiled to form a continuous laminated loop having substantially straight top and bottom portions and semicircular end portions, and attaching means secured to said top and bottom portions respectively, at unequal distances from the ends of the bond.

8. The combination with a pair of rails of a rail-bond comprising a U-shaped portion, the bend of the U being free and flexible, and the sides of the U being secured to the rails respectively and extending in the same direction from the bend of the U and substantially parallel with the length of the rails.

9. The combination with a pair of rails, of a rail-bond having substantially semicircular end portions and intermediate straight portions, said straight portions being secured in fixed relation to the rails respectively at points nearer to the ends of the rails than are the ends of the loop, and extending substantially parallel with the length of said rails.

10. The combination with a pair of rails of a rail-bond comprising a closed loop extending substantially parallel with the length of the rails, the sides of the loop being secured in fixed relation to the rails respectively at points nearer to the ends of the rails than are the ends of the loop.

11. The combination with a pair of rails of a loop-shaped rail-bond extending substantially parallel with the length of the rails, and attaching means connecting the sides of the loop and the rails respectively at points nearer to the ends of the rails than are the ends of the loop, and extending into the interior of the loop.

12. The combination with a pair of rails of a laminated rail-bond comprising U-shaped portions having the bend of each U free and flexible and located at one end of the bond, one side of each U-shaped portion being secured to one of the rails and extending substantially parallel with the length thereof.

13. The combination with a pair of rails of a laminated rail-bond comprising a closed loop extending substantially parallel with the length of the rails, and attaching means connecting the sides of the loop and the rails respectively at points nearer to the ends of the rails than are the ends of the loop.

14. A rail-bond comprising a U-shaped flexi-

ble portion having attaching means secured to the arms of the U at unequal distances from the bend of the U and on the same side thereof, said arms extending substantially in the same direction from the bend of the U to said attaching means.

15. A rail-bond comprising an elongated, closed loop, and attaching means secured to the sides of the loop at unequal distances from each end thereof.

16. The combination with a pair of rails of a U-shaped rail-bond having arms of unequal length, said arms being secured to the rails with the axis of the U substantially parallel with the length of the rails and leaving the bend of the U free.

In testimony whereof I have hereunto subscribed my name this 23d day of March, 1903.

EDWARD G. THOMAS.

Witnesses:

E. D. CHADWICK,

JOSEPH T. BRENNAN.