United States Patent

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[45] Patented **Dec. 1, 1970**

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[54] **MULTI-METALLIC RAIL DEVICE AND PROCESS**
13 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **191/22,**
164/76, 164/82; 238/122, 238/150, 238/151

[51] **Int. Cl.** **B60m 1/30,**
B22d 11/00, F01b 5/10

[50] **Field of Search** ..... 191/220(M);
238/145—159, 163

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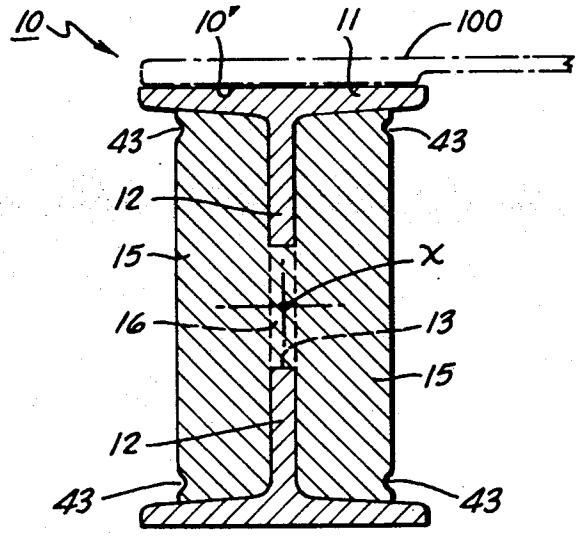
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ABSTRACT: This invention relates to an improved multimetallic rail device wherein the different metal components making up the rail device are permanently secured together in intimate interfacial and electrical contact.



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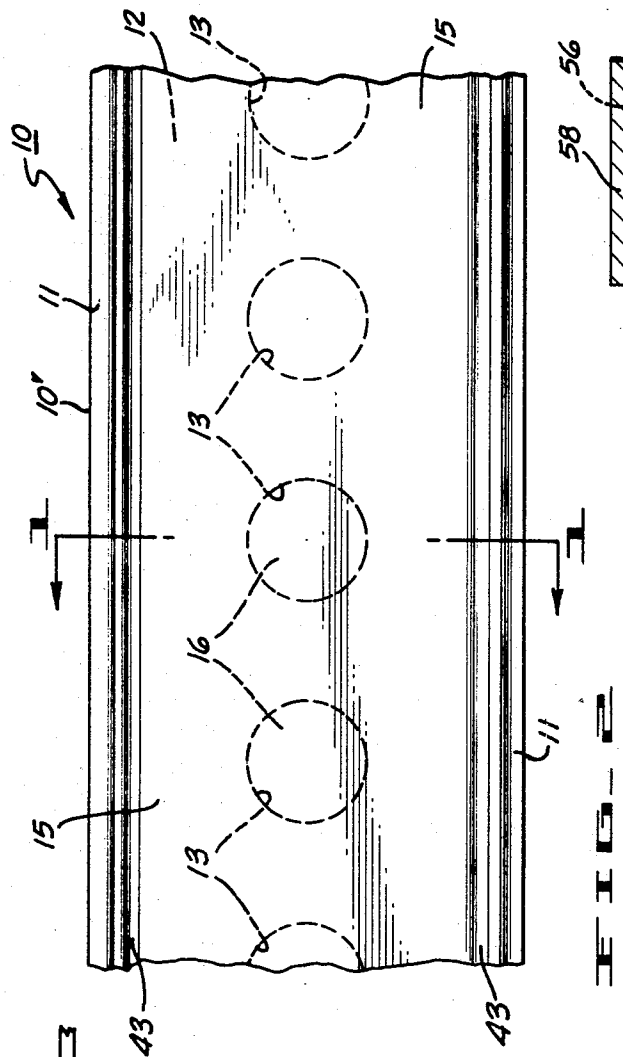


FIG. 2

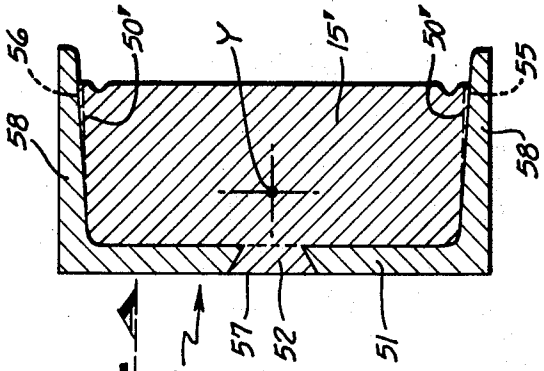


FIG. 3

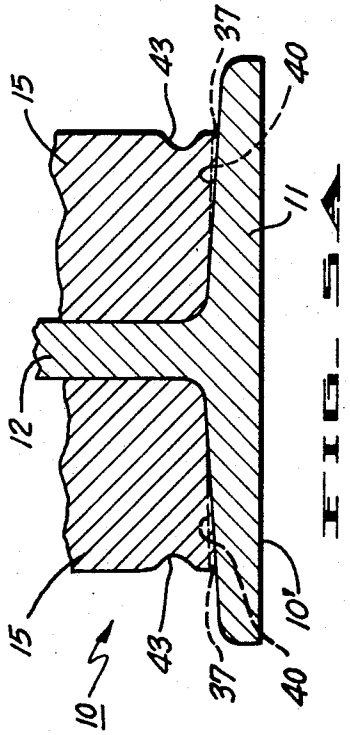


FIG. 4

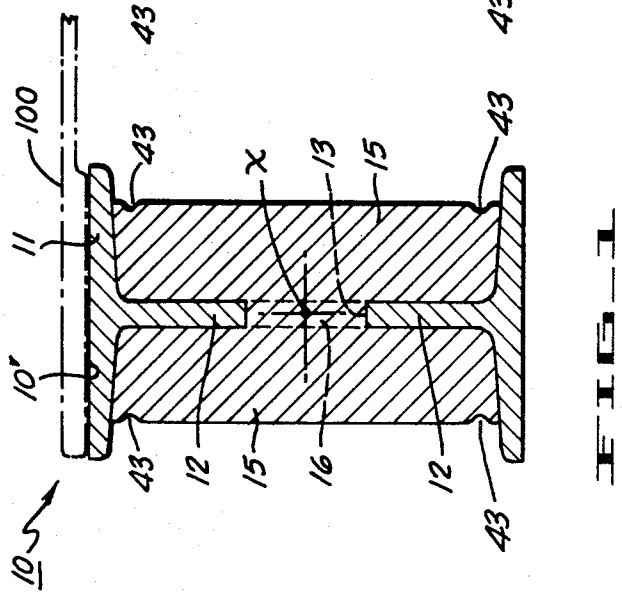


FIG. 1

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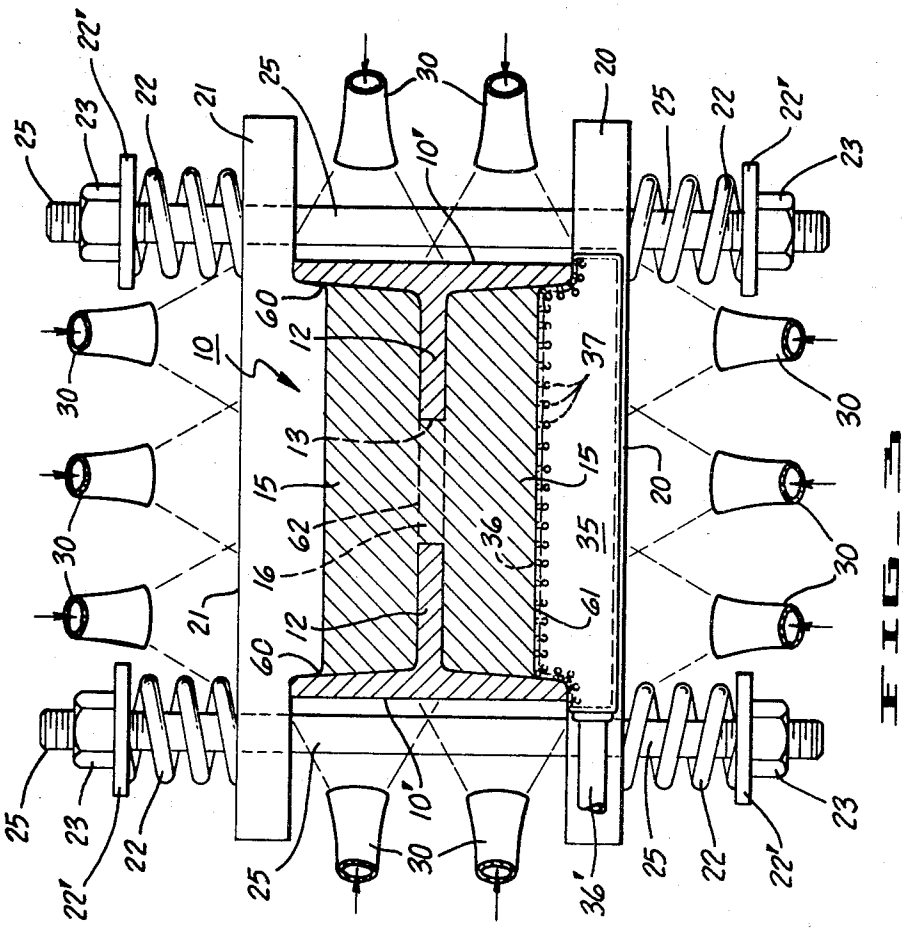


FIG. 3

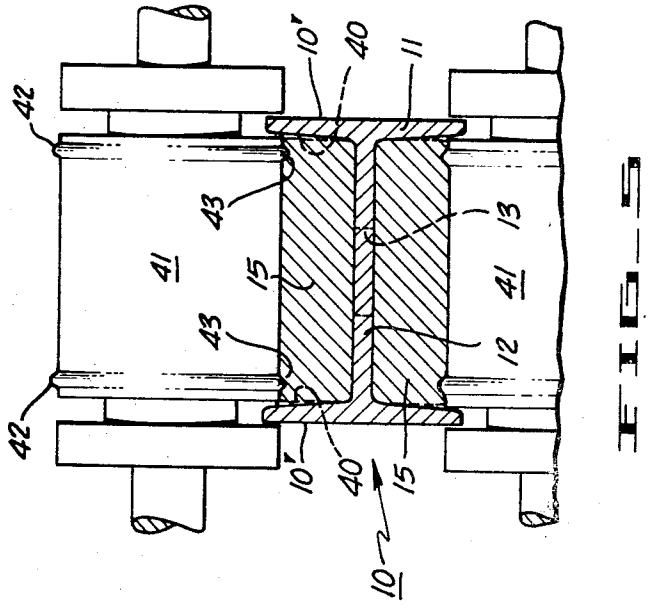


FIG. 5

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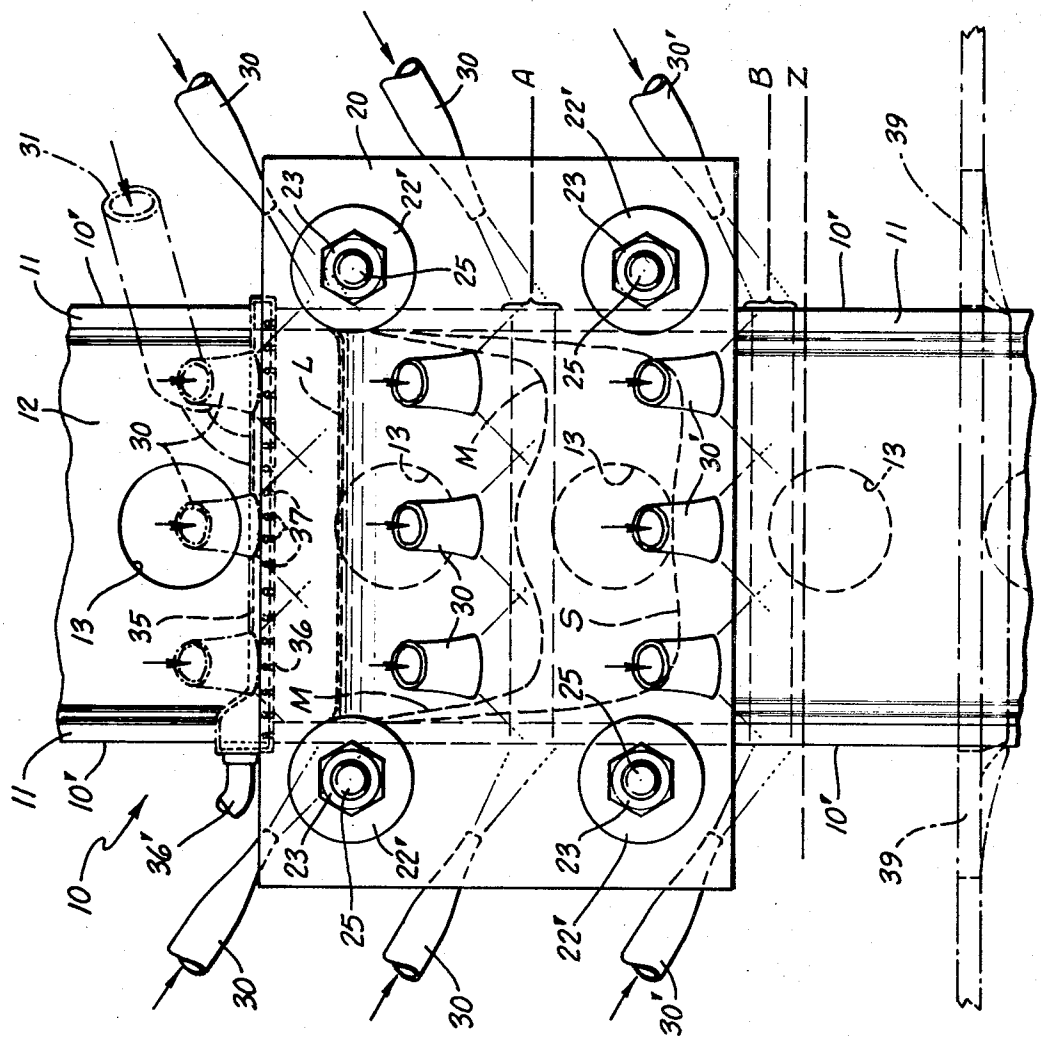


FIG. 4

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MULTI-METALLIC RAIL DEVICE AND PROCESS

DESCRIPTION OF INVENTION

This application is a continuation-in-part of my prior U.S. Pat. application Ser. No. 666,654, filed Sept. 11, 1967, now abandoned.

This invention relates to a novel multimetallic rail device for use, among other things, in electric railway installations and to an improved process for producing the rail device. This rail device also satisfies the following criteria essential in commercially acceptable rails used in electric railway systems. It is capable of conducting electric current efficiently over long distances with minimal power loss. The various metallic components used therein are secured together in such fashion that separation of the same will ordinarily not occur irrespective of the varying and severe stresses induced therein as a consequence of the normal and expected differential thermal expansion and contraction of the components and the normal expected loads and abuse to which the rails are subjected including contact with a collector on a moving train. The rail device also has optimum resistance to corrosion caused by galvanic activity.

In many electric railway systems, steel rails alone are employed as the conducting or third rail. Although steel has good strength characteristics, it is a relatively conductor of electricity. Steel rails must, therefore, of necessity, be of a relatively large cross section in order to carry the current required to power the trains that traverse the rails. Rails of relatively large cross section, however, are expensive to manufacture, install and maintain. The high energy losses resulting from the use of steel rails and the complex arrangements required to compensate for the same are continuing undesirable expenses in the operation of electric railways.

Although rail devices wherein a ferrous metal, such as steel, has been combined with a more conductive metal, such as copper or aluminum, have been proposed and used to some extent in the past in order to take advantage of certain characteristics of each metal, these bimetallic rails have still suffered from one or more of the following deficiencies. The structure of many bimetallic rail devices used in the past was such that the galvanic couples readily created between the different metals upon track installation were followed by corrosion at the contact surface between the metals. This corrosion not only causes current loss at the contact surface, but ultimately leads to severe erosion of one of the metals and markedly shortens the service life of such a rail.

Where mechanical connections such as bolts and rivets were used to secure the different metals together to form a composite rail, they frequently become loosened due to the differential thermal expansion of the metallic components. This loosening among other things aggravated moisture penetration and accelerated corrosion at the contact surfaces. Further, many prior art bimetallic rails were of necessity asymmetrical in construction. In other words, the cross-sectional masses of the metals used did not have a common centroid. In such instances, the forces imposed on the different portions of a given rail by thermal expansion were not fully balanced and tended to permanently distort the rail and in most prior bimetallic rails the various metallic elements had to be machined in order to provide good mating surfaces and electrical contact therebetween. All of the above factors have added significantly either to the initial or overall maintenance costs of such rails and precluded their full commercial exploitation.

The rail device of this invention and the process for manufacturing the same substantially overcomes the aforesaid problems usually associated with multimetallic and in particular bimetallic rails. The rail device of this invention can comprise in one advantageous embodiment a steel rail section having at least one flange section and a perforated section such as a web section. The perforations can advantageously comprise a series of longitudinally spaced open passageways that extend entirely through this web section. The rail further includes an

element that is more electrically conductive than the steel rail section, such as an aluminum or aluminum alloy element or section that is in intimate interfacial and electrical contact with the steel rail section for the entire length thereof and which substantially fills the perforations or apertures of the steel portion of the rail device.

The aluminum element or insert can be advantageously anchored to the steel rail section in a preferred embodiment of the invention by being continuously cast about certain major portions of the steel rail device and in such fashion that the cast metal contemporaneously and substantially completely fills the preformed apertures in the steel rail section whereby the metal in the apertures can, in effect, act as auxiliary rivets in anchoring the aluminum to the steel. Several advantages result from casting the aluminum portion of the rail in place. Firstly, an intimate interfacial and electrical contact between steel and aluminum is assured because the inherent shrinkage of the cast aluminum upon cooling causes the aluminum to be squeezed tightly against the steel. Secondly, the aluminum during casting will substantially completely fill the apertures in the steel rail. Thirdly, no machining of either the aluminum insert or steel rail is required to provide full mating surfaces on either member. Finally, casting of the aluminum in place makes it relatively easy to locate the mass of aluminum and the mass of the steel on a common centroid.

When the apertures in the steel rail are large and spaced closely together, they enhance the overall conductivity of the composite rail by virtue of the aluminum metal disposed in said apertures and provide a means for advantageously equalizing the level of molten aluminum metal in the casting mold as the aluminum insert or inserts, as the case may be, are cast in place and for thereafter controllably cooling the same as will be hereinafter more fully discussed.

In one advantageous embodiment of the invention, the aluminum component of the composite rail device of he invention can have two exposed surfaces, such as when it is cast on both sides of the web of an H- or I-shaped rail. Shrinkage due to solidification and cooling of the cast aluminum will normally cause certain portions of the aluminum inserts adjacent certain portions of the flanges of the steel rail to be pulled slightly away from and to be out of contact with these flanges at the aforesaid portions. In this embodiment of the invention and in order to compensate for such pulling away of the aluminum from the flanges of the steel rail, the exposed surfaces of the aluminum element are partially worked, as by rolling, pressing or forging, whereby the aluminum is deformed in the outer steel flange area or reaches and forced into firm contact with these portions of the steel flanges. In such instance, the aluminum faces may be hot or cold worked. Preferably at least some cold work is employed to produce some residual stresses in the aluminum that tend to hold it more firmly in contact with the steel flanges and thereby enhance the mechanical interlock between steel and aluminum.

The process for producing the novel rail of this invention involves continuously casting an aluminum or aluminum alloy in place by passing an apertured and flanged steel rail element through a casting zone containing a molten metal such as aluminum, allowing the molten metal to fill the apertures in the steel rail while encompassing other portions of the steel rail and then while controllably cooling the molten metal allowing the cooled metal to shrink into an intimate contact and mechanical bond with the steel rail while at the same time making the centroid of the mass of the steel rail coincident with that of the mass of the cooled and solidified metal.

In one advantageous embodiment of the invention, the casting in place of the aluminum insert is effected by passing an H- or I-shaped steel section vertically downward at a predetermined rate through a casting mold so that the steel rail section passes through and emerges from the bottom of the mold as substantially solid aluminum formed on at least one side of the web of the steel rail portion. In this casting operation, the molten aluminum may be fed to the mold on both sides of the web or on only one side of the web. Where the steel rail section has

molten metal cast on several sides thereof and the distance between adjacent perforations in a portion of the steel section is less than the depth of the liquid phase in the mold, a self-leveling effect occurs. For example, the liquid portion of the molten aluminum on both sides of the steel section perforated web can then be connected by a continuous liquid phase through at least one of the perforations, with the molten aluminum tending to seek its own level and with the liquid phase in the mold on both sides of the web always being in substantially the same relation to the chilled portion of the mold that causes solidification. The molten metal then will solidify from the bottom of a liquid pool so that no meeting lines are formed by molten aluminum spilling onto already solidified aluminum. This guarantees or assures that the aluminum element will be a substantially sound cast mass and a continuous solid monolithic type element that will provide good electrical conductivity throughout its length as applied to a given length of the final bimetallic rail device.

Although the ingot formed by the process is not conventional in that it is made up of both aluminum and steel sections, some of the usual continuous casting techniques can be used in making the same. For example, molten aluminum can be introduced into the top of a mold and the mold chilled in the usual fashion. The bimetallic ingot can also be withdrawn from the bottom of the mold at such a rate that the cast aluminum at least in the peripheral areas of the emerging portions of the ingot will have been completely solidified. Thereafter by the further application of coolant to these emerging portions, the remaining cross-sectional unsolidified parts of these emerging portions will rapidly solidify. In other words, the solidification of aluminum in a given rail portion that is begun in the chilled mold by the formation of a shell of solid aluminum surrounding a molten aluminum core in the aluminum section can be completed in said rail portion substantially immediately after the emergence of such rail portion from the mold. As noted above, the aluminum segment of the bimetallic ingot that will become the final rail device can in effect take the form of a continuous aluminum element that occupies the space on either side of the web of the steel element as well as the perforations in the said web. Because of the rate of casting and the higher melting point of the steel relative to the aluminum or approximately 2800°F. versus approximately 1200° F. for E.C. grade aluminum, neither the mechanical nor physical properties of the steel element that is used are adversely affected during the casting operation.

This invention will be further understood by reference to the accompanying drawings which illustrate various embodiments of bimetallic rail devices made in accordance with the instant invention and a preferred process for fabricating such rail devices.

FIG. 1 is a sectional view of a typical finished rail device embodying this invention when taken along the line 1–1 of FIG. 2 with an electrical contact shoe in engagement therewith being shown in dotted lines;

FIG. 2 is a partial side elevational view of the rail device illustrated in FIG. 1;

FIG. 2*a* is a sectional view of another bimetallic rail embodying the teachings of this invention;

FIG. 3 is a general and somewhat schematic plan view of a casting mold arrangement suitable for use in forming the rails of FIGS. 1, 2 and 2*a*;

FIG. 4 is a further schematic representation of the casting mold arrangement of FIG. 3;

FIG. 5 is a partial elevational view of a roll arrangement through which the bimetallic rail of FIG. 1 can be passed after the casting operation; and

FIG. 5*a* is a fragmentary sectional view of a portion of the rail device of FIG. 1.

Although this invention will be described with particular reference to a process for manufacturing a bimetallic electric third rail device wherein an I-shaped steel element is used and the product produced thereby, it is to be understood that the process is equally applicable to the manufacture of bimetallic articles of varying shapes and uses. For example, the steel element can be H-shaped, I-shaped, Y-shaped or channel-shaped and the finished product used as a bus bar or a third rail.

With further reference to the drawings and particularly FIG. 1, the composite rail device **10** includes a steel element **10'** that can be roughly I-shaped whereby it is provided with opposing symmetrical end flanges **11** and the usual web **12**. The web is provided along its length with a longitudinally disposed series of holes **13** which can be circular or elliptical or of any desirable shape.

The aluminum portion of rail device **10** comprises aluminum or an aluminum alloy cast as a monolithic insert **15** or cladding with at least one of the U-shaped cavities formed by the web **12** and flanges **11** of the steel rail **10'** for the entire length of the rail as well as within the various perforations **13** in the web **12**.

The particular type of steel used for the rail **10'** will be dependent to a large extent upon the use to which the rail device is put. In the case of a bimetallic third rail, a relatively mild, low carbon content steel conforming to the American Society of Testing Materials Specification A - 36 can be used for the rail element **10'** can be used for the rail element **10'** and conventional E.C. grade aluminum or aluminum alloys can be used for the cast-in inserts **15** since such alloys will ordinarily meet the usual current carrying requirements of most third rail installations. Although the final length of the finished rail element **10** to be cast is dependent primarily on the limitations of the particular casting facility employed, the rail **10** ordinarily should be in 30 to 60 foot lengths for convenience of manufacture and handling.

The longitudinally spaced holes **13** in the web **12** of the rail element **10** shown in a preferred form in FIG. 1 are rather large circular holes that are prepunched and closely spaced so that the consecutive insert portions **16** of the aluminum element that fill these openings are relatively large in diameter and closely spaced together. The close spacing of the perforations or openings provides for consecutive openings **13** to be immersed in liquid aluminum during the casting process whereby substantially simultaneous solidification of aluminum on both sides of the web can be readily effected and spilling of molten aluminum over from one side of the web to the other is avoided. Thus, for example, the openings **13** could be 1½inches in diameter on 2½inch centers in a steel beam or element **10** that is 5 inches in height and provided with 3 inch wide flanges.

In a preferred embodiment of the invention it is contemplated that prior to introducing steel rail element **10'** into the casting mold, the rail element **10'** be sand blasted to remove mill scale, rust, oil and other contaminants that might be present on the surfaces of the steel and possibly inhibit complete adhesion of the cast-in aluminum insert **15** to the steel element **10'** during casting. A further advantageous result of this sand blasting operation is that it acts to roughen the surfaces of the steel element **10'**. This operation promotes the desired later intimate interfacial contact and mechanical bond between the two metals making up the final product.

An overall casting arrangement suitable for continuously casting the bimetallic rail device of the instant invention is generally illustrated in FIGS. 3 and 4 of the drawings. This mold arrangement can include chilled mold wall sections **20** and **21** preferably of a metal having good heat conductivity, such as aluminum or copper. The mold elements **20** and **21** are cooled by a series of suitable liquid coolant spray devices **30** appropriately arranged peripherally about and adjacent the mold elements or plates so that coolant can be directed against the plates **20** and **21** and the flanges **11** of rail **10'**. Plates **20** and **21** could also be constructed with internal cooling fluid chambers, if desired. The mold elements or plates **20** and **21** advantageously coact with the flanges of steel rail **10** to form mold cavities on either side of web **12** of rail **10**. The appropriate close contact is maintained between plates **20**, **21** and rail flanges **11** by means of the tension exerted by the

several springs 22, mounted on the extremities of locking bolts 25 intermediate mold plates 20 and 21 and washers 22' and lock nuts 23. The overall assembly of plates 20, 21 and bolts 25, etc. is mounted in the appropriate casting position by suitable brackets (not shown). Rail 10' is shown in cross section in FIG. 3 to illustrate how chilled mold elements 20 and 21 are shaped to accommodate the shape of rail 10' in the mold. It may be seen from an inspection of FIG. 3 that chilled mold elements 20 and 21 advantageously contact the flanges 11 or rail element 10' in relative fluid tight engagement as the rail 10' passes therebetween while at the same time being appropriately spaced from the web 12 thereof to create an overall mold cavity made up of the individual smaller mold cavities 60, 61 between the flanges 11 and 62 in the web 12 of rail 10'.

Advantageously located on top of each of the mold plates 20 and 21 is a relatively shallow mold lubricant dispensing receptacle 35 provided with a hollow interior and a plurality of suitable dispensing openings 36 for dispensing the mold lubricant 37 such as sperm oil continuously upon the inner faces of the mold plates 20 and 21 in the form of a thin film that is a fraction of a mil in thickness. For the sake of simplicity only one such receptacle 35 is shown. The molten metal, such as an E.C. aluminum or aluminum alloy is introduced into the top of the mold assembly by the usual trough 31 at the proper rate such that the normal level L of the molten metal in the mold which is several inches below the top of the mold plates is substantially the same as or close to the level of coolant liquid application on the backside of mold plates 20 and 21 and flanges 11 or rail 10' whereby the normal solidus line S of cast aluminum and liquidus line M will be formed in the general manner shown in FIG. 4. If severe tears or surface defects appear on the face of cast aluminum as it emerges from the mold, additional sperm oil lubricant can be applied by increasing the volume from the supply line 36' that feeds chamber 35.

Although the volume and rate of coolant application are dependent on the particular rail device being fabricated, the coolant can be applied in the casting arrangement shown from suitable primary spray heads 30 at about 30 p.s.i. at a rate of 10 to 15 gallons a minute. It is preferred that the spray heads to of such a design that the sprays overlap to form a continuous coolant sweep line on the outer surfaces of plates 20 and 21 and rail flanges 11. In a preferred embodiment of the invention, the casting operation can be such that the outer peripheral portions of the aluminum begin to fully solidify generally at the level A of FIG. 4 or several inches below level L with the entire aluminum mass rapidly solidifying just below the mold bottom and generally in the area B that is several inches below area A where coolant can still be dispensed from secondary spray nozzles 30' directly onto the cast product with the approximate 1320° F. to 1350° F. temperature of the molten metal at the level of pour being reduced down to about 900° F. at the area B with the rail 10' passing through the mold assembly at a rate on the order of 10' per minute as it is lowered by the usual platen (not shown).

A coolant wiper device 39 (shown in dotted lines in FIG. 4) can be disposed at an appropriate distance below the bottom of the mold plates 20 and 21 so as to wipe the coolant from the bimetallic rail device 10 and divert the coolant into a suitable collection or drain means (not shown). The purpose of this wiper device will be described more fully hereinafter. Although various casting arrangements can be used, a vertical casting arrangement is preferred wherein rail element 10' is fed into the top of the mold and passes between chilled mold elements 20 and 21 and then emerges below these elements with the aluminum cast in place. In the vertical casting arrangement shown there will be an automatic self-leveling of the molten metal during casting. This can be particularly important during later solidification of the aluminum in that the liquid phase of the molten metal by always engulfing at least one hole 13 in the web 12 and levelling itself on both sides of the web 12 will place the aluminum in a condition and a position in the overall mold cavity as defined above whereby a given cross section of aluminum can start to solidify in the manner noted above and be completely solidified as a sound cast mass along the same general planar line Z. The establishment of areas A and B and liquid level L in the mold can be formulated by adherence to the usual continuous casting practices.

Because of the type of steel rail element used as well as its size and relatively fast rate of travel through the mold, which can be on the order of 10' per minute as noted above, the steel rail 10 is not adversely affected by the casting operation and retains all of its desired mechanical and physical properties and the aluminum in turn is not adversely affected by the steel rail during casting.

One of the advantageous features of the instant invention is the fact that the final bimetallic rail device as fabricated by the instant process is of a symmetrical or balanced construction wherein the centroid of the mass of one metal, such as steel, is made substantially coincident with that of the mass of aluminum at point X on the cross section of the final rail device shown in FIG. 1. This factor of balanced mass construction means that in the final product, such as that of FIG. 1, the overall twisting axis of both metals, e.g. steel and aluminum, will be the same. Thus, during any differential thermal expansion and contraction of the different metals during use of the rail device 10, both the aluminum and steel metals will tend to twist if at all about the same axis uniformly thereby inhibiting disengagement from each other. In other words, this balanced construction and symmetry result in the forces, which tend to distort the rail, counterbalancing one another thereby avoiding rail distortion, because substantially all of these forces will act on or about the same centroid for both masses of metal. For example, differential thermal expansion between the steel and aluminum portions of the rail will not create forces that tend to bend or curl the rail since every force created by such thermal expansion is fully counterbalanced by a symmetrical and equal compensating or counterbalancing force. The casting operation provides a convenient and fully controlled technique for this common centroid location of the metal masses in the bimetallic rail 10 of FIG. 1.

After the casting operation, the aluminum upon cooling will normally tend to shrink and pull away somewhat from the flanges 11 of the steel element thereby forming voids or pockets 40 shown in the somewhat exaggerated dotted lines in the topmost aluminum insert 15 in FIG. 5. In order to alleviate this condition, the rail device can then be subjected to an appropriate compressing operation such as the rolling operation of FIG. 5 wherein the rolls 41 are provided with side ribs 42 which compress the inserts 15 sufficiently to force the aluminum inserts 15 back into full interfacial contact with the flanges 11 of the steel element to produce the final rail product of FIG. 1 while leaving small valleys 43 in the final inserts 15 as shown in FIGS. 1 and 5a. The aforesaid shrinkage due to cooling and solidification although creating a small separation problem as noted above, on the other hand, has an overall beneficial effect in that it enhances the mechanical bond and interfacial contact between aluminum and steel through the major areas of steel and aluminum contact and the minor portions of the aluminum filling openings 13, which is important where current is to be transferred from the aluminum to the steel element during rail use and where a contact shoe 100 on a moving train contacts the steel rail portion 10. Any working of the aluminum due to the aforesaid rolling or pressing operation can also further improve the mechanical joinder of the aluminum with the steel; for example, by compressing the inserts or auxiliary rivets 16 in openings 13.

The formation of the aforesaid voids 40 due to shrinkage of the aluminum elements 15 upon cooling results in coolant from sprays 30 filling these voids as the rail device emerges below the solidification line in the area Z. By using wiper device as noted above at an appropriate level below the solidification line Z whereby the coolant is removed from the surfaces of the composite rail, an advantageous use may be

made of the residual heat of about 900° F. in the cast masses of aluminum to effectively drive out from these voids all of the coolant which may have collected in the same.

The use of sperm oil or equivalent material as a mold lubricant and which can contain a corrosion inhibitor, if desired, has a further beneficial effect in the final product in that in the areas of outer rail flange and aluminum insert contact, where the aluminum insert shrinkage is most pronounced, the sperm oil acts as a beneficial coating on the mating steel and aluminum surfaces located adjacent the closed voids **40**. This sperm oil coating is not destroyed or broken down during casting of rolling even though it may tend to exude outwardly a small amount during rolling and not only does not inhibit passage of current from aluminum to steel during use, but actually promotes such current passage. The presence of this coating of sperm oil in the closed voids **40** minimizes the occurrence of the galvanic action in the area of the closed voids **40**. Even though this sperm oil coating will in most instances suffice to minimize the galvanic activity problem, there will be some instances of use where the application of a fillet of sealant material such as urethane varnish to the area of steel flange and aluminum intersection might be desirable. It may also be desirable in some instances to spray additional sperm oil into the voids **40** prior to rolling.

In general galvanic couples and corrosion problems are to a major extent negated by virtue of the overall substantially intimate interfacial contact and mechanical bond that occurs throughout the contact areas of the dissimilar metals such as aluminum and steel in the final rail device.

The particular casting techniques employed in the instant invention provide for an efficient, and cheap manufacturing operation, wherein a balanced structure can be easily obtained, tolerance problems in the starting steel rail readily compensated for, and the desirable interfacial contact and mechanical bimetallic bond effected.

The additional step of rolling, when used can further enhance the bond and interfacial contact between the different metal elements in the rail and in some instances, if desired, can be used to give the product the advantageous features of a partially worked or deformed product as well as a good final finish to the surfaces of the elements or element rolled.

In some instances after rolling and as a final fabricating step, it may be desirable to subject the composite rail to a stretching operation. This operation can be performed to finally true the rail and correct any deleterious bending that may have occurred during the casting and/or rolling operation. If stretched by use of conventional stretching machines, the composite rail should be preferably stretched just beyond the yield strength of the steel to put a permanent set in the steel but not up to the yield strength of the aluminum and in such fashion that no residual stresses remain in either the steel or aluminum whereby separation of the bimetallic components would be initiated or later promoted.

Although this invention has been described with particular reference to electric railways, it is intended that the term "electric railway"as used herein is in its generic sense and includes overhead crane systems, and other devices that are mobile and pick up power from a stationary conductor for locomotion or for operation of other equipment. The preferred use for the rail of this invention is for electric railway systems because such systems employ long lengths of track where constant and continuous high conductivity is required. Although the invention has been illustrated with respect to a rail device having a steel element with two flanges, the rail device may have only one flange. For example, for overhead rail systems it might be desirable to hang the rail from the web in which case a one flange rail may be employed with the web extending beyond the aluminum element to provide a means for suspending the rail from a hanger or other support. Further, although it is preferred to produce a multimetallic rail device that is symmetrical about its center, it is within the scope of this invention to produce asymmetrical rails, particularly where the rails are used indoors where temperature variations affecting the shape of the rail are not a significant factor in the rail design.

As a further example of a rail device that can be made in accordance with the instant invention, reference is made to FIG. **2***a*. In this instance, the steel element **50** is merely channel shaped, and the aluminum insert **15'** is cast within the channel **50'** of element **50**. Web **51** of element **50** can be provided with a series of suitable perforations **52** which act as in the case of the holes in the I-beam of FIG. **1** as part of the overall mold cavity. The steel and aluminum masses in cross section can also have the same centroid Y whereby the rail device is fully symmetrical. The finished rail of FIG. **2***a* can likewise be subjected to a pressing or rolling operation to close the gaps or voids **55** and **56** shown in dotted lines in FIG. **2***a* that occur between the aluminum and steel at the outer extremities of the flanges **58**. The outwardly flaring configuration of the openings **52** in the web **51** of the rail device aid in obtaining a good interlock of the rivetlike elements **57** that are formed by the aluminum that fills these openings during casting and subsequent solidification.

Finally, it is within the scope of this invention to provide continuous casting mold elements that create asymmetrical cavities so that the aluminum portion of the rail may be tapered, arced or have other forms for a particular use, as well as to shape the aluminum portion of the rail element to provide a mechanical function. For example, as a flange for attaching the rail to its support which is a beneficial variation where the support forces are not severe. Additionally, the rail of this invention may be of materials other than steel as the load bearing contact shoe engaging portion and aluminum as the electrically conductive portion such as cast iron, titanium for the steel element or beam **10'** and copper or magnesium as the cast-in insert or cladding **15**.

Advantageous embodiments of the invention have been shown and described. It is obvious that various changes and modifications may be made therein without department from the appended claims, wherein:

I claim:

1. A fully integrated composite metallic rail device having good electrical conductivity characteristics along its entire length comprising a first metallic base element provided with a web portion and a flanged portion connected thereto with one of said portions being provided with spaced apertures along its length and a second element of a dissimilar metallic material from but of superior electrically conductive properties to that of said base element intimately secured to and interlocked with said base element for substantially the length of said base element by virtue of minor portions of said second element substancially completely filling the apertures of said base element while major surface areas of the remainder of said second element are in intimate interfacial and electrical contact with the web and flanged portions of said base element for substantially the length of said base element.

2. A composite rail device as set forth in claim **1** wherein the mass of the first metallic element and the mass of the second metallic element have a common centroid.

3. A composite rail device as set forth in claim **1**, wherein said first element is made of a ferrous metal and said second element is made from the group consisting essentially of aluminum and aluminum alloys.

4. A composite rail device as set forth in claim **1**, wherein the rail device has the properties of a partly deformed product by virtue of said second element being at least in part deformed within and pressed against certain parts of said first element.

5. A substantially distortion resistant fully integrated composite rail device having good electrical conductivity characteristics along its entire length comprising a first metallic base element provided with a web portion and at least one flanged portion connected thereto with one of said portions being provided with spaced apertures along its length, a second element of a dissimilar metallic material from but of superior electri-

cally conductive properties to that of said base element cast in place against and intimately secured to said base element for substantially the entire length of said base element with the masses of said first and second elements having a common centroid and minor portions of said second element substantially completely filling the apertures of said base element while major surfaces of the remainder of said second element are in intimate interfacial and electrical contact with the web and flanged portions of said base element for substantially the entire length of said base element.

6. A composite rail device as set fort in claim **5** wherein the web portion of the rail device is the portion thereof provided with said apertures and the second element is cast in place on both sides of the web portion in the form of a sound casting.

7. A composite rail device as set forth in claim **5** wherein said device is provided with a plurality of flanged portions which form in conjunction with the web portion a channel on at least one side of said web portion, the major portion of which channel is filled by said second metallic element.

8. A composite rail device as set forth in claim **5** wherein the walls defining the apertures in one of said portions are selectively tapered.

9. A composite rail device as set forth in claim **6** wherein the common centroid of the first and second elements is located in the said web portion.

10. A composite rail device as set forth in claim **7** wherein the web portion is the portion of the rail device provided with said apertures.

11. A substantially distortion resistant fully integrated composite rail device having good electrical conductivity properties along its length comprising a first metallic base element of ferrous metal provided with a web having spaced apertures along its length and a pair of flanges connected to opposing ends of said web, a second cast in place metallic element of sound monolithic structure and of a dissimilar metal material from but of superior electrically conductive properties to that of the metal of said base element substantially completely filling the apertures in the said web and disposed on opposite sides of the web for substantially the length of said base element, said second metallic element being cast in place and pressed into intimate interfacial and electrical contact with the web and all of said flanges of said first base element for substantially the length of said base element and the masses of said first and second elements having a common centroid in the web of the first element.

12. A rail device as set forth in claim **11** wherein said second element is made from the group consisting essentially of aluminum and aluminum alloys.

13. A rail device as set forth in claim **11** wherein a thin film of sperm oil is disposed between certain portions of said first and second elements.