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(54) Title: MANUFACTURING METHOD OF PRODUCING FROG AND CROSSING ASSEMBLIES FOR OVERHEAD CON-
TACT SYSTEMS

(57) Abstract: A modular crossing assembly structure in an overhead contact system. The modular crossing assembly structure in-
cludes a plurality of rail under-running contact segments and a body to which the plurality of these rail segments are attached, where
the plurality of rail segments are connectable to an overhead conductor rail and/or overhead contact system. The plurality rail seg-
ments are securely affixed to the body by one or more connectors.



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MANUFACTURING METHOD OF PRODUCING FROG AND CROSSING ASSEMBLIES FOR OVERHEAD CONTACT SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from United States Provisional Application No. 61/766,988, filed February 20, 2013, in the United States Patent and Trademark Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

1. Field

[0002] The invention relates to the field of electric current collection/distribution systems for railway traction systems. More particularly, the invention relates to the field of electric current collection/distribution systems employing an overhead contact system.

2. Related Art and Background

[0003] Railway traction systems, such as trains and subways, employ a variety of electric current collection/distribution systems such as: traditional third rail collection/distribution systems, overhead third rail collection/distribution system, tramway suspension systems, and flexible overhead contact line or catenary.

[0004] Traditional third rail collection/distribution system has been broadly used for many years for railway electrification in metropolitan railways because they are simple, robust and easy to maintain. However, such systems pose a significant risk that accidental contact with the electrified rail occurs since the rail is normally located in easily accessible areas. Because of the above risk such systems are not used in high-voltage and high-power systems. Consequently, they are not suitable for high traveling speeds.

[0005] Another commonly used electric current collection/distribution system is the overhead flexible contact line collection/distribution system, also known as flexible catenary

or catenary. The catenary systems have the advantage that they present a better dynamic performance of the catenary - pantograph system which makes this system suitable for high speed trains. However, the catenary systems have a number of significant drawbacks. A first drawback comes from the fact that the catenary systems involve a large number of components and, consequently, they require greater assembly and maintenance costs. Another drawback comes from the fact that catenary systems require greater overall height and consequently they are difficult to assemble in tunnels with tight clearance gauges. Further, another drawback comes from the fact that the flexible catenary requires a power distribution messenger cable or wire which makes installation more expensive.

[0006] The overhead third rail collection/distribution system (overhead contact system) has many of the advantages of the traditional third rail systems. However, the overhead third rail collection/distribution system does not pose such a significant risk of accidental contact with the electrified rail because it is disposed at an elevated height over the track. Thus, such a system can be used with higher voltages and higher speed trains. When compared with other overhead collection/distribution systems, such as the flexible catenary, the overhead third rail collection/distribution system has the advantage that it requires less overall height for its assembly and thus overhead third rail collection/distribution system is more suitable for use in tunnels, overpasses, maintenance shops, and bridges. Further, third rail distribution systems do not require a power distribution messenger cable or wire. Thus, overhead third rail collection/distribution system systems may be used, among others, in high speed applications and in situations involving a reduced height.

[0007] In the conventional systems, the overhead third rail collection/distribution system has conductor rails including a grooved contact or conductor wire for providing

electric traction power to trains and other vehicles. The trains have metal and/or graphite contact blocks called “shoes” which make contact with the conductor rails to receive the traction current to power the trains. When there is a railway junction or where a spur or siding branches off, the overhead third rail system is provided with frogs and crossing assemblies at turnout points to continuously supply power to the train allowing for transitions to be made by the collector shoes. The conventional frogs and crossing assemblies are made of a single solid body casting of iron or bronze. During maintenance of the railway system, since the entire single solid body structure (commonly under tension) has to be completely removed due to both aging and wear from contact with passing collector shoes, hazardous situations are created and difficulty of the maintenance process is increased. Also, the fixed solid body castings restrict the adaptation of variable crossing conditions of the overhead third rail collection/distribution structures based on track turnout geometry to that of fixed or compromised crossings and turnouts.

[0008] Thus, there is a need for overhead third rail collection/distribution systems that allow for ease of installation and maintenance. Also, there is a need for overhead third rail collection/distribution systems that provides flexibility in design to accommodate non-standard crossing and turnout geometry.

SUMMARY

[0009] Exemplary embodiments of the present invention provide frog and crossing assemblies for connecting conductor rails in an overhead railway electrification system.

[0010] Additional features of the invention will be set forth in the following description, and in part will be apparent from the description, or may be learned from practice of the invention.

[0011] An exemplary embodiment of the present invention provides a modular crossing assembly structure in an overhead contact system. The modular crossing assembly structure includes a plurality of rail underrunning contact segments and a body to which the plurality of these rail segments are attached, where the plurality of rail segments are connectable to an overhead conductor rail and/or overhead contact system. According to an embodiment, one or more connectors securely affix the plurality of rail segments to the body.

[0012] The plurality of rail segments may include a first rail segment, a second rail segment, a third rail segment and a fourth rail segment. Further, the first and the second rail segments may be attached to one side of the body and the third and the fourth rail segments maybe attached to another side of the body; the first, second, third and fourth rail segments forming a crossing junction. Also, each of the first, second, third and fourth rail segments may have a tapered end.

[0013] The modular crossing assembly structure may further include a central alignment portion that is provided at the center of a crossing between the first, second, third and fourth rail segments to assure proper passage of collector shoe.

[0014] The body may have a guard portion to prevent inadvertent disconnect from overhead structure and attachment portion(s) for connecting the body of the overhead structure to supporting systems of the overhead contact system.

[0015] Another exemplary embodiment of the present invention provides a modular frog assembly structure in an overhead contact system. The modular frog assembly structure includes a plurality of rail segments and a body to which the plurality of rail segments are attached, wherein the plurality of rail segments are connectable to an overhead conductor rail and/or overhead contact system. According to an embodiment, one or more connectors securely affix the plurality of rail segments to the body.

[0016] The plurality of rail segments may include a first rail segment, a second rail segment, and a third rail segment. The first and the second rail segments may be attached to one side of the body and the third rail segment may be attached to another side of the body, the first, second, and third rail segments form a turnout junction.

[0017] According to an embodiment, the modular frog assembly structure includes a switch connector that selectively connects the third rail segment with the first rail segment and the second rail segment. The switch connector may include one or two movable linking rail segments.

[0018] The modular frog assembly structure may include a lever that selectively controls the movement of the two movable linking rail segments, such that when the lever is moved to a first position, one of the movable linking rail segments is moved laterally into one of two positions to connect the third rail segment with the first rail segment, and when the lever is moved to a second position, the other of the two movable linking rail segments is moved laterally into the other of two positions to connect the third rail segment with the second rail segment.

[0019] The body may have a guard portion to prevent inadvertent disconnect from overhead structure and an attachment portion for connecting the body of the overhead structure to supporting systems of the overhead contact system.

BRIEF DESCRIPTION OF THE DRAWING

[0020] The above and other aspects, features and advantages of the disclosed exemplary embodiments will be more apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0021] FIG. 1 shows an illustrative diagram of a top view of a crossing assembly in an overhead contact system according to a first exemplary embodiment.

[0022] FIG. 2 shows an illustrative diagram of an underside view of a crossing assembly in an overhead contact system according to the first exemplary embodiment.

[0023] FIG. 3 shows an illustrative diagram of an underside view of a frog assembly in an overhead contact system according to a second exemplary embodiment.

[0024] FIG. 4 shows an illustrative diagram of a top view of a frog assembly in an overhead contact system according to the second exemplary embodiment.

[0025] FIGS. 5A-5F illustrate additional views of a frog assembly in an overhead contact system according to the second exemplary embodiment.

DETAILED DESCRIPTION

[0026] The following detailed description is provided to gain a comprehensive understanding of the methods, apparatuses and/or systems described herein. Various changes, modifications, and equivalents of the systems, apparatuses and/or methods described herein will suggest themselves to those of ordinary skill in the art. Descriptions of well-known functions and structures are omitted to enhance clarity and conciseness.

[0027] Hereinafter, exemplary embodiments of frogs and crossing assemblies in overhead contact systems are disclosed. This invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these exemplary embodiments are provided so that this disclosure is thorough, and will fully convey the scope of the invention to those skilled in the art.

[0028] Throughout the drawings and the detailed description, unless otherwise described, the same drawing reference numerals are understood to refer to the same elements, features, and structures. The relative size and depiction of these elements may be exaggerated for clarity.

[0029] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. Furthermore, the use of the terms a, an, etc. does not denote a limitation of quantity, but rather denotes the presence of at least one of the referenced item.

[0030] The use of the terms “first”, “second”, and the like does not imply any particular order, but they are included to identify individual elements. Moreover, the use of the terms first, second, etc. does not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another.

[0031] Although some features may be described with respect to individual exemplary embodiments, aspects need not be limited thereto such that features from one or more exemplary embodiments may be combined with other features from one or more exemplary embodiments.

[0032] The aspects of the invention in this application are not limited to the disclosed elements, components, configurations, operations and sequence of operations. For instance, elements and components may be consolidated, may be omitted, and may be altered without departing from the spirit and scope of the present invention.

[0033] Aspects of a crossing assembly in an overhead conductor system, according to a first exemplary embodiment, are further described with reference to FIGS. 1 and 2.

[0034] FIG. 1 illustrates a modular crossing assembly 1 that may include rail segments 2a-2d and a body 3. Rail segments 2a-2d may be cast, fabricated or machined bars. In an exemplary embodiment, the rail segments 2a-2d may have a conductor wire affixed to a rigid rail for conducting power to the collector shoe of a train or other vehicle that is in contact with the rail segments 2a-2d. According to an exemplary non-limiting embodiment, the rails segments 2a-2d may be made of bronze or tin plated bronze. However, the rail segments 2a-2d may be made of other materials.

[0035] The body 3 may be a plate fabricated or cast to have various shapes, sizes and proportions. In an exemplary embodiment, the body 3 may be fabricated according to the track work crossing and/or turnout angle requirements. In an exemplary non-limiting embodiment, the body 3 may be made of bronze, aluminum or steel. However, the body 3 may be made of other materials.

[0036] According to an embodiment, the body 3 is a frame that holds the rail segments in place. As shown according to an embodiment in FIG. 2, the rail segments 2a-2d may be attached to the body 3 using one or more connectors 5. The connectors 5 can be one or more screws, captive screws, studs or fastener, but is not limited thereto. The connectors 5

securely affix the rail segments 2a-2d to the body 3. In another embodiment, the rail segments 2a-2d are attached to the body 3 using other fastening techniques.

[0037] For example, a first rail segment 2a and a second rail segment 2b are attached to one side of the body 3 using connectors 5 and a third rail segment 2c and a fourth rail segment 2d are attached to another side of the body 3 using connectors 5. The first, second, third and fourth rail segments 2a-2d form a crossing junction.

[0038] In an embodiment, each of the rail segments 2a-2d has a tapered end 6 at the crossing junction to allow for passage of collector shoe. The other end of each of the rail segments 2a-2d are provided with mechanism to connect the modular crossing assembly 1 to conductor rails and/or conductor wire in the overhead contact system. For example, the rail segments 2a-2d are provided with connecting portion 7 to connect the rail segments 2a-2d to conductor rails and/or conductor wire (not shown) allowing for smooth passage between incoming and outgoing system conductors. The connecting portion 7 can be one or more screws, captive screws or fastener, but is not limited thereto.

[0039] According to an embodiment, the crossing assembly may include a central alignment portion 4 that is provided at the center of the crossing between the rail segments 2a-2d. The central alignment portion 4 is a filler portion that may be fabricated using material similar to the rail segments 2a-2d, or any other material. The central alignment portion 4 may be attached to the body 3 at the junction using connectors 5. The central alignment portion 4 is provided such that collector shoe of a train or other vehicle that is in contact with the conductor rail segments smoothly goes through the intersection without bumping, jamming or hanging in a gap at the intersection of the rail segments 2a-2d.

[0040] According to an embodiment, the body 3 may have a guard portion 8 for guiding the collector shoes through the junction and to prevent inadvertent disconnect from overhead structure. The guard portion may be an extension from the body that covers the side of the junction. Also, the body 3 may have attachment portions 9 for rigging and/or affixing the body 3 to special work structures of the overhead contact system. In one embodiment, the attachment portions 9 may be rigging holes or slots.

[0041] The above crossing assembly illustrated in FIGS. 1 and 2 are exemplary non-limiting embodiments. However, the skilled artisan would understand that the crossing assembly 1 may be configured in many other configurations without departing from the spirit and scope of the present invention. For example, the rail segments 2a-2d can be arranged such that the angle between the first and second rail segments 2a and 2b (or third and fourth rail segments 2c and 2d) may be different based on the street and track crossing requirements. This provides flexibility in design to accommodate non-standard crossing and turnout geometry.

[0042] Aspects of a frog assembly in an overhead conductor system, according to a second exemplary embodiment, are further described with reference to FIGS. 3 and 4. FIGS. 5A-5F show additional views of a frog assembly in an overhead contact system according to the second exemplary embodiment.

[0043] FIG. 3 illustrates a modular frog assembly 11 that may include rail segments 12a-12c and a body 13. Rail segments 12a-12c may be cast, fabricated or machined bars. In an exemplary embodiment, the rail segments 12a-2c may have a conductor wire affixed to a rigid rail for conducting power to the collector shoe of a train or other vehicle that is in contact with the rail segments 12a-12c. According to an exemplary non-limiting

embodiment, the rails segments 12a-12c may be made of bronze or tin plated bronze.

However, the rail segments 12a-12c may also be made of other materials.

[0044] The body 13 may be a plate fabricated or cast to have various shapes, sizes and proportions. In an exemplary embodiment, the body 13 may be fabricated according to the track work crossing and/or turnout angle requirements. In an exemplary non-limiting embodiment, the body 3 may be made of bronze, aluminum or steel. However, the body 13 may also be made of other materials.

[0045] According to an embodiment, the body 13 is a frame that holds the rail segments in place. As shown according to an embodiment in FIG. 4, the rail segments 12a-12c may be attached to the body 13 using one or more connectors 16. The connectors 16 can be one or more screws, captive screws, studs or fastener, but is not limited thereto. The connectors 16 securely affix the rail segments 12a-2c to the body 13. In another embodiment, the rail segments 12a-12c are attached to the body 13 using other techniques.

[0046] For example, one end of a first rail segment 12a and a second rail segment 12b are attached to one side of the body 13 using connectors 16 and one end of a third rail segment 12c is attached to another side of the body 13 using connectors 16. The first, second, and third rail segments 12a-12c form a turnout junction. The other ends of each of the rail segments 12a-12c are provided with mechanism to connect the frog assembly 11 to conductor rails and/or conductor wire in the overhead contact system. For example, the rail segments 12a-12c and provided with connecting portion 17 to connect the rail segments 12a-12c to conductor rails and/or conductor wire (not shown) allowing for smooth passage between incoming and outgoing system conductors. The connecting portion 17 can be one or more screws, captive screws or fastener, but is not limited thereto.

[0047] In one embodiment, the first rail segment 12a and the second rail segment 12b and the third rail segment 12c may be connected using a mechanical or electromechanical switch connector 15. The switch connector 15 may be provided such that collector shoe of a train or other vehicle that is in contact with the conductor rail segments smoothly goes through the turnout without bumping, jamming or hanging in a gap at the turnout portion of the rail segments 12a-12c. Also, the switch connector 15 may continuously provide the collector shoe of a train or other vehicle with power through the turnout junction.

[0048] In one embodiment, the switch connector 15 may have one or two movable linking rail segments 15a and 15b. According to an embodiment, a reset lever 20 is connected to the switch connector 15 to selectively control the reset movement of the one or two movable linking rail segments 15a and 15b upon passage through the turnout frog assembly.

[0049] In an embodiment, the reset lever 20 and linking rail segment 15 may be automatically controlled by a controller 21 to selectively control the movement of the one (not shown) or two movable linking rail segments 15a and 15b. For instance, when a control source is calling for the controller 21 to be in a first position, the movable linking rail segments 15a and 15b of the switch connector 15 are moved laterally into one of two positions to connect the third rail segment 12c with the first rail segment 12a. That is, the movable linking rail segment 15a connects the third rail segment 12c with the first rail segment 12a. The control source may be a secondary control source.

[0050] In another case, when the control source is calling for the controller 21 to be in a second position, the movable linking rail segments 15a and 15b of the switch connector 15 are moved laterally into the other of two positions to connect the third rail segment 12c with

the second rail segment 12b. That is, the movable linking rail segment 15b connects the third rail segment 12c with the second rail segment 12b.

[0051] In an exemplary embodiment, reset lever 20 may include a manual lever for selectively controlling the movement of the one or two movable linking rail segments 15a and 15b.

[0052] In yet another exemplary embodiment, when the control source is calling for the controller 21 to be in the second position (i.e., in contact with the second rail segment 12b) or first position (i.e., in contact with the second rail segment 12a), a single pivoting link (not shown) would combine the efforts of 15a and 15b into one single link having a pivot point about the tapered end of the third rail segment 12c. In another embodiment, this effort may also be followed by a manual reset lever for positioning the normal function of the switch point.

[0053] According to an embodiment, the body 13 may have a guard portion 18 for guiding the collector shoes through the junction and to prevent inadvertent disconnect from overhead structure. The guard portion may be an extension from the body that covers the side of the junction. Also, the body 13 may have attachment portions 19 for rigging and/or affixing the body 13 to special work structures of the overhead contact system. In one embodiment, the attachment portions may be rigging holes and/or slots.

[0054] The above frog assembly illustrated in FIGS. 3 and 4 are exemplary non-limiting embodiments. However, the skilled artisan would understand that the turnout assembly may be configured in many other configurations without departing from the spirit and scope of the present invention. For example, the rail segments 12a-12c can be arranged such that the angle between the first and second rail segments 12a and 12b may be different

based on the street and track turnout requirements. This provides flexibility in design to accommodate non-standard crossing and turnout geometry.

[0055] Thus, the overhead third rail collection/distribution systems, according to the exemplary embodiment of the present invention, are suitable for use both in high speed applications and in situations involving reduced overall heights of the transportation system. The modular frog and crossing assembly described according to exemplary embodiments allow for additional safety and ease of maintenance by allowing for interchanging of necessary replacement wear items (i.e., components that are worn by the collector shoe movement and are prone to excessive wear) without the need to completely remove critical special work structures supporting these arrangements. For example, an aspect of the assembly allows for the use of modular replaceable collector shoe runners and/or main contact wear pieces which are designed in such a way to be easily replaced during normal maintenance conditions without the need to remove the entire support structure or make provisions for common adverse maintenance conditions due to high tension applications.

[0056] Also, the modular frog and crossing assembly allows for an infinitely adjustable angle design scale, as opposed to the fixed crossing and/or turnout designs restricted by the selection of solid body castings in the conventional systems which commonly drive installations to not align with the vehicle track geometry therefore jeopardizing the integrity and imposing accelerated wear of the overhead contact system. This flexibility in design allows for the accommodation non-standard crossing and turnout geometry as is dictated by the track work crossing and/or turnout angle requirements. The design also allows for the addition of certain mechanical, magnetic and/or electrical alignment pieces for future design intent to allow for smooth passage of collector devices for

shallow, deep and/or high speed collector shoe operation as well as interaction with that of variable transit system types (i.e. Pantograph Collector Systems).

[0057] The frogs and crossing assemblies in the overhead conductor systems described in the exemplary embodiments of the present invention may be used in conjunction with various equipment, devices, hardware and software that may be necessary or desirable to the specific transportation system. The frogs and crossing assemblies described in the exemplary embodiments of the present invention may accommodate and may be used with various other assemblies, such as: Conductor Rail Assemblies, Door Bridge Assemblies, Shop Hanger Assemblies, Turn-out Transition Glider Assemblies, Alignment Knuckle Assemblies, Transition Dead-ends from Main-Line OCS to T-Rail, Vibration Mitigation assemblies, etc.

[0058] While the exemplary embodiments have been shown and described, it will be understood by those skilled in the art that various changes in form and details may be made thereto without departing from the spirit and scope of the present disclosure as defined by the appended claims.

[0059] In addition, many modifications can be made to adapt a particular situation or material to the teachings of the present disclosure without departing from the essential scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular exemplary embodiments disclosed as the best mode contemplated for carrying out the present disclosure, but that the present disclosure will include all embodiments falling within the scope of the appended claims.

What is claimed:

1. A modular crossing assembly structure in an overhead contact system comprising:
 - a plurality of rail segments; and
 - a body to which the plurality of rail segments are attached,wherein the plurality of rail segments are connectable to an overhead conductor rail or conductor wire.
2. The module crossing assembly structure of claim 1, further comprising one or more connectors that securely affix the plurality of rail segments to the body.
3. The module crossing assembly structure of claim 1, wherein the plurality of rail segments include a first rail segment, a second rail segment, a third rail segment and a fourth rail segment.
4. The module crossing assembly structure of claim 3, wherein the first and the second rail segments are attached to one side of the body and the third and the fourth rail segments are attached to another side of the body, and wherein the first, second, third and fourth rail segments form a crossing junction.
5. The module crossing assembly structure of claim 3, wherein each of the first, second third and fourth rail segments have a tapered end for smooth passage of collector shoe.
6. The module crossing assembly structure of claim 3, further comprising a central alignment portion that is provided at the center of a crossing between the first, second, third and fourth rail segments.

7. The module crossing assembly structure of claim 1, wherein the body has a guard portion to prevent inadvertent disconnect from overhead structure.

8. The module crossing assembly structure of claim 1, wherein the body has an attachment portion for connecting the body to a special work structure of the overhead contact system.

9. A modular frog assembly structure in an overhead contact system comprising:
a plurality of rail segments; and
a body to which the plurality of rail segments are attached,
wherein the plurality of rail segments are connectable to an overhead conductor rail or conductor wire.

10. The modular frog assembly structure of claim 9, further comprising one or more connectors that securely affix the plurality of rail segments to the body.

11. The modular frog assembly structure of claim 9, wherein the plurality of rail segments include a first rail segment, a second rail segment, and a third rail segment.

12. The modular frog assembly structure of claim 11, wherein the first and the second rail segments are attached to one side of the body and the third rail segment is attached to another side of the body, and wherein the first, second, and third rail segments form a turnout junction.

13. The modular frog assembly structure of claim 11, further comprising a switch connector that selectively connects the third rail segment with the first rail segment and the second rail segment.

14. The modular frog assembly structure of claim 13, wherein the switch connector includes one or two movable linking rail segments.

15. The modular frog assembly structure of claim 14, further comprising a reset lever that selectively controls the reset movement of the one or two movable linking rail segments,

wherein when the reset lever is moved to a first position, the movable linking rail segments is moved laterally into one of two reset positions to connect the third rail segment with the first rail segment, and

when the reset lever is moved to a second position, the movable linking rail segment is moved laterally into the other of two reset positions to connect the third rail segment with the second rail segment.

16. The module crossing assembly structure of claim 9, wherein the body has a guard portion to prevent inadvertent disconnect from overhead structure.

17. The module crossing assembly structure of claim 9, wherein the body has an attachment portion for connecting the body to a special work structure of the overhead contact system.

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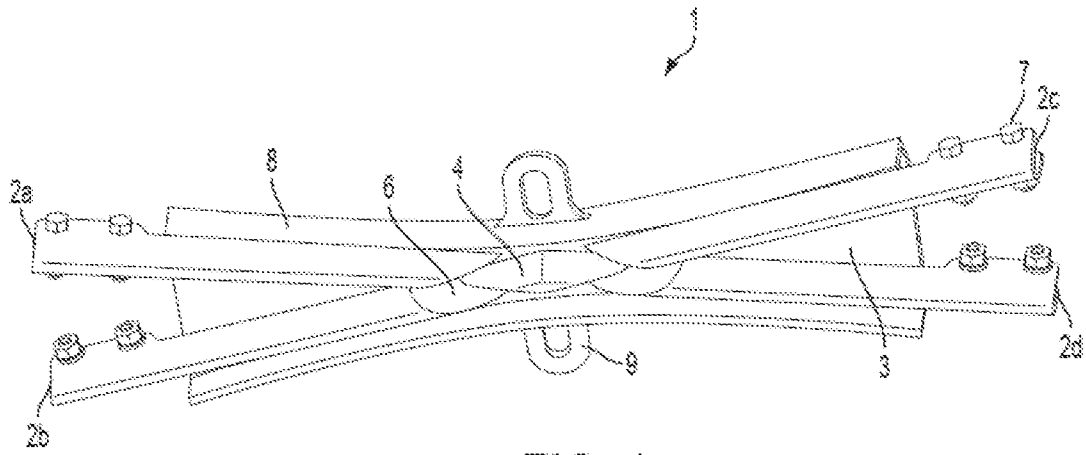


FIG. 1

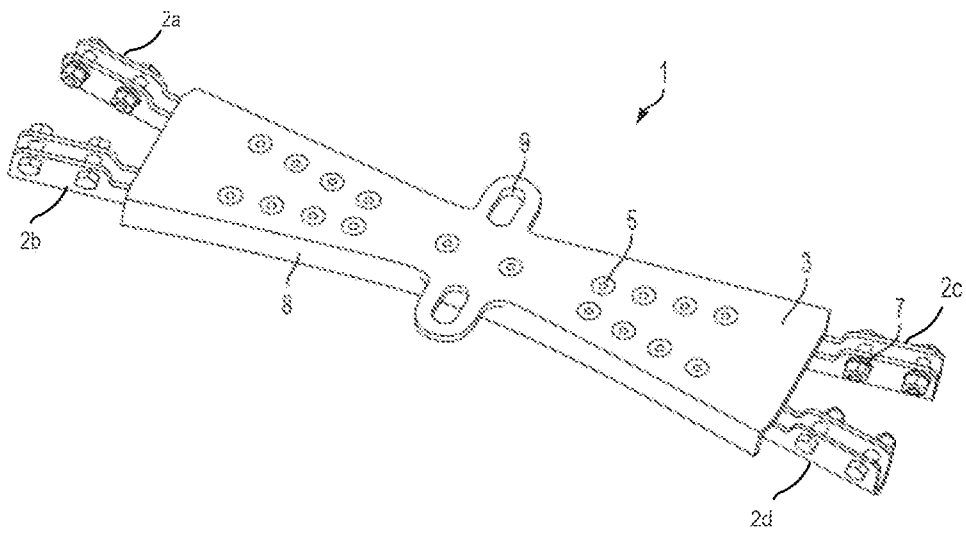


FIG. 2

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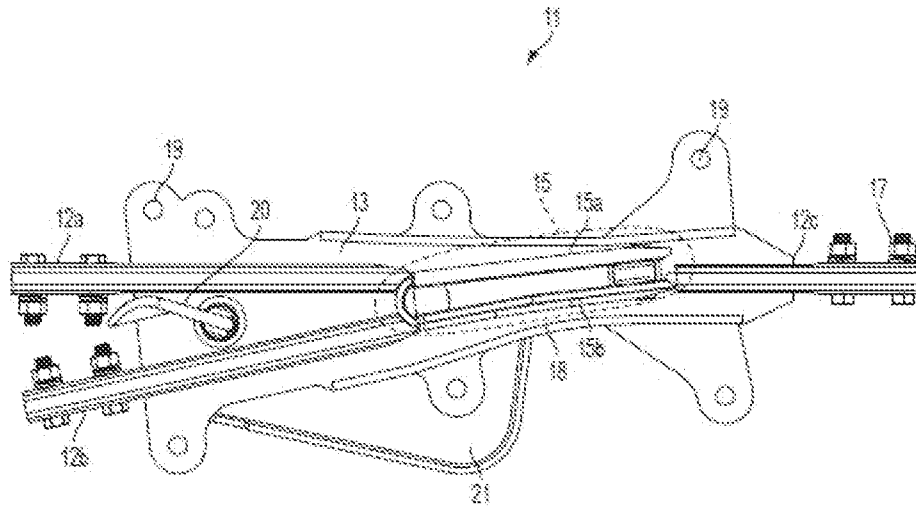


FIG. 3

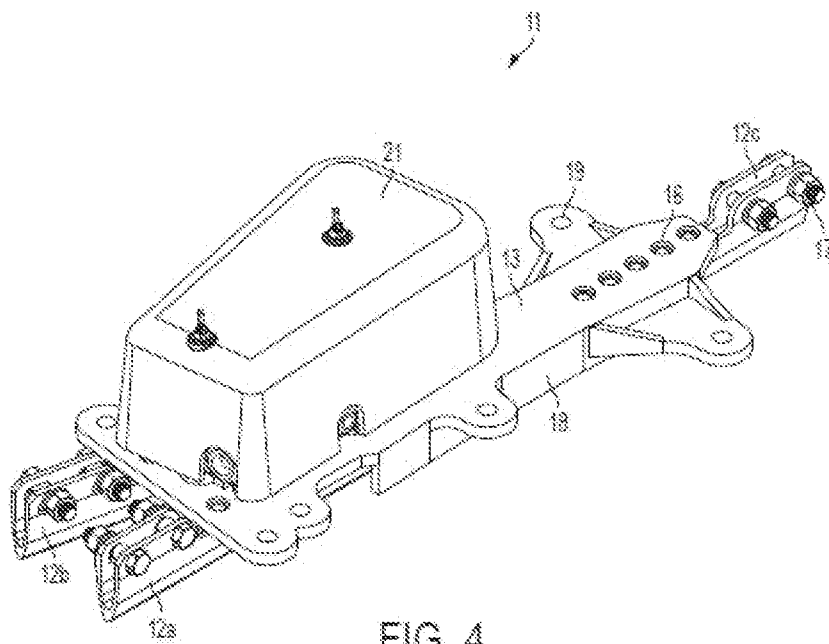


FIG. 4

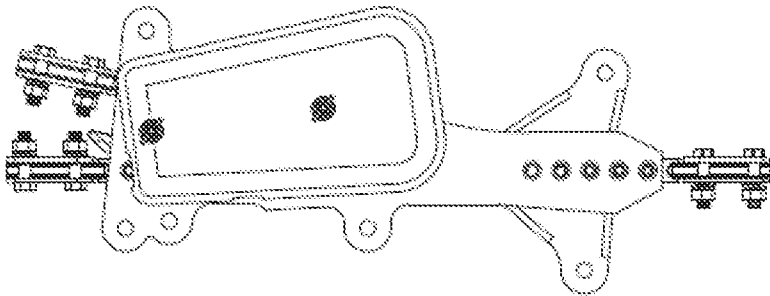


FIG. 5A

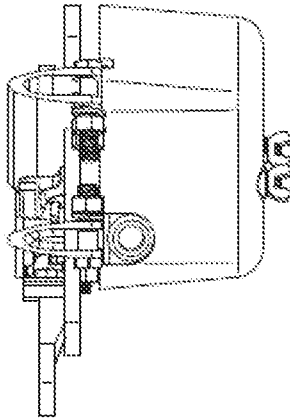


FIG. 5B

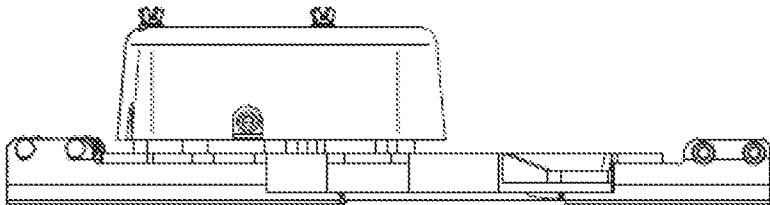


FIG. 5C

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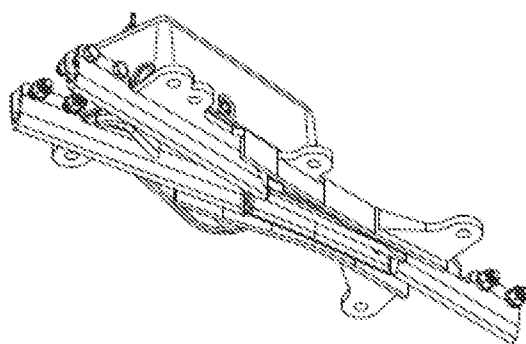


FIG. 5D

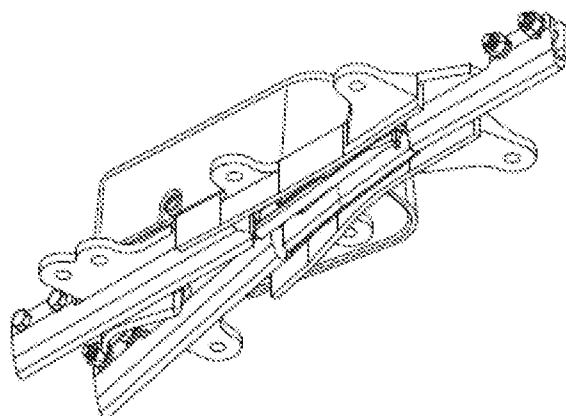


FIG. 5E

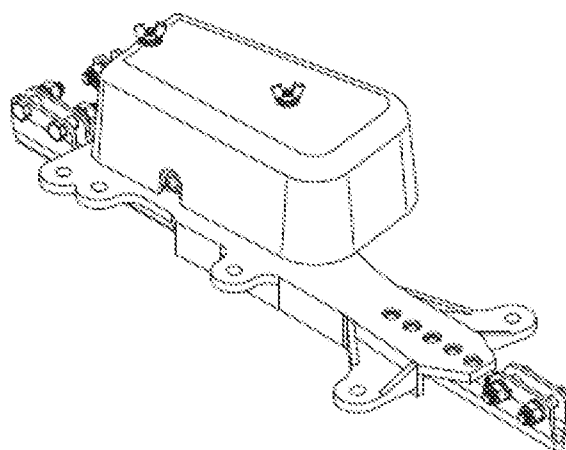


FIG. 5F