(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) **World Intellectual Property Organization**
International Bureau

(43) **International Publication Date**
02 February 2023 (02.02.2023)

WIPO | PCT

(10) **International Publication Number**
WO 2023/009761 A1

(51) **International Patent Classification:**
B61F 3/12 (2006.01) ***B61D 3/16*** (2006.01)
B61F 3/10 (2006.01)

(21) **International Application Number:**
PCT/US2022/038734

(22) **International Filing Date:**
28 July 2022 (28.07.2022)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
63/226,250 28 July 2021 (28.07.2021) US

(71) **Applicant: KASGRO RAIL CORPORATION** [US/US]; 121 Rundle Road, New Castle, PA 16102 (US).

(72) **Inventors: ODDEN, Jon**; 121 Rundle Road, New Castle, PA 16102 (US). **HINSCH, Nicholas, Scott**; 121 Rundle Road, New Castle, PA 16102 (US).

(74) **Agent: MONYOK, Michael, G.** et al.; Meyer, Unkovic & Scott LLP, 535 Smithfield Street, Suite 1300, Pittsburgh, PA 15222 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *with international search report (Art. 21(3))*

(54) **Title:** MULTIPLE-AXLE RAIL CAR WITH SPAN BOLSTERS

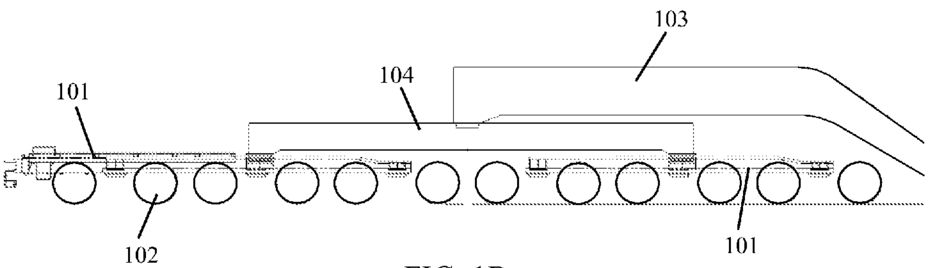

FIG. 1B

(57) **Abstract:** A multiple-axle railcar having a load supported by an upper span bolster attached to a plurality of lower span bolsters is disclosed. A group of axles are attached to each lower span bolster using truck assemblies. The method of manufacturing the span bolsters involves fabricating and joining the components of the span bolsters in a manner that forms a camber in the unloaded span bolster.

WO 2023/009761 A1

TITLE

MULTIPLE-AXLE RAIL CAR WITH SPAN BOLSTERS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. § 119 of U.S. Provisional Application Serial No. 63/226,250, filed July 28, 2021, which is incorporated by reference herein.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

[0002] Not applicable.

BACKGROUND

[0003] The present invention relates generally to railcars. More specifically, the invention relates to a multiple-axle railcar having cambered span bolsters to distribute a load among the axles of the railcar.

[0004] When a railway transports oversized or heavy cargo, it accommodates the excessive load by using railcars with additional axles compared to standard capacity railcars. To realize the load carrying capacity of the additional axles, the load must be evenly distributed across each axle. A twelve-axle rail vehicle manufactured by Kasgro Rail Corp. and disclosed in U.S. Pat. No. 5,802,981 uses six axles at each end of the railcar, where each set of six axles are mounted to a common carrier, known as a span bolster, that distributes the load among the axles. The benefit of twelve-axle railcar, in addition to its load carrying capability, is improved turning performance resulting from the fact that one span bolster can pivot independent of the other.

[0005] The increased load carrying capability of the twelve-axle railcar or any other railcar having additional axles is the result of evenly distributing the weight of the cargo to maintain reasonable wheel and axle loadings. Having equal loading on each axle provides numerous benefits, such as improved safety of operation and reduced maintenance costs. High capacity railcars, such as a 24-axle railcar or a Schnabel car, present additional loading problems as they are designed to carry extremely heavy loads and can have twice the number of axles as standard high-capacity railcars. Further, these railcars can have depressed decks where centralized loads are not directly supported by axles beneath the load. It would therefore be advantageous to develop a multiple-axle railcar having span bolsters that promote consistent loading across each axle.

BRIEF SUMMARY

[0006] Disclosed is a multiple-axle railcar with four lower span bolsters, each span bolster providing an attachment point for a group of axles mounted on truck assemblies. An upper span bolster connects multiple lower span bolsters and receives the load from the car body. A camber is introduced into each lower span bolster and each upper span bolster to reduce loading variances due to deformation of the bolsters when weighted. Further disclosed is a method of manufacturing the span bolsters, which minimizes variances that can be introduced during fabrication or welding operations. The camber of each span bolster creates a peak near the point where the bolster attaches to the upper span bolster or to the main body of the railcar. The result of creating a camber is that the span bolster tends to flatten under load, equalizing the load among the axles supported by the bolster. The arrangement can be used on railcars such as 24-axle depressed center railcars and Schnabel railcars.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] Fig. 1A is a side view of a 24-axle depressed center railcar utilizing upper span bolsters and lower span bolsters to attach the axles to the load carrying member.

[0008] Fig. 1B is a detailed view of a span bolster on a depressed center railcar.

[0009] Fig. 2 is a view of truck assemblies used to carry the axles.

[0010] Fig. 3A is a side view of a Schnabel railcar utilizing span bolsters and upper span bolsters to attach the axles to the load carrying components.

[0011] Fig. 3B is a detailed view of one end of a Schnabel railcar.

DETAILED DESCRIPTION

[0012] The railcar 100 shown in Fig. 1A is a 24-axle depressed center railcar capable of carrying oversized loads. As shown in Fig. 1A, the railcar 100 contains four lower span bolsters 101, where each span bolster 101 provides a mounting point for a group of axles 102. Each span bolster 101 in the railcar 100 depicted in Fig. 1A carries six axles. However, the number of axles 102 carried by the span bolster 101 may vary depending on the intended load. In a depressed center railcar 100, the span bolsters 101 are positioned towards the end of the railcar 100, with two span bolsters 101 at each end. See, for example, Fig. 1B, which shows one end of a depressed center railcar 100. This configuration permits the center of the load carrying member 103 to be lowered relative to the points where it attaches to span bolsters 101 via an upper span bolster 104. Excessive height could prevent the railcar from travelling through tunnels or under low overhangs. As shown in Fig. 1A, an upper span bolster 104 connects the two lower span bolsters 101 at each end of the railcar 100. The upper span bolster 104 is positioned above the lower span bolsters 101 and pivotally connects near a midpoint of each individual span bolster 101. A main carrying member 103 attaches to each upper span bolster 104, linking the four span bolsters 101 via the upper span bolsters 104.

[0013] The railcar 100 shown in Fig. 1A has an overall length of 184 feet and a carrying capacity of about 500 tons. Each lower span bolster 101 is about 21 feet long with a total length of roughly 58 feet between the end axles 102 of adjacent span bolsters 101. The pivoting connection permits the span bolsters 101 to move independently when the railcar traverses a bend in the track. Given the length of the railcar 100, turning performance could be limited without independent span bolsters 101. As will be discussed in greater detail, truck assemblies 110 carrying the axles have been modified compared to standard swing motion truck assemblies to permit additional lateral movement, thereby increasing turning performance.

[0014] Referring now to Fig. 2, the axles 102 are carried by truck assemblies 110, which are then mounted to a lower span bolster 101. As shown in Fig. 2, the truck assemblies 110 are swing motion truck assemblies and include a transom connecting a pair of side plates. The transom may include elongated slots 111 to permit additional lateral movement, aiding turning ability. As is typical in the art, each truck assembly 110 includes a pair of axles 102. Referring again to Fig. 1A, each span bolster 101 carries three truck assemblies 110, or six total axles 102.

[0015] As previously discussed, the upper span bolster 104 attaches to each lower span bolster 101 near its midpoint, which may be centered over the axles 102. For example, in a grouping of three truck assemblies 110, the attachment point would be centered over the center truck assembly 110. Unlike the span bolsters 101 of the present disclosure, a flat span bolster would overweight the center axles 101 due, in part, to deformation of the span bolster under the heavy load. The unequal loading of the axles 102 degrades the performance and longevity of the railcar 100. To better equalize the loading of each axle 102, the span bolster 101 is manufactured with a slight camber. The camber is formed with a peak near the midpoint of the bolster 101 or, alternatively, at the attachment point for the upper span bolster 104. More specifically, the camber is a deviation in the vertical direction, creating an arc-shaped bolster 101. In the railcar 100 depicted in Fig. 1A, the attachment point coincides with the midpoint of the bolster 101, which is also directly above the center truck assembly 110 of the three assembly 100 set. When loaded, the camber will slightly deform and flatten, equalizing the load on the axles 102 attached to the span bolster 101. Depending on the load, the height of the camber is in the range of several millimeters. For the 500-ton railcar shown in Fig. 1A, the camber is about 19-20 millimeters.

[0016] Similar to the lower span bolsters 101, the upper span bolster 104 includes a camber to offset load induced deformations, thereby equalizing the force distributed to each span bolster 101 to which it is connected. Each upper span bolster 104 carries a significantly higher load than the lower span bolsters 101 as there are fewer upper span bolsters 104 compared to lower span bolsters 101. For example, in the railcar 100 shown in Fig. 1A, a single upper span bolster 104 carries the same load as two lower span bolsters 101 at each end of the railcar 100. As a result, the height of the camber in the upper span bolster 104 may be several millimeters greater than the height of the camber in the lower span bolster 101. Alternatively, the upper span bolster 104 can be fabricated with increased stiffness to minimize the amount of deformation under load.

[0017] Upper span bolsters 104 can be used on a variety of high-load capacity railcars 100. Fig. 3A depicts upper span bolsters 104 used on a Schnabel car 100. In these types of railcars 100, the load or cargo itself will become a structural member connecting each end of the railcar 100. The Schnabel railcar 100 depicted in Fig. 3A has a similar bolster 101/104 configuration to the depressed center railcar 100 shown in Fig. 1A. Fig. 3B shows a detailed view of one end of the Schnabel car. One difference is that the main carrying member 103 is replaced by a pair of Schnabel frames 105. When not carrying cargo, the Schnabel frames 105 will be connected to each other, linking each end of the railcar 100. When a load is present, the frames 105 will support opposite ends of the cargo, where the cargo itself links each end of the railcar 100. The Schnabel frames 105 attach to the upper span bolsters 104 at the peak of the camber, near the midpoint of the upper span bolster 104. The Schnabel car 100 depicted in Fig. 3A has an empty, coupled length of about 140 feet and has a load carrying capacity exceeding one million pounds.

[0018] Manufacturing a railcar 100 with span bolsters 101 and upper span bolsters 104 uniformly distributing a load requires fabrication of bolsters 101/104 having a camber. Each bolster 101/104 may have a longitudinal support, or stringer, constructed from flat plate steel with a top plate and bottom plate attached to the stringers. The top and bottom plates may be flat plate steel and forced against the stringers prior to attachment, causing the top and bottom plate to assume the profile of the stringers. The height of the stringers may vary, with the greatest height at its center (i.e. the location of the highest loading) and a taper towards the end where it connects to the outbound truck assemblies 110. To create the camber, the area of the bolster 101/104 near the attachment point is raised in the vertical direction compared to the ends of the bolster 101/104. That is, the span bolster is fabricated with a slight arc which is convex in shape. It is not necessary for the peak of the camber to be located in the center of the bolster 101/104. Rather, load equalization among the axles is realized when the peak is located near the attachment point. The amount of camber required for the span bolster 101/104 is determined based on the specifications of the railcar, such as the length of the bolster 101/104, the number of axles, trucks, and bolsters 101/104 being used, the size of material used to create the bolster 101/104, and the load expected to be carried by the railcar, to name a few.

[0019] During the fabrication of longitudinal supports, the pre-determined camber is cut into the profile of each support stringer, creating an arced profile. The longitudinal stringers are beam-like members spanning substantially the length of the bolster 101/104, with a height from a few to several inches, depending on the load to be carried. Cutting the stringers can be accomplished by any typical method, such as using a plasma, waterjet, laser, or oxygen fuel cutter. A computer-controlled cutting process allows for tight tolerances. For example, the tolerances for the peak of the camber is plus ¼ of an inch and the tolerances for other components are plus or minus 1/16 of an inch for lengths and plus or minus ½ of a degree for angles. Over the span of a bolster 101/104 having a length of over 20 feet or more, ¼ of an inch offers very little room for error.

[0020] Once longitudinal supports complete, structures for mounting the truck assemblies 110 and attachment points can be fabricated and attached to the stringers. Next, top and bottom plates are attached to the stringers. The plates can be fabricated with bends matching the camber of the bolsters 101/104, which would result in a structure with little deformation in an unloaded state. Alternatively, flat plates can be forced into the shape of the stringers and welded into place. The top and bottom plates can be attached to the structures using a jig, as is known in the art. Prior to final assembly and depending on the application, weld inspections may be performed by a mag particle or a dye penetrant test. Inspection of the weld between the longitudinal supports to top plate and bottom plate are most critical.

[0021] While the disclosure has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modification can be made therein without departing from the spirit and scope of the embodiments. Thus, it is intended that the present disclosure cover the modifications and variations of this disclosure provided they come within the scope of the appended claims and their equivalents.

[0022] Further, the features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilized for realizing the invention in diverse forms thereof. In particular, one or more features in any of the embodiments described herein may be combined with one or more features from any other embodiments described herein.

[0023] Protection may also be sought for any features disclosed in any one or more published documents referred to and/or incorporated by reference in combination with the present disclosure.

CLAIMS

What is claimed is:

1. A multiple-axle railcar comprising:

a railcar body have a first end and a second end;

a first upper span bolster pivotally attached to the first end and a second upper span bolster pivotally attached to the second end,

wherein each of the first and second upper span bolster have a camber with a peak coinciding with an attachment point to the railcar body;

a pair of lower span bolsters attached to each of the first upper span bolster and the second upper span bolster,

wherein each lower span bolster has a camber with a peak coinciding with an attachment point to the upper span bolster; and

a plurality of truck assemblies carrying axles, wherein the truck assemblies are mounted to the span bolsters.

2. The multiple-axle railcar of Claim 1, wherein the railcar body comprises a pair of Schnabel frames.

3. The multiple-axle railcar of Claim 1, wherein three truck assemblies are mounted to each span bolster and have a slot to permit lateral movement of the plurality of axles.

4. The multiple-axle railcar of Claim 1, wherein the multiple-axle railcar has 24 axles.

5. The multiple-axle railcar of Claim 1, wherein the railcar body comprises a depressed center load carrying member, wherein a center of the depressed center load carrying member is below a mounting point of the load carrying member to the first upper span bolster and the second upper span bolster.

6. The multiple-axle railcar of Claim 1, wherein the peak of the camber of each lower span bolster is located at a center of each lower span bolster.

7. The multiple-axle railcar of Claim 1, wherein the peak of the camber of each upper span bolster is located at a center of each upper span bolster.

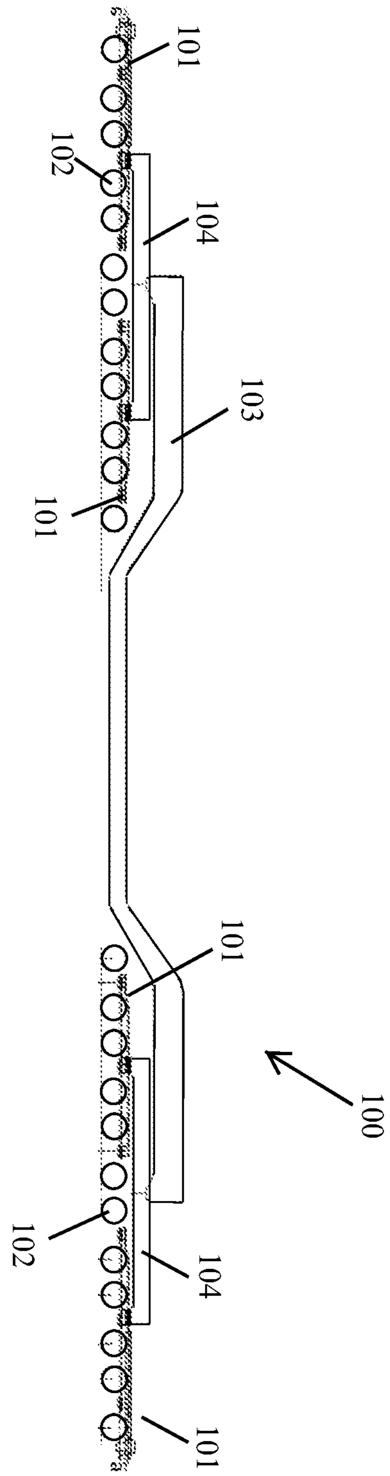

FIG. 1A

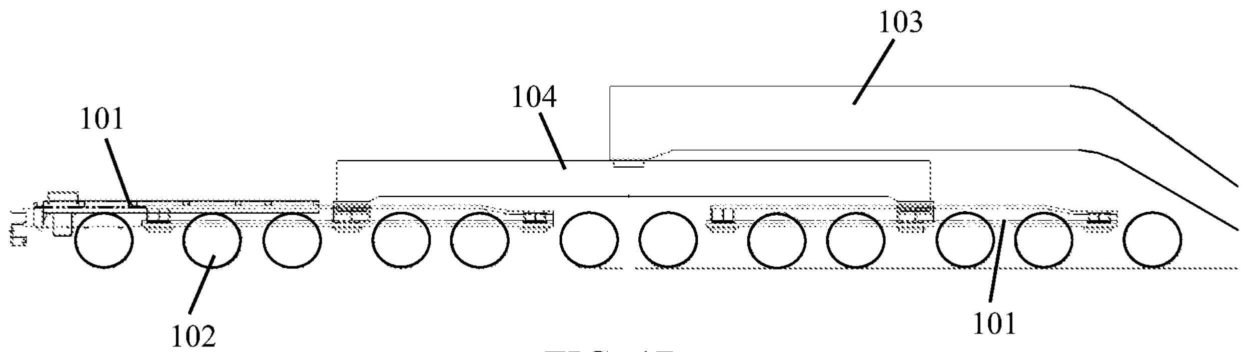

FIG. 1B

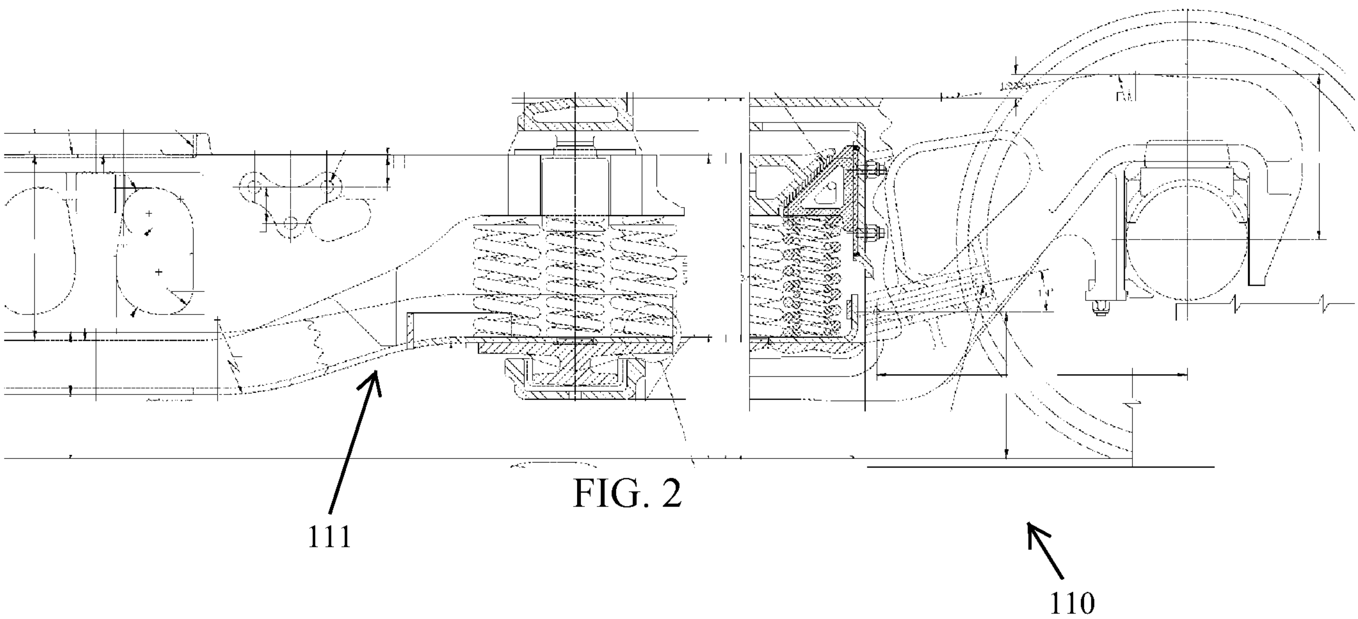

FIG. 2

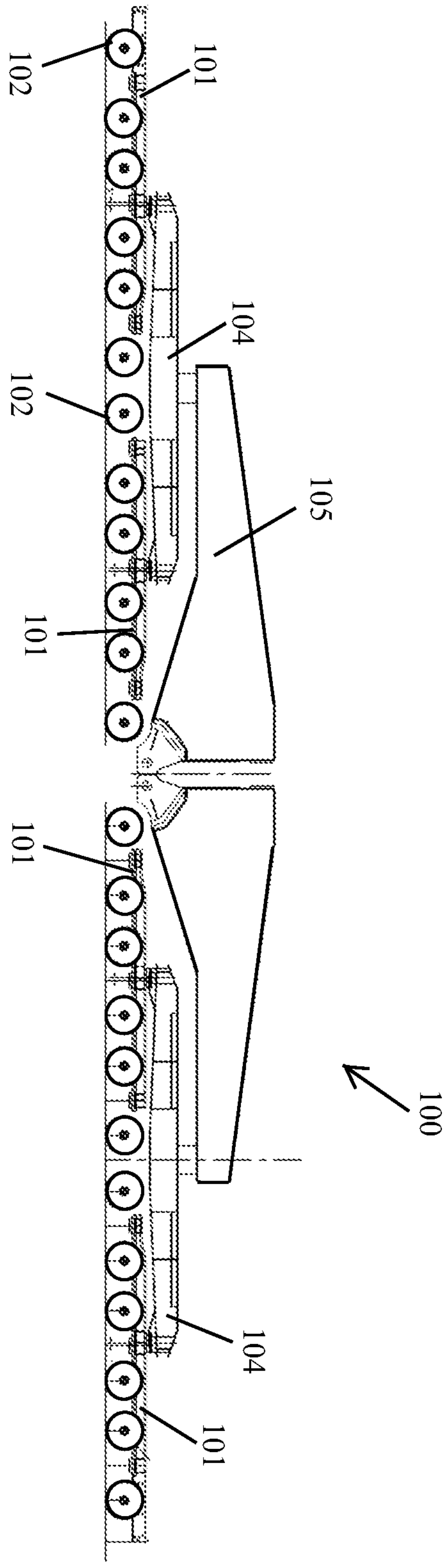

FIG. 3A

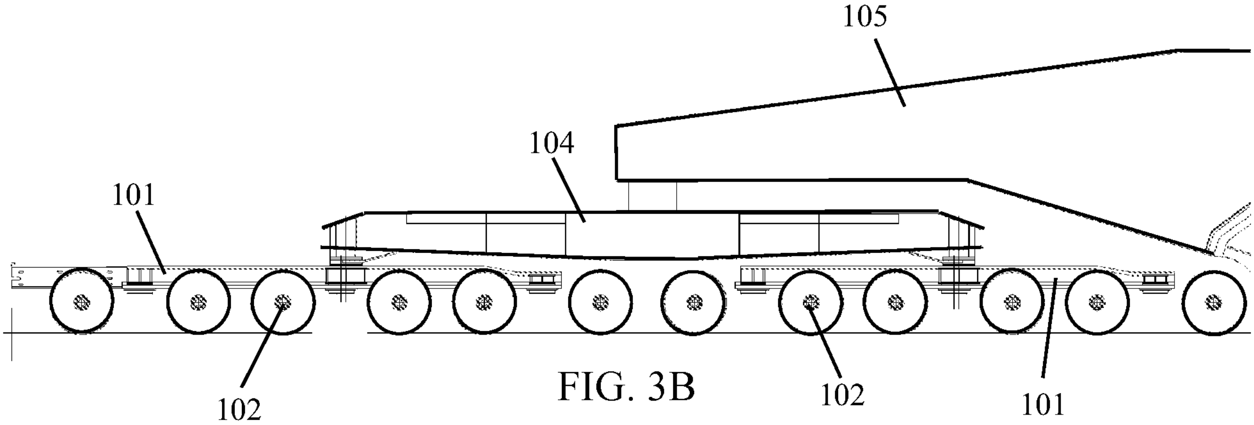

FIG. 3B

4835-9649-0739.1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2022/038734

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - INV. - B61F 3/12; B61F 3/10; B61D 3/16 (2022.01)
ADD.

CPC - INV. - B61F 3/125; B61F 3/10; B61D 3/166 (2022.08)

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic database consulted during the international search (name of database and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	MARIUSZ SULEK. Relocation of the Unit 1 RPV, from the San Onofre Nuclear Generating Station SONGS. YouTube. 25 May 2020 [retrieved on 20 September 2022]. Retrieved from internet: <URL: https://www.youtube.com/watch?v=yasYkAzRdRw>. entire video. See pages 6-7 of ISA/237.	1-7
Y	US 10,766,507 B2 (KASGRO RAIL CORPORATION) 08 September 2020 (08.09.2020) entire document	1-7
Y	US 9,403,542 B2 (MAMMOET USA SOUTH INC.) 02 August 2016 (02.08.2016) entire document	3
A	US 5,802,981 A (KASSAB) 08 September 1998 (08.09.1998) entire document	1-7
A	US 4,901,649 A (FEHRENBACH et al) 20 February 1990 (20.02.1990) entire document	1-7
A	US 4,341,494 A (FEDELE) 27 July 1982 (27.07.1982) entire document	1-7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 September 2022	OCT 31 2022

Name and mailing address of the ISA/	Authorized officer
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Taina Matos Telephone No. PCT Helpdesk: 571-272-4300