

APPARATUS AND METHOD FOR REPLACING RAILWAY SLEEPERS

Technical Field

5 The present disclosure generally relates to an apparatus and a method for replacing railway sleepers. More particularly, the present disclosure describes various embodiments of an apparatus and a method for replacing or changing railway sleepers (also known as railway ties), which are disposed along railway tracks for supporting thereof.

10

Background

Railway sleepers or railway ties are used to support railway tracks. They are disposed perpendicular to the railway tracks, such that the railway tracks are supported on the railway sleepers. Particularly, the railway tracks comprise two track lines on either side of the railway, and each track line is fastened to and supported on the perpendicular railway sleepers. As trains and other vehicles move along the railway, their loads are transferred onto the railway tracks, and in turn transferred onto the railway sleepers. The railway sleepers are disposed on ballast comprising materials such as small rocks, and the loads are subsequently transferred to the ballast and the ground underneath the railway sleepers. In addition to the transfer of loads, the railway sleepers keep the railway tracks upright and spaced to the correct track gauge, i.e. the distance between the two track lines.

25 Railway sleepers are generally made from wood, timber, or concrete materials. The railway sleepers have to be replaced or changed at predetermined maintenance intervals, especially for railway sleepers made from wood or timber materials.

Timber and wooden railway sleepers are designed to last 15 to 25 years, and have to be replaced towards the end of their lifespan. These timber and wooden railway sleepers also tend to be more prone to wear and tear, for reasons such as moisture content and termite infestation. At these predetermined maintenance intervals, the railway sleepers need to be maintained and repaired. In worse conditions, the old

railway sleepers may need to be removed and be replaced with new railway sleepers when they show significant wear and tear. In some situations, old railway sleepers that are made from wood or timber materials may need to be changed to newer railway sleepers made from concrete materials. Concrete railway sleepers have a longer lifespan of about 50 years, and are also more weather resistant than timber or wooden railway sleepers.

There are some existing apparatuses and methods for replacing the old railway sleepers. For example, United States patent number 5,465,666 discloses an apparatus and a method for changing railway sleepers using devices to lift the railway tracks, and a vehicle to remove and replace the railway sleepers. The vehicle comprises a crane device for lifting the railway sleepers. The railway sleepers can thus be lifted and transported along the railway tracks using the vehicle. However, the vehicle and the lifting devices are heavy machinery which is cumbersome to manoeuvre around within the tight confines of the railway tracks, especially if the railway tracks are not on ground level, i.e. along underground tunnels or overhead viaducts. Further, more time is required to install or setup the heavy machinery for replacing the railway sleepers, and to remove the heavy machinery after replacing the railway sleepers, thereby reducing the operational hours of the railway tracks.

Another existing solution is disclosed in South Korea patent number 10-2014-0024639. There is disclosed a gantry device placed across the railway tracks. The gantry device comprises two hydraulic cylinders for lifting and balancing the railway sleepers. The removed railway sleepers are then placed on a transport carrier for subsequent disposal. The gantry device comprises wheels or rollers for moving along the railway tracks, such that the other railway sleepers along the railway tracks can be removed and lifted in a similar manner. However, this requires manual work to keep moving the gantry device slightly forward to the next railway sleeper. A problem associated with this is that the gantry device can only move the railway sleepers in the vertical direction; the railway sleepers cannot be moved longitudinally along the railway tracks.

Therefore, in order to address at least one of the aforementioned problems and/or disadvantages, there is a need to provide an apparatus and a method for replacing railway sleepers, in which there are improved features compared to the aforementioned prior art.

5

Summary

According to a first aspect of the present disclosure, there is provided an apparatus for replacing railway sleepers disposed along a railway track. The apparatus
10 comprises a plurality of gantry devices distributed along the railway track; a guiding beam removably coupled to at least some of the plurality of gantry devices, the guiding beam being disposed above the railway track; and a lifting mechanism moveably coupled the guiding beam for carrying the railway sleepers. The lifting mechanism is adapted for travel along the guiding beam to thereby displace the
15 railway sleepers along the guiding beam.

An advantage of the apparatus of the present disclosure is that the apparatus allows railway sleepers to be raised and lowered using the lifting mechanism, as well as to be displaced along the guiding beam. Thus, the railway sleepers can be moved in
20 both the vertical direction and the horizontal or longitudinal direction using the lifting mechanism in the apparatus. The apparatus thus provides an assembled structure for transporting the railway sleepers longitudinally. The apparatus can be disassembled after replacing the railway sleepers.

25 Preferably, the guiding beam comprises a plurality of channels removably coupled to the plurality of gantry devices for suspending the lifting mechanism therefrom. The guiding beam preferably comprises a deflected section for leading the railway sleepers away from the railway track, and the deflected section is supported by one of the plurality of gantry devices. The removability of the plurality of channels
30 advantageously allows the apparatus to be easily disassembled and reassembled at another section of the railway track. The deflected section allows the removed railway sleepers to be guided to an area away from the railway tracks, thereby reducing the clutter at the site area.

The railway sleepers are displaced through the plurality of gantry devices by the lifting mechanism moving along the guiding beam; and crossbar heights of each of the plurality of gantry devices are adjustable. The adjustability of the crossbar heights allows the gantry devices to be used at different sections of the railway tracks, wherein each section is of a different crossbar height. This advantageously keeps the guiding beam in a horizontal position that allows ease of movement of the railway sleepers.

Preferably, each gantry device comprises an overhead crossbar; and structural columns disposed alongside the railway track for supporting and disposing the overhead crossbar above the railway track. More preferably, each gantry device comprising two structural columns, wherein the gantry device is spaced and disposed such that the railway track is positioned between the two structural columns. The arrangement of each gantry device thus forms an inverted U-shape disposed on the railway tracks, such that the displacement of the railway sleepers passes through the inverted U-shapes.

The lifting mechanism preferably comprises rollers for travelling along the guiding beam. The rollers advantageously allow the lifting mechanism to displace or roll smoothly along the guiding beam, while carrying the railway sleepers therewith.

The lifting mechanism preferably comprises a chain block operable for adjusting a height of the railway sleepers coupled thereto in relation to the railway track. The lifting mechanism also preferably comprises a clamp for holding the railway sleepers. The chain block provides a convenient means for workers to manually lift a removed railway sleeper upwards from the railway tracks, and to lower a new railway sleeper downwards towards the railway tracks. The clamp provides a securing device to hold the railway sleepers while they are being transported by the lifting mechanism along the guiding beam.

According to a second aspect of the present disclosure, there is provided a method for replacing railway sleepers disposed along a railway track. The method comprises

unfastening a first railway sleeper from a sleeper location on the railway track; coupling and lifting the first railway sleeper with a lifting mechanism, the lifting mechanism being moveably coupled to a guiding beam above and along the railway track; displacing the first railway sleeper by moving the lifting mechanism along the
5 guiding beam to a predetermined location; releasing the first railway sleeper from the lifting mechanism at the predetermined location; coupling and lifting a second railway sleeper with the lifting mechanism; displacing the second railway sleeper by moving the lifting mechanism along the guiding beam to the sleeper location on the railway track; releasing the second railway sleeper from the lifting mechanism at the sleeper
10 location; and fastening the second railway sleeper at the sleeper location on the railway track. The second railway sleeper replaces the first railway sleeper.

An advantage of the method of the present disclosure is that the railway sleepers are raised and lowered using the lifting mechanism, as well as displaced along the
15 guiding beam. Thus, the railway sleepers are moveable in both the vertical direction and the horizontal or longitudinal direction using the lifting mechanism disclosed in the method.

Preferably, the guiding beam is removably coupled to at least some of a plurality of
20 gantry devices distributed along the railway track. More preferably, the guiding beam comprises a plurality of channels removably coupled to the plurality of gantry devices for suspending the lifting mechanism therefrom. The removability of the channels and the guiding beam advantageously allows the guiding beam and the gantry devices to be easily disassembled and reassembled at another section of the railway
25 track.

The method preferably comprises displacing one of the first and second railway sleepers along a deflected section of the guiding beam, the deflected section being directed away from the railway track. The deflected section allows the removed
30 railway sleepers to be guided to an area away from the railway tracks, thereby reducing the clutter at the site area.

Preferably, each of the first and second railway sleepers are displaced through the plurality of gantry devices by the lifting mechanism moving along the guiding beam. The arrangement of each gantry device is such that each forms an inverted U-shape disposed on the railway tracks. The displacement of the railway sleepers passes
5 through the inverted U-shapes.

An apparatus and a method for replacing railway sleepers according to the present disclosure is thus disclosed hereinabove. Various features, aspects, and advantages of the present disclosure will become more apparent from the following detailed
10 description of the embodiments of the present disclosure, by way of non-limiting examples only, along with the accompanying drawings in which like numerals represent like components.

Brief Description of the Drawings

15 FIG. 1 is an isometric view of an apparatus in use with a railway system for replacing railway sleepers thereof, according to an embodiment of the present disclosure.

FIG. 2 is a top plan view of the apparatus in use with the railway system for replacing
20 railway sleepers thereof, according to an embodiment of the present disclosure.

FIG. 3 is a side view of the apparatus in use with the railway system for replacing railway sleepers thereof, according to an embodiment of the present disclosure.

25 FIG. 4 is a magnified view of a section of the top plan view shown in FIG. 2.

FIG. 5 is a magnified view of a section of the side view shown in FIG. 3.

FIG. 6 is a side view of a gantry device of the apparatus for replacing railway
30 sleepers, according to an embodiment of the present disclosure.

FIG. 7 is a front view of a gantry device in use for replacing railway sleepers, according to an embodiment of the present disclosure.

FIG. 8 is a magnified front view of the gantry device shown in FIG. 7.

FIG. 9 is a front view of a lifting mechanism in use for replacing railway sleepers,
5 according to an embodiment of the present disclosure.

FIG. 10 is a side view of a railway track of the railway system, according to an
embodiment of the present disclosure.

10 Detailed Description

For purposes of brevity and clarity, descriptions of embodiments of the present disclosure are limited hereinafter to an apparatus and a method for replacing railway sleepers, in accordance with the drawings in FIG. 1 to FIG. 10. Unless explicitly
15 stated otherwise, in the description herein the recitation of particular numerical values or value ranges is taken to be a recitation of particular approximate numerical values or approximate value ranges. Various embodiments of the present disclosure are directed toward structural and functional aspects of the apparatus and method for replacing the railway sleepers. While aspects of the present disclosure will be
20 described in conjunction with the embodiments provided herein, it will be understood that they are not intended to limit the present disclosure to these embodiments. On the contrary, the present disclosure is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the present disclosure as defined by the appended claims. Furthermore, in the following detailed
25 description, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be recognized by an individual having ordinary skill in the art, i.e. a skilled person, that the present disclosure may be practiced without these specific details. In other instances, well-known systems, methods, procedures, and components have not been described in
30 detail as not to unnecessarily obscure aspects of the embodiments of the present disclosure.

In a preferred embodiment of the present disclosure, an apparatus 100 for replacing railway sleepers in a railway system 200, as well as a method for replacing the railway sleepers using the apparatus 100, is described hereinafter.

5 FIG. 1 shows an isometric view of the apparatus 100 in use with the railway system 200 for replacing the railway sleepers. Referring also to FIG. 2 and FIG. 3, the railway system 200 comprises a pair of railway tracks 202 on either side of the railway system 200, and a plurality of railway sleepers 204 evenly distributed along the railway tracks 202. The railway sleepers 204 are disposed perpendicular or
10 transverse to the railway tracks 202, such that the railway tracks 202 are seated and supported on the railway sleepers 204. The railway tracks 202 are supported on baseplates 206 that are disposed between the railway tracks 202 and the railway sleepers 204. The railway tracks 202 are coupled or tied to the railway sleepers 204 through the baseplates 206, using fasteners 208 such as screws, bolts, and nuts.
15 Other fastening means may also be used, as known to the skilled person.

Due to the arrangement of the railway tracks 202, the railway system 200 is separated into two areas, an inside area 210 that is between the railway tracks 202, and an outside area 212 that is outside of both sides of the railway tracks 202. Loads
20 on the railway tracks 200 are transferred onto the railway sleepers 204. The railway sleepers 204 are disposed and supported on ballast 214 distributed over the inside area 210 and the outside area 212. The loads are subsequently transferred to the ballast 214 and to the underneath ground or earth. The horizontal plane comprising the top surface of the railway tracks 202 is known as the rail level, and the horizontal
25 plane within the ballast 214 is known as the sub ballast level.

With reference to FIG. 1 to FIG. 3, the railway system 200 comprises a third rail or conductor rail 216 for providing electric power to trains. The conductor rail 216 runs parallel to, but slightly above and outside of, the railway tracks 202. The conductor
30 rail 216 is coupled to some of the railway sleepers 204 via angle brackets 218. The angle brackets 218 merely provide a mechanical support for the conductor rail 216 and are not electrically conductive. As such, the angle brackets 218 are electrically insulated at the points of contact with the conductor rail 216 and the railway sleepers

204. Additionally or alternatively, the angle brackets 218 are made from a non-conductive material.

The apparatus 100 comprises a plurality of gantry devices 102 distributed along the railway track 202, approximately every 2.8 metres. The plurality of gantry devices 102 are evenly spaced apart from each other, or may be separated at various predetermined distances. The height or crossbar height of each gantry device 102 is approximately 1.5 metres, and the length of each gantry device 102 is approximately 3 metres to accommodate the width of the railway tracks 202. Referring to FIG. 4 and FIG. 5, each gantry device comprises a pair of structural columns 104 and an overhead crossbar 106. The gantry devices 102, including the structural columns 104 and the overhead crossbars 106, are preferably made from a lightweight material, such as an aluminium alloy. This advantageously allows workers to easily handle the gantry devices 102 manually. Each structural column 104 is disposed on the ground and supports the overhead crossbar 106, which is coupled to the top portion of the structural columns 104. The plurality of gantry devices 102 are arranged along the railway tracks 202 such that the overhead crossbars 106 are perpendicular or transverse to the railway tracks 202. The length of the overhead crossbars 106 is approximately 3 metres, but may be varied if the railway tracks 202 are wider, such as around turnout sections. The adjustment of the length of an overhead crossbar 106, and consequently the length of the corresponding gantry device 102, may be done by combining multiple sections fastened together to form the overhead crossbar 106. The structural columns 104 of the gantry devices 102 are supported on the ballast 214 at the outside areas 212 of the railway tracks 202.

Additionally, the apparatus 100 comprises a guiding beam 108 disposed above the railway tracks 202. Like the plurality of gantry devices 102, the guiding beam 108 is preferably made from a lightweight material, such as an aluminium alloy. The guiding beam 108 is coupled to at least some, if not all, of the plurality of gantry devices 102, specifically at the overhead crossbars 106. A straight section of the guiding beam 108 runs above and parallel to the railway tracks 202, until reaching a deflected section 110 of the guiding beam 108. In the preferred embodiment, the deflected section 110 is a substantially curved section of the guiding beam 108, the curved

section having a radius of approximately 2.8 metres. The curvature of the deflected section 110 need not be a perfect arc, but may comprise of a plurality of straight sections. Alternatively, the deflected section 110 may be a single section bent at an angle to the guiding beam 108. The deflected section 110 of the guiding beam 108 leads the guiding beam 108 away from the railway tracks 202.

If the railway tracks 202 are above ground, the deflected section 110 may lead the guiding beam 108 to a lifting platform outside of the railway tracks 202. The lifting platform is configured for transporting equipment and supplies, such as and including new railway sleepers 204, from the ground level to the railway tracks 202. If the railway tracks 202 are already on ground level, the deflected section 110 may lead the guiding beam 108 to a predetermined location or site area outside of the railway tracks 202, wherein the site area is meant for temporary storage of equipment and supplies.

As with the straight section of the guiding beam 108, the deflected section 110 is supported by one of the gantry devices 102. Due to the change in direction of the deflected section 110, the gantry device 102 supporting the deflected section 110 is arranged in a different direction as compared to the other gantry devices 102 supporting the straight section of the guiding beam 108.

Each structural column 104 of the plurality of gantry devices 102 comprises a vertical beam 112 and two corner beams 114. The bottom surfaces of the vertical beam 112 and the corner beams 114 are supported on a wooden block 116 on the ground. The vertical beam 112 extends upwards for coupling with the overhead crossbar 106 while the corner beams 114 provide reinforcement supports to the vertical beam 112 on the ground. To further distribute the load of the structural column 104 on the wooden block 116, and subsequently on the ground, there are enlarged plates 118 disposed between the wooden block 116 and the bottom surfaces of the vertical beam 112 and the corner beams 114. The enlarged plates 118 are welded to the bottom surfaces of the vertical beam 112 and the corner beams 114. The enlarged plates 118 are fastened to the wooden block 116 using screws or bolts and nuts. Other fastening means known to the skilled person may also be used. Different sizes

of wooden blocks 116 may be used for the plurality of gantry devices 102 distributed along the railway tracks 202, such as for catering to heights and gradients of the railway tracks 202. The ability to vary the heights of the gantry devices 102, specifically the vertical beams 112 using the wooden blocks 116, is also
5 advantageous when the railway tracks 202 is around a corner or bend, such that one track is vertically higher than the other. Consequently, by varying the heights of the vertical beams 112, the overhead crossbars 106 can be maintained horizontal. For providing increased stability to the plurality of gantry devices 102, the wooden blocks 116 are wedged within the ballast 214, such that the bottom surfaces of the wooden
10 blocks 116 are below the bottom surfaces of the railway sleepers 204 and coplanar with the sub ballast level. The increased stability allows the railway sleepers 204 to be transported more efficiently, mitigating the risks of the gantry devices 102 losing stability and toppling over.

15 In each gantry device 102 as shown in FIG. 6 and FIG. 7, there are two vertical beams 112 for supporting the overhead crossbar 106. One end of the overhead crossbar 106 is welded to the top surface of one vertical beam 112, and the other end of the overhead crossbar 106 is welded to the top surface of the other vertical beam 112. Corner beams 120 are provided between the overhead crossbar 106 and
20 the vertical beams 112 for reinforcing support of the overhead crossbar 106. In the preferred embodiment, the vertical beams 112 and the overhead crossbars 106 of the plurality of gantry devices 102 are made from hollow section beams. In order to support the guiding beam 108, each gantry device 102 comprises an I-beam 122 welded thereto. Specifically, the I-beam 122 is welded underneath the centre portion
25 of the overhead crossbar 106. Each I-beam 122 is approximately 150 millimetres in length with a hole 123 on both sides of the I-beam 122 extending away from the overhead crossbar 106. Each hole 123 is approximately 10 millimetres in diameter and is intended for receiving a dowel pin (not shown).

30 Referring to FIG. 5 to FIG. 7, the guiding beam 108 is coupled to the I-beams 122 of the overhead crossbars 106, around the centre portions of the overhead crossbars 106. Thus, the guiding beam 108 is supported by the overhead crossbars 106 and consequently by the wooden blocks 116. The guiding beam 108 comprises a

plurality of C-channels 124 on both sides thereof, the C-channels 124 extending through the plurality of gantry devices 102. As the spacing or distance between two gantry devices 102 is approximately 2.8 metres, the length of each C-channel 124 is correspondingly approximately 2.8 metres. Similar to the I-beam 122, each C-channel 124 has a hole 125 on both ends thereof, each hole 125 being approximately 10 millimetres in diameter and intended for receiving the dowel pin. A pair of C-channels 124 connects a pair of gantry devices 102 together, specifically on both sides of the I-beams 122. The C-channels 124 are coupled to the I-beams 122 by aligning the holes 123 & 135 and fastening with dowel pins.

The C-channels 124 provide a track or pathway along the guiding beam 108 for moving the railway sleepers 204. As the guiding beam 108 comprises a straight section and a deflected section 110, the plurality of C-channels 124 consequently conforms to the length profile of the guiding beam 108. As the plurality of C-channels 124 are coupled to the plurality of gantry devices 102, specifically to the plurality of I-beams 122, using the holes 123 & 125 and dowel pins, there is no permanent fastening between the guiding beam 108 and the plurality of devices 102. Thus, the C-channels 124 of the guiding beam 108 can be modularly removed from the plurality of gantry devices 102. This advantageously provides a modular configuration for the apparatus 100, and allows the apparatus 100 to be disassembled and reassembled on site.

Referring to FIG. 8 and FIG. 9, the apparatus 100 comprises a lifting mechanism 126 for moving the railway sleepers 204. The lifting mechanism 126 comprises wheels or rollers 128 which allow the lifting mechanism 126 to move along the guiding beam 108, specifically along the plurality of C-channels 124. The lifting mechanism 126 further comprises a hoist or chain block 130 which allows the railway sleepers 204 to be manually lifted and lowered. The railway sleepers 204 can be manually lifted and lowered by actuating a chain that is exposed outside the chain block 130. The railway sleepers 204 may be tied to a hook end 132 of the chain block 130 using chains 134, or through an intermediate device. For example, the lifting mechanism 126 comprises such an intermediate device – a clamp 136 – disposed between the chain block 128 and the railway sleepers 204. The clamp 136 is connected to the

hook end 132 of the chain block 130, wherein the clamp 136 can be lifted and lowered by using a ratchet 138 connected to the chain block 130. The clamp 136 may be used to clamp or grip on a particular railway sleeper 204 for movement thereof. Once the railway sleeper 204 is clamped or gripped by the clamp 136, the railway sleeper 204 can be lifted or lowered using the ratchet 138 of the chain block 130. Consequently, the lifted railway sleeper 204 can be displaced by moving the lifting mechanism 126, specifically the rollers 128, along the guiding beam 108.

The apparatus 100 can be used with the railway system 200 along any section of the railway tracks 202. After replacing a set of railway sleepers 204 from a section of the railway tracks 202, the apparatus 100 can be conveniently moved, due to its lightweight aluminium alloy material, to another section of the railway tracks 202 for subsequent replacement works. Due to the modular configuration of the apparatus 100, the apparatus 100 can be easily disassembled and reassembled during the movement between sections of the railway tracks 202. This allows workers to quickly set up the apparatus 100 for replacing the railway sleepers 204 and to quickly pack up the apparatus 100 after the replacement works are completed, and further allowing the replacement works to be done more efficiently and completed within a shorter period of time. Additionally, the apparatus 100 is manually and mechanically operated, without requiring any electrical power, thereby reducing the dependencies on major electrical equipment or heavy machinery which is commonly used in existing systems. The apparatus 100 reduces manual labour because the railway sleepers 204 can be easily carried and transported using the guiding beam 108, thereby increasing productivity and efficiency of replacing the railway sleepers 204. Therefore, the use of the apparatus 100, as compared to existing systems, allows contractors to reduce their business overhead expenses and maintenance costs.

In the railway system 200 shown in FIG. 1 to 3, the replacement of the railway sleepers 204 along the railway tracks 202 normally occurs after service hours, when trains are no longer in operation. This would minimize any inconvenience to commuters as the replacement works would hinder train service. The replacement works normally take place during the night and may require a few nights to complete, depending on the number of railway sleepers 204 to change. Materials, tools, and

equipment are delivered to the site area around the railway system 200 at viaduct sections of the railway system 200. The mode of delivery may be by ladder lifts, scissor lifts, mobile cranes, trolleys, and/or manual labour. Other modes of delivery known to the skilled person may also be used. The choice of the mode of delivery will depend on the conditions of the site area, such as whether the railway system 200 is underground. The materials, tools, and equipment are removed from the site area using the same mode of delivery after the replacement of the railway sleepers 204 has been completed.

As the replacement works take place during the night, site lighting must be put in place to illuminate the site area, as well as to maintain the necessary standard of safety. A predetermined location within the site area of the railway system 200 is set aside for temporarily storing the new railway sleepers 204. The removed old railway sleepers 204 may also be temporarily stored at the predetermined location before being removed from the site area. The predetermined location is preferably under the deflected section 110 of the guiding beam 108, away from the railway tracks 202, allowing for more space to change the railway sleepers 204. Alternatively, the predetermined location may be on top of the railway sleepers 204 at another section of the railway tracks 202, wherein the section is not currently undergoing replacement works. Yet alternatively, the predetermined location may be just adjacent to the railway tracks 202. The railway sleepers 204 may be stored lengthwise along the direction of the railway tracks 202 to minimize clutter.

The existing ballast 214 around the site area would hinder the replacement of the railway sleepers 204. As such, the existing ballast 214 is dug up and removed from the site area, thereby creating a void or space for replacing the railway sleepers 204. The removal of the existing ballast 214 can be performed using manual labour with shovels and other similar tools and equipment. If necessary, other mechanical means like excavators may be used. The removed ballast 214 are packed in ballast bags and placed aside such that they do not hinder the subsequent replacement works of the railway sleepers 204. Each ballast bag is packed to approximately 20 kilograms in weight.

The method for replacing the railway sleepers 204 occurs one at a time. The affected railway sleepers 204, i.e. those that have been designated for replacement, are clearly marked on the railway tracks 202. This would indicate to the workers that the railway sleepers 204 proximate to the markings on the railway tracks 202 are designated for replacement. Firstly, one railway sleeper 204 among the affected railway sleepers 204 is unfastened from the railway tracks 202 for replacement thereof. For purposes of brevity and clarity and with reference to FIG. 4 to FIG. 6, this railway sleeper 204 being replaced is referred to as the first railway sleeper 204a. If the first railway sleeper 204a is fastened to the conductor rail 216, the associated angle bracket 218 is unfastened and removed from the first railway sleeper 204a. The other fasteners 208 that connect the first railway sleeper 204a to the railway tracks 202 via the baseplates 206 are subsequently detached. Thus, the first railway sleeper 204a, as well as the other affected railway sleepers consequently, is unfastened from the railway tracks 202 and the conductor rail 216.

15

Due to the loads on the railway sleepers 204 over extended periods of time from running trains, the railway tracks 202 may be tightly compacted against the railway sleepers 204. Rail jacks or lifting jacks are used to apply upward forces on the railway tracks 202, thereby relieving the downward forces on the railway sleepers 204 caused by the loads. Care has to be taken to ensure that the railway tracks 202 are lifted vertically upwards by the rail jacks, so as not to change the track gauge. If necessary, additional rail jacks may be used to control the lateral or side movement of the railway tracks 202. For example, if the sleeper location of the first railway sleeper 204a is around a corner or bend of the railway tracks 202, one of the railway tracks 202 will be higher than the other, i.e. there is a high rail and a low rail. Rail jacks may be positioned between the high rail and the viaduct or tunnel wall, and between the low rail and the viaduct or tunnel wall, to avoid lateral movement of the railway tracks 202.

30 Once the risks of lateral movement of the railway tracks 202 has been mitigated or eliminated, the railway tracks 202 are jacked upwards using the rail jacks that were initially intended for relieving the stresses on the railway sleepers 204. Referring to FIG. 10, by lifting the railway tracks 202 until they are separated from the first railway

sleeper 204a, there is a gap or space 220 in between. The space 220 created by the rail jacks allow the first railway sleeper 204a to be manoeuvred and subsequently removed from the railway tracks 202. Similarly, the space 220 allows for a new railway sleeper 204 to be installed in the void created by the removed first railway sleeper 204a.

The plurality of gantry devices 102 are subsequently placed at evenly spaced locations along the railway tracks 202. The spacing or distance between two gantry devices 102 is approximately 2.8 metres. The plurality of C-channels 124, each having a length of approximately 2.8 metres, are subsequently coupled to between the plurality of gantry devices 102 piece by piece. The C-channels 124 thereby forms the guiding beam 108, with a pair of C-channels 124 running on both sides thereof. The guiding beam 108 should extend at least between the first and last affected railway sleepers 204. To give some safety tolerance, the straight section of the guiding beam 108 extends approximately 1.5 metres beyond both the first and last affected railway sleeper 204. The deflected section 110 of the guiding beam 108 begins after the extension beyond the last affected railway sleeper 204.

Referring to FIG. 7 to FIG. 9, the lifting mechanism 126 is subsequently positioned onto the guiding beam 108, such that the rollers 128 can glide or move freely along the plurality of C-channels 124. The first railway sleeper 204a is manually manoeuvred and displaced around the voids created by the removed ballast 214 until it can be freely carried by the lifting mechanism 126. For example, workers may manually remove the first railway sleeper 204a from under the railway tracks 202 and place it on top of the railway tracks 202. The first railway sleeper 204a can be clamped across its short side using the clamp 136. The clamp 136 is secured to the hook end 132 of the chain block 130. Alternatively or additionally, the first railway sleeper 204a can be tied to the hook end 132 of the chain block 130 of the lifting mechanism 126 using the chains 134. Once the first railway sleeper 204a is secured to the chain block 130, workers will actuate the ratchet 138 to raise or lift the first railway sleeper 204a until it is approximately midway between the railway tracks 202 and the guiding beam 108. The first railway sleeper 204a is subsequently manually displaced and moved with the lifting mechanism 126 along the guiding beam 108,

until it reaches the deflected section 110 above the predetermined location of the site area. While moving the first railway sleeper 124a, the first railway sleeper 124a may be rotated between the transverse and longitudinal orientations for more convenience of movement. The first railway sleeper 204a is lowered using the
5 ratchet 138 of the chain block 130 and then released from the lifting mechanism 126.

The first railway sleeper 204a is to be replaced with a new railway sleeper that has been temporarily stored at the predetermined location. For purposes of brevity and clarity, the new railway sleeper that replaces the first railway sleeper 204a is referred
10 to as the second railway sleeper 204b. The second railway sleeper 204b is coupled to the lifting mechanism 126 in a similar way as the first railway sleeper 204a. Once the second railway sleeper 204b is secured to the chain block 130 of the lifting mechanism 126, workers will actuate the ratchet 138 to raise or lift the second railway sleeper 204b until it is approximately midway between the railway tracks 202
15 and the guiding beam 108. The second railway sleeper 204b is subsequently manually displaced and moved with the lifting mechanism 126 along the guiding beam 108, until it reaches above the sleeper location of the first railway sleeper 204a. While moving the second railway sleeper 124b, the second railway sleeper 124b may be rotated between the transverse and longitudinal orientations for more
20 convenience of movement. The second railway sleeper 204b is lowered using the ratchet 138 of the chain block 130 and then released from the lifting mechanism 126.

The second railway sleeper 204b is manually moved underneath the railway tracks 202 until it is aligned with the sleeper location of the first railway sleeper 204a. The
25 second railway sleeper 204b is then fastened to the railway tracks 202 using the fasteners 208 through the baseplates 206 of the second railway sleeper 204b. If the removed first railway sleeper 204a was originally fastened to the conductor rail 216, the second railway sleeper 204b will be fastened to the conductor rail 216 using the associated angle bracket 218. Thus, the second railway sleeper 204b, as well as the
30 other new railway sleepers 204b which replace the old railway sleepers 204a consequently, is fastened to the railway tracks 202 and the conductor rail 216. Clip restraints may be used on the fasteners 208 to provide additional security as well as to prevent tampering.

After all the old railway sleepers 204a have been replaced with the new railway sleepers 204b, the rail jacks on the railway tracks 202 can be slowly released to lower the railway tracks 202 back to their original positions. If the railway tracks 202 are of different heights on both sides, i.e. there is a high rail and a low rail, the low rail is released to its original position first before releasing the high rail. If the railway tracks 202 have moved or deviated from their positions during the replacement works, such that the fasteners 208 cannot be aligned with the new railway sleepers 204b, the railway tracks 202 need to be re-aligned to the correct positions using the rail jacks. The fasteners 208, as well as the angle brackets 218, can only be secured after the railway tracks 202 are aligned with the new railway sleepers 204b. The placement of the rail jacks around the railway tracks 202 advantageously reduces the disturbance to the railway tracks 202 and mitigates the risks of misalignments during the replacement works.

The removed ballast 214 from the ballast bags are subsequently emptied into the voids and spaces underneath the new railway sleepers 204b after the replacement works. If necessary, new ballast 214 may be used if the existing ballast 214 is insufficient or if some of the existing ballast 214 is in poor conditions. The ballast 214 underneath the railway sleepers 204 is manually shoved and tamped down by the workers to compact the ballast 214, thereby reducing or eliminating any remaining voids or spaces. Any presence of voids or spaces could affect the transfer of loads from the railway tracks 202 to the ballast 214. As such, the shoving of the ballast 214 underneath the railway sleepers 204 serves as a means to mitigate such risks.

In an alternative embodiment, the apparatus 100 may be used for transporting objects or equipment other than the aforementioned railway sleepers 204. These may include cable trough, conductor rails, and/or check rails for turnout sections. These objects and equipment may require transporting to the railway system 200 for installation therewith. It will be apparent to the skilled person as to the types of objects, in terms of size and weight, which can be transported using the apparatus 100 set up on the railway system 200.

As described hereinabove, the method for replacing the railway sleepers 204 is accomplished using the apparatus 100, without having to use any heavy mechanized or electrical machinery. The reduction of complex machinery advantageously mitigates the risks of injuries to the workers, such as workers accidentally getting their fingers trapped between moving parts of the machinery. Further, the absence of heavy machinery consequently reduces the reliance on oils and lubricants, minimizing spillage of such substances onto the railway tracks 202. The spillage of these substances could dangerously lead to derailing of trains when they travel along the railway tracks 202. Yet further, the use of the apparatus 100 involves lesser moving parts as compared to heavy machinery in existing systems, thereby reducing the noise generated during the replacement works. This advantageously minimizes any inconvenience caused to the public, especially if the railway tracks 202 are located in close proximity to housing or office buildings.

In the foregoing detailed description, embodiments of the present disclosure in relation to an apparatus and a method for replacing railway sleepers are described with reference to the figures. Description of the preferred embodiment in the detailed description is not intended to callout specific or particular representations of the present disclosure, but merely to illustrate non-limiting examples of the present disclosure. The present disclosure serves to address at least some of the mentioned prior art problems and issues. Although only some embodiments of the present invention are disclosed herein, it will be apparent to a person having ordinary skill in the art in view of this disclosure that numerous changes and/or modifications can be made to the disclosed embodiments without departing from the scope of the present invention. The scope of the disclosure as well as the scope of the following claims is not limited to embodiments described herein.

Claims

1. An apparatus for replacing railway sleepers disposed along a railway track, the apparatus comprising:
 - 5 a plurality of gantry devices distributed along the railway track;
a guiding beam removably coupled to at least some of the plurality of gantry devices, the guiding beam being disposed above the railway track; and
a lifting mechanism moveably coupled to the guiding beam for carrying the railway sleepers,
 - 10 wherein the lifting mechanism is adapted for travel along the guiding beam to thereby displace the railway sleepers along the guiding beam.
2. The apparatus as in claim 1, wherein the guiding beam comprises a plurality of channels removably coupled to the plurality of gantry devices for suspending the
15 lifting mechanism therefrom.
3. The apparatus as in claim 1, wherein the guiding beam comprises a deflected section for leading the railway sleepers away from the railway track.
- 20 4. The apparatus as in claim 3, wherein the deflected section is supported by one of the plurality of gantry devices.
5. The apparatus as in claim 1, wherein the railway sleepers are displaced through the plurality of gantry devices by the lifting mechanism moving along the
25 guiding beam.
6. The apparatus as in claim 1, wherein crossbar heights of each of the plurality of gantry devices are adjustable.
- 30 7. The apparatus as in claims 1 or 6, each gantry device comprising:
 - an overhead crossbar; and
 - structural columns disposed alongside the railway track for supporting and disposing the overhead crossbar above the railway track.

8. The apparatus as in claim 7, each gantry device comprising two structural columns, wherein the gantry device is spaced and disposed such that the railway track is positioned between the two structural columns.

5

9. The apparatus as in claim 1, wherein the lifting mechanism comprises rollers for travelling along the guiding beam.

10. The apparatus as in claims 1 or 9, wherein the lifting mechanism comprises a chain block operable for adjusting a height of the railway sleepers coupled thereto in relation to the railway track.

10

11. The apparatus as in claims 1 or 9, wherein the lifting mechanism comprises a clamp for holding the railway sleepers.

15

12. A method for replacing railway sleepers disposed along a railway track, the method comprising:

unfastening a first railway sleeper from a sleeper location on the railway track;

20

coupling and lifting the first railway sleeper with a lifting mechanism, the lifting mechanism being moveable coupled to a guiding beam above and along the railway track;

displacing the first railway sleeper by moving the lifting mechanism along the guiding beam to a predetermined location;

25

releasing the first railway sleeper from the lifting mechanism at the predetermined location;

coupling and lifting a second railway sleeper with the lifting mechanism;

displacing the second railway sleeper by moving the lifting mechanism along the guiding beam to the sleeper location on the railway track;

30

releasing the second railway sleeper from the lifting mechanism at the sleeper location; and

fastening the second railway sleeper at the sleeper location on the railway track,

wherein the second railway sleeper replaces the first railway sleeper.

13. The method as in claim 12, wherein the guiding beam is removably coupled to at least some of a plurality of gantry devices distributed along the railway track.

5

14. The method as in claim 13, wherein the guiding beam comprises a plurality of channels removably coupled to the plurality of gantry devices for suspending the lifting mechanism therefrom.

10 15. The method as in claim 12, further comprising displacing one of the first and second railway sleepers along a deflected section of the guiding beam, the deflected section being directed away from the railway track.

15 16. The method as in claims 13 or 14, wherein each of the first and second railway sleepers are displaced through the plurality of gantry devices by the lifting mechanism moving along the guiding beam.