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(54) **A method and an apparatus for tuning concrete railway sleepers**

(57) A method of tuning a concrete sleeper, comprising deforming the reinforced concrete sleeper beyond its elasticity limits by bending at least a portion of the reinforced concrete sleeper about a transverse axis thereof, thereby generating cracks in the reinforced concrete sleeper, before mounting it at a rail.

An apparatus for tuning reinforced concrete sleepers, comprising means for deforming a concrete sleeper beyond its elasticity limits by forcing at least a portion of the concrete sleeper to bend about a transverse axis thereof, thereby causing cracks in the concrete sleeper.

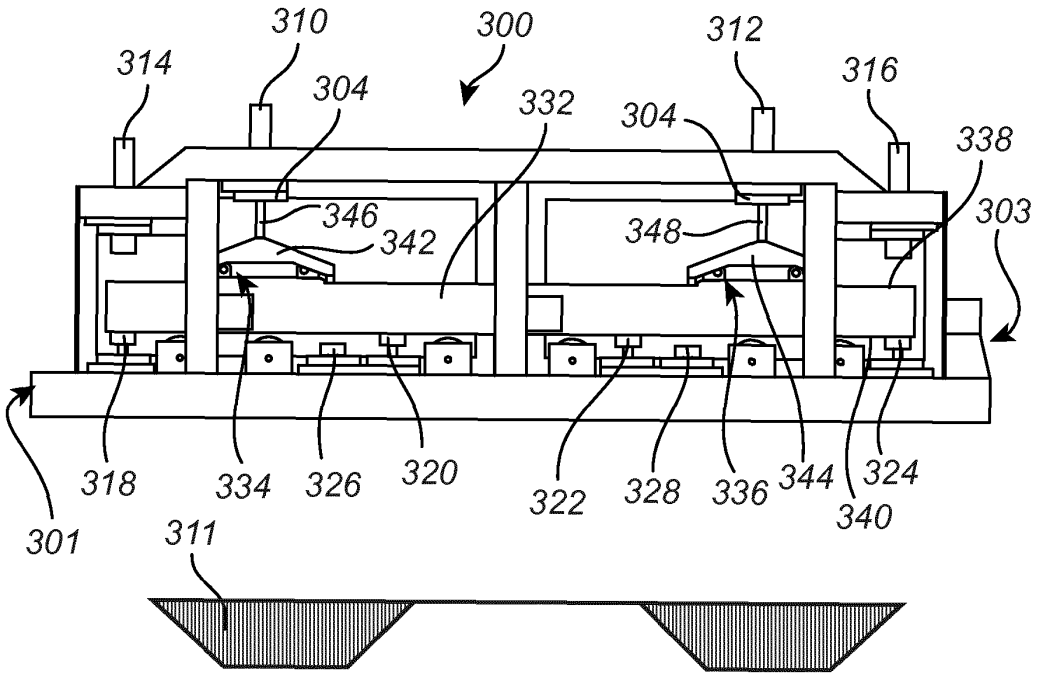

Fig. 4

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method and an apparatus for tuning a sleeper having a concrete body, and being reinforced, i.e. having reinforcement elements embedded in the concrete.

BACKGROUND OF THE INVENTION

[0002] When building railway tracks today non-wooden materials are typically used for the sleepers. Most commonly, the sleepers are made of pre-stressed reinforced concrete. However, there are still many kilometres of railway tracks with timber sleepers. The timber sleepers degrade over time, and when a need for maintenance occurs it would be desired to replace all sleepers with new non-timber sleepers. However, mostly this is considered to be too expensive, and therefore typically only a part of the sleepers are replaced with new sleepers, i.e. spot replacement is common due to economic reasons. It is preferable to replace the degraded timber sleepers with concrete sleepers due to, inter alia, long time environmental aspects. However, mixing concrete sleepers and timber sleepers causes problems such as unstable tracks due to different material properties. Therefore is would be desirable to be able to modify the concrete sleeper in some way to make its properties more equal to those of the timber sleeper.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a method and an apparatus for tuning a concrete sleeper that alleviates the above-mentioned problems of the prior art and provide the concrete sleeper with similar properties as a timber sleeper.

[0004] The object is achieved by a method of tuning a sleeper according to the present invention as defined in claim 1, and an apparatus for tuning a concrete sleeper as defined in claim 8.

[0005] The invention is based on the insight that an important property that differs a lot between a timber sleeper and a concrete sleeper is the bending stiffness, and that by deliberately cracking the concrete at predetermined portions of the sleeper it is possible to adapt the bending stiffness to resemble that of a timber sleeper in those portions.

[0006] Thus, in accordance with an aspect of the present invention, there is provided a method of tuning a reinforced concrete sleeper comprising deforming the reinforced concrete sleeper beyond its elasticity limits by bending at least a portion of the reinforced concrete sleeper about a transverse/lateral axis thereof, thereby generating cracks in the reinforced concrete sleeper, before mounting it at a rail. Thus, by means of pre-cracking the concrete sleeper in this way it becomes tuned to a bending stiffness at the respective cracks, to a level similar to the bending stiffness of a timber sleeper.

[0007] According to an embodiment of the method, the operation of deforming the sleeper comprises bending the sleeper such that at least a portion of its upper surface becomes curved and cracks at multiple locations.

[0008] According to an embodiment of the method, the operation of deforming the sleeper comprises bending the sleeper such that at least a portion of its lower surface becomes curved and cracks at multiple locations. Consequently, the cracks can be formed in one or both of the upper and lower surfaces.

[0009] According to an embodiment of the method, it comprises placing the sleeper on at least two supports, respectively arranged at a distance from each respective end of the sleeper, and applying a load to the upper surface acting on the sleeper at at least two loading positions, which are located closer to the respective ends than the supports. This is one way of providing the concrete sleeper with cracks at the upper surface thereof. The positioning of the supports relative to the load positions makes the sleeper bend upwards between the load positions.

[0010] According to an embodiment of the method, it comprises placing the sleeper on at least two supports and applying a load to the upper surface between the supports. This operation causes the sleeper to bend downwards between the supports, thereby generating cracks at the bottom surface.

[0011] According to an embodiment of the method, the load is applied at two distanced positions between each two supports. Thereby a more extended portion of the sleeper can be subjected to the same load than if using a single application position.

[0012] According to an embodiment of the method, it comprises placing the concrete sleeper on a conveyer and conveying the concrete sleeper transversely through a deformation zone where the sleeper is gradually deformed beyond its elasticity limits and cracks at multiple positions. This is an alternative way to generate the cracks.

[0013] In accordance with another aspect of the present invention, there is provided an apparatus for tuning reinforced concrete sleepers, comprising means for deforming a concrete sleeper beyond its elasticity limits by bending at least a portion of the sleeper about a transverse axis of the concrete sleeper, thereby generating cracks in the concrete sleeper. The apparatus is useful for performing the above method, and provides similar advantages.

[0014] According to an embodiment of the apparatus, said means for deforming a sleeper comprises a plurality of supports arranged to receive and support a sleeper, and at least one reciprocating load device arranged to apply a load to the sleeper at a predetermined position. This is a relatively simple structure for tuning the concrete sleeper, yet flexible to be arranged to work on any desired portion of the concrete sleeper.

[0015] According to an embodiment of the apparatus, said supports are arranged to engage with the concrete sleeper at one side thereof, and said at least one load device is/are arranged to engage with the concrete sleeper at an opposite side thereof.

[0016] According to an embodiment of the apparatus, it comprises at least three supports arranged at a distance from each other along the length of the concrete sleeper, when placed in the apparatus, and at least four load devices, a first and a second load device thereof being arranged to act on the sleeper at end portions thereof, wherein at least one of the supports is positioned between the first and second load devices, and a third and a fourth load device thereof are arranged to act on the sleeper at two different portions of the concrete sleeper, each portion being located between two of the supports.

[0017] According to an embodiment of the apparatus, each one of said third and fourth load devices has two engagement elements, which are distanced longitudinally of the concrete sleeper.

[0018] These and other aspects and advantages of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The invention will now be described in more detail and with reference to the appended drawings in which:

Fig. 1 schematically shows a railway track in a perspective view;
Fig. 2 schematically shows an embodiment of a sleeper according to the present invention;
Fig. 3 is a schematic perspective view of an embodiment of an apparatus for deforming concrete sleepers;
Figs. 4 and 5 are side views of the apparatus of Fig. 3, at different positions of operation; and
Fig. 6 and 7 schematically show other embodiments of the apparatus.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] The method and the apparatus according to this invention are suitable to employ as a final step of the manufacture of concrete sleepers. Thus, first the sleepers are casted by embedding reinforcement elements in concrete, and then, after having hardened for a time period, the sleepers are subjected to the tuning procedure. Preferably, the tuning procedure is performed after the same time period for all sleepers in order to obtain an even result. As is understood, in practise the tuning may not be made after exactly the same time period, but within a time interval that is short enough not to have any noticeable impact on the final result, which here is considered to be the same time period.

[0021] The resulting tuned concrete sleepers, which also can be referred to as pre-cracked concrete sleepers, are particularly useful as replacement for a timber sleeper of a railway track where a considerable part of the sleepers are timber sleepers. For example, referring to Fig. 1, a railway track 100 comprises two rails 102 and timber sleepers 105, which have been recessed in ballast (not shown). After having performed maintenance on the railway track 100, typically most of the sleepers are still timber sleepers 105, while some of them have been replaced with concrete sleepers 104.

[0022] In accordance with an embodiment of the concrete sleeper 104, as shown in Fig. 2, it comprises a concrete body 109, reinforcement elements 108 embedded in the concrete body 109, and rail fasteners 106 mounted at a top surface 116 of the concrete sleeper 104. Furthermore, the concrete body 109 is provided with multiple crack portions 110, which have been formed at predetermined portions of the sleeper 104 between its ends 112, 114. At least one of the crack portions 110 is provided at a bottom surface 118 of the sleeper 104, and preferably below the rail fastener 106, which is arranged on top surface opposite thereof.

[0023] Within the present field of technology, cracks in the concrete body 109 has been considered a problem, but it has shown that to the contrary the cracks, when being pre-formed in a controlled fashion in accordance with the present invention, is a good solution to the problem of adapting the properties of the concrete sleepers 104 to those of the timber sleepers 105.

[0024] Each crack portion 110 contains multiple cracks 120, which extend from the surface 116, 118 into the concrete body 109 to a depth corresponding to a fraction of the total height of the concrete sleeper 104. By providing the concrete sleeper 104 with such limited cracks 120 the concrete sleeper 104 is being tuned, and more particularly the bending stiffness of the concrete sleeper 104 is being tuned at the cracks. Thereby, a significant reduction of the bending stiffness is obtained at the cracks 120. An appropriate depth in order to reduce the bending stiffness enough has shown to be about half the height of the concrete sleeper 104. It is possible to make the cracks 120 deeper, even to make them reach all way through the concrete sleeper 104. Similarly, due to the circumstances it can be applicable to make the cracks 120 more shallow, extending to a depth corresponding to only a small fraction of the height. It has been foreseen that considerations regarding corrosion of the reinforcement elements 108 may arise from persons skilled in the art, since the reinforcement elements 108 may be uncovered. While in practise, within this field, it may not be a problem, corrosion protected reinforcement elements 108 are preferred. For instance the reinforcement elements 108 can be surface protected or made of stainless steel. The reinforcement elements are conventionally arranged, and will not be further described.

[0025] In this particular embodiment of the concrete sleeper 104, there are three crack portions 110, wherein

two crack portions 110 are respectively positioned at the bottom surface 118 below each respective rail fastener 106, and one crack portion 110 is positioned at the top surface 116 between the rail fasteners 106. Thereby the bending stiffness has been reduced at the rails and at the mid section of the concrete sleeper 104 in comparison with an un-cracked concrete sleeper. The reduction causes a softer behaviour which resembles the behaviour of the adjacent timber sleepers 105.

[0026] The controlled tuning of the concrete sleeper 104 is achieved by means of the method and apparatus according to the present invention. Exemplifying embodiments thereof will be described below.

[0027] Referring to Figs. 3 and 4, an embodiment of the apparatus 300 for tuning concrete sleepers comprises a frame 302, which is elongated and has an entrance end 301 where one concrete sleeper 332 at a time is entered into the apparatus, and an opposite exit end 303 where the concrete sleeper 332 exits the apparatus. The frame 302 has upper frame elements 304, lower frame elements 306, and side frame elements 308 extending between the upper and lower frame elements 304, 306. Furthermore, the apparatus 300 comprises four load devices, i.e. a first load device 310, a second load device 312, a third load device 314, and a fourth load device 316, which are mounted at some of the upper frame elements 304 consecutively along the length of the frame 302, and which are reciprocating piston-cylinder assemblies. Furthermore, the apparatus comprises six supports, i.e. a first support 318, a second support 320, a third support 322, a fourth support 324, a fifth support 326, and a sixth support 328, which are mounted along the length of the frame 302 at some of the lower frame elements 306. The supports are reciprocating piston-cylinder assemblies as well. The apparatus 300 comprises conveyer rolls 330 as well, which are mounted at some of the lower frame elements 306, and which are distributed along the length of the frame 302. The conveyor rolls 330 carry the concrete sleeper 332 during movement thereof into the apparatus 300 and out of the apparatus 300, and otherwise when the concrete sleeper 332 is not carried by the supports 318, 320,322,324,326,328.

[0028] The basic tuning operation is to deform the concrete sleeper 332 beyond its elasticity limits by bending at least a portion of the concrete sleeper 332 about a transverse axis thereof, thereby generating cracks in the concrete sleeper. In this embodiment of the apparatus 300, the load devices 310, 312, 314, 316 and the supports 318, 320, 322, 324, 326, 328 are arranged to deform the concrete sleeper 332 at three different portions. For that matter the first and second load devices 310, 312 are aligned with respective first and second rail fasteners 334, 336 arranged at a top surface 338 of the concrete sleeper 332. The first and second load devices 310, 312 are arranged to be applied across the respective first and second rail fasteners 334, 336, and they each comprise a bracket shaped element 342, 344 being pivotally attached to the piston 346, 348 of the load device 310, 312.

[0029] When the first and second load devices 310, 312 are to be operated to load the concrete sleeper 332, first the associated first, second, third and fourth supports 318, 320, 322, 324 are vertically extended, and more particularly raised until they slightly lift the concrete sleeper 332 up from the conveyer rolls 330. The first and fourth supports 318, 324 are placed at each respective end of the concrete sleeper 332, i.e. at the entrance end 301 and at the exit end 303 of the apparatus 300. The second and third supports 320, 322 are placed at about a third of the length of the concrete sleeper 332 from each end thereof. Then the first and second load devices are vertically extended downwards until the ends of the bracket shaped elements 342, 344 engage with the top surface 338 of the concrete sleeper 332 at either side of the respective rail fastener 334. Then the first and second load devices 310, 312 are further extended, thereby bending the concrete sleeper 332 downwards between the first and second supports 318, 320, and between the third and fourth supports 322, 324, respectively. The distribution of the bending moment thereby exerted on these two portions of the concrete sleeper 332 is most schematically and approximately illustrated by the diagram at 311 in Fig. 3. By applying a predetermined and accurately estimated load to these portions of the concrete sleeper 332 its elasticity limit is exceeded and it cracks from the bottom surface 340 inwards at several locations of each portion. Preferably, the generated cracks extend from the very bottom surface 340 of the concrete sleeper 332 to a depth corresponding to at least half of the total height of the concrete sleeper 332. However, depending on the dimensions of the concrete sleeper 332, the properties of the concrete and the reinforcing elements, etc., other depths can be preferred as well.

[0030] Having thus generated cracks extending bottom-up at two portions of the concrete sleeper 332, approximately below the respective rail fasteners 334, 336, next upper surface cracks will be generated at a portion between the rail fasteners 334, 336. The just used load devices 310, 312 and supports 318, 320, 322, 324 are retracted, i.e. respectively raised and lowered, in the mentioned order. The fifth and sixth supports 326, 328 are extended, i.e. raised, instead. Then, the third and fourth load devices 314, 316 at the ends of the concrete sleeper 332 are extended, i.e. lowered, into engagement with the top surface 338 of the concrete sleeper 332, and a bit further according to the predetermined load, as shown in Fig. 5. Thereby, the ends of the concrete sleeper 332 are bent downwards about the fifth and sixth supports 326, 328 exerting the concrete sleeper 332 to a bending moment that is largest between the supports 326, 328, as schematically illustrated by means of the diagram at 313, where cracks are generated extending from the top surface 338 and inwards of the concrete sleeper 332. Consequently, the bottom cracks are primarily generated below the rail fasteners 334, 336, and the top cracks are primarily generated between the rail fasteners 334, 336.

[0031] The apparatus 300 is operating on one concrete sleeper 332 at a time, but concrete sleepers 332 are preferably continuously fed through the apparatus 300, i.e. as soon as one concrete sleeper 332 has been tuned it is fed out of the apparatus at the exit end, and a new concrete sleeper 332 is fed into the apparatus 300. Feeding is obtained by at least the end most conveyor rolls 330 being driven, or by driven side feeders 350 arranged at both sides of the frame 302, and thus of the concrete sleeper 332. Some or all of the side feeders can be non-driven as well. The apparatus 300 is used for tuning the concrete sleepers after casting, and hardening during a predetermined time period as explained above. The apparatus can be extended to handle several sleepers at a time as understood by the person skilled in the art.

[0032] As an alternative more simple embodiment, shown in Fig. 6a and 6b, the apparatus 400 comprises several bottom supports 402, 403, on which the concrete sleeper 404 is placed, several top supports 406, 407 which are placed on top of the concrete sleeper 402, and a load device 408, 409 embodied as an elongated heavy block, which is placed on top of the top supports 406, 407. The bottom and top supports 402, 403, 406, 407 are positioned such that the concrete sleeper 404 becomes bent at the desired portions when subjected to the load device 408. The weight of the load device 408, 409 is high enough to generate cracks in the concrete sleeper 404 at the desired portions.

[0033] Just like in the above embodiment, the tuning is performed in two steps, as respectively shown if Figs. 6a and 6b. In a first step, there are four bottom supports 402, which are placed in pairs on either side of each rail fastener 412, i.e. they are placed on the ground and the sleeper 404 is placed on top of them such that said positions are obtained. Furthermore, there are two bracket shaped top supports 406, which resemble the bracket shaped elements 342, 344 of the above-described embodiment, and which are placed at each rail fastener 412. The weight 408 is then placed on top of the top supports 406. Thereby cracks 414 are generated at the underside of the sleeper 404, approximately below the rail fasteners 412.

[0034] In a second step there are two bottom supports 403, arranged close to the ends of the sleeper 404, and closer to the ends than the rail fasteners 412. The sleeper 404 is placed upside down on the bottom supports 403. There are two top supports 407 arranged close to each respective rail fastener 412 and between them, i.e. closer to the centre of the sleeper 404 seen along its length than the rail fasteners 412, and at the opposite side of the sleeper 404. The weight 409 is placed on top of the top supports 407. Thereby cracks 416 are generated at the upper side of the sleeper 404 between the rail fasteners 412.

[0035] According to another embodiment of the apparatus 500, as shown in Fig. 7, it comprises upper and lower conveyors 502, 504, which are arranged at a distance from each other, and arranged to clamp the concrete sleeper 506 between them and to force the concrete sleeper 506 to bend during the movement thereof through the space between the upper and lower conveyors 502, 504. In order to obtain the bending, the cross sectional area of the space between the upper and lower conveyors 502, 504 changes from an entrance end 508 of the apparatus 500 to an exit end 510 of the apparatus 500 from a rectangular shape to a curved shape, such as a wave shape, where the shortest distance between the upper and lower conveyors 502, 504 corresponds with the height of the concrete sleeper 506, at least at the most curved shape. In this particular embodiment there are four lower conveyors 504 positioned along the length of the sleeper 506 like the four bottom supports 402 in the above-described embodiment when performing the first step as shown in Fig. 6a. Furthermore, there are two upper conveyors 502, positioned at each respective rail fastener 512, like the above-mentioned top supports 406.

[0036] When passing through the apparatus 500, the sleeper 506 is forced to bend at three portions causing cracks below the rail fasteners 512, and between the rail fasteners 512 like described in the above embodiments as well. A difference is that the cracks are generated in one step instead of two steps.

[0037] Above, embodiments of the sleeper and the method according to the present invention, as defined in the appended claims, have been described. These should be seen as merely non-limiting examples. As understood by the person skilled in the art, many modifications and alternative embodiments are possible within the scope of the invention as defined by the appended claims.

[0038] It is to be noted that for the purposes of this application, and in particular with regard to the appended claims, the word "comprising" does not exclude other elements or steps, and the word "a" or "an" does not exclude a plurality, which per se will be evident to a person skilled in the art.

Claims

1. A method of tuning a concrete sleeper comprising:

   - deforming the reinforced concrete sleeper beyond its elasticity limits by bending at least a portion of the reinforced concrete sleeper about a transverse axis thereof, thereby generating cracks in the reinforced concrete sleeper, before mounting it at a rail.

2. The method according to claim 1, said deforming the sleeper comprising bending the sleeper such that at least a portion of its upper surface becomes curved and cracks at multiple locations.

3. The method according to claim 1 or 2, said deforming

comprising bending the sleeper such that at least a portion of its lower surface becomes curved and cracks at multiple locations.

4. The method according to claim 2, comprising placing the sleeper on at least two supports, respectively arranged at a distance from each respective end of the sleeper, and applying a load to the upper surface acting on the sleeper at at least two loading positions, which are located closer to the respective ends than the supports.

5. The method according to claim 3, comprising placing the sleeper on at least two supports and applying a load to the upper surface between the supports.

6. The method according to claim 5, wherein the load is applied at two distanced positions between each two supports.

7. The method according to anyone of claims 1 to 3, said deforming the sleeper comprising placing the sleeper on a conveyer and conveying the sleeper transversely through a deformation zone where the sleeper is deformed beyond its elasticity limits and cracks at multiple positions.

8. An apparatus for tuning reinforced concrete sleepers, comprising

- means for deforming a concrete sleeper beyond its elasticity limits by forcing at least a portion of the concrete sleeper to bend about a transverse axis thereof, thereby causing cracks in the concrete sleeper.

9. The apparatus according to claim 8, said means for deforming a concrete sleeper comprising:

- a plurality of supports arranged to receive and support the concrete sleeper;
- at least one reciprocating load device arranged to apply a load to the concrete sleeper at a predetermined position.

10. The apparatus according to claim 9, said supports being arranged to engage with the sleeper at one side thereof, and said at least one load device being arranged to engage with the sleeper at an opposite side thereof.

11. The apparatus according to claim 10, comprising at least three supports arranged at a distance from each other along the length of the concrete sleeper, when placed in the apparatus, and at least four load devices, a first and a second load device thereof being arranged to act on the concrete sleeper at two different portions of the concrete sleeper, each portion being located between two of the supports, and a third and a fourth load device thereof being arranged to act on the concrete sleeper at end portions thereof, wherein at least one of the supports is positioned between the first and second load devices.

12. The apparatus according to claim 11, wherein each one of said third and fourth load devices has two engagement elements, which are distanced longitudinally of the concrete sleeper.

13. The apparatus according to claim 12, wherein the first and second load devices are arranged to be applied across a respective rail fastener.

14. The apparatus according to any one of claims 9 to 13, wherein at least one of the supports is reciprocating between an active state of engagement with the concrete sleeper and an idle state of non-engagement with the concrete sleeper.

15. The apparatus according to claim 8, wherein said means for deforming a sleeper comprises upper and lower conveyors 502, 504, which are arranged at a distance from each other, and arranged to clamp the concrete sleeper 506 between them and to force the concrete sleeper 506 to bend during the movement thereof through the space between the upper and lower conveyors 502, 504.

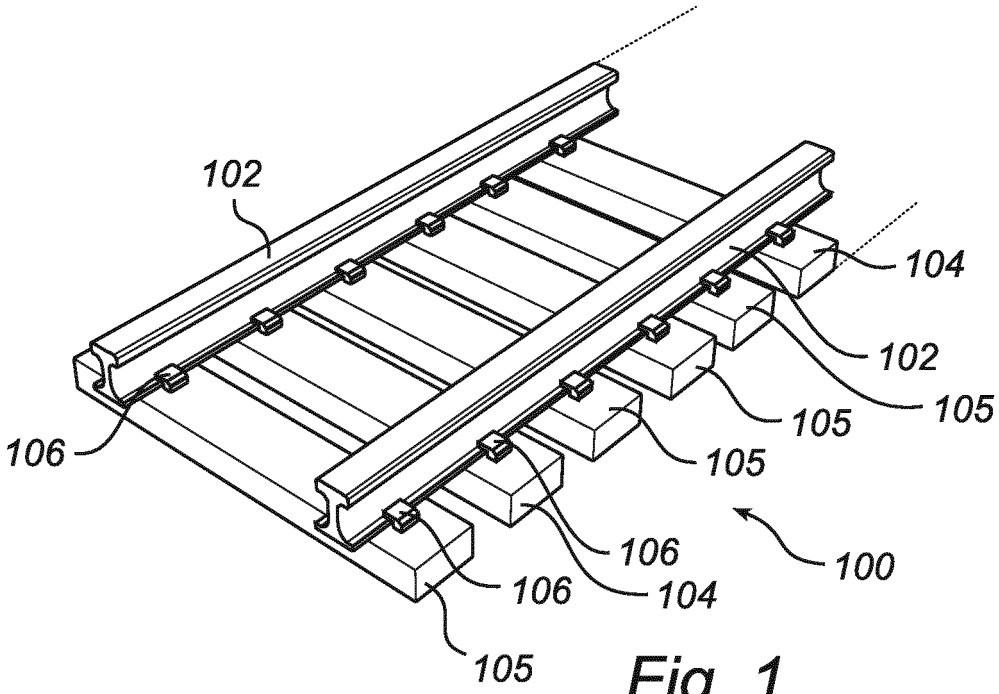
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Fig. 1

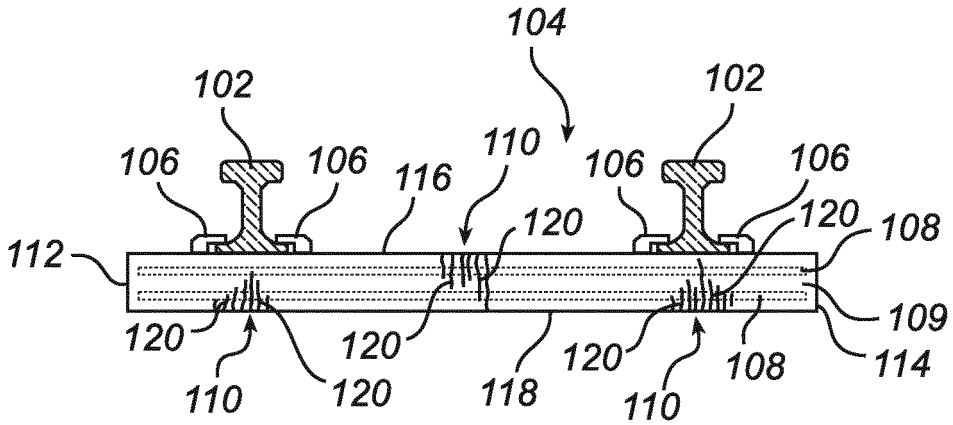
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Fig. 2

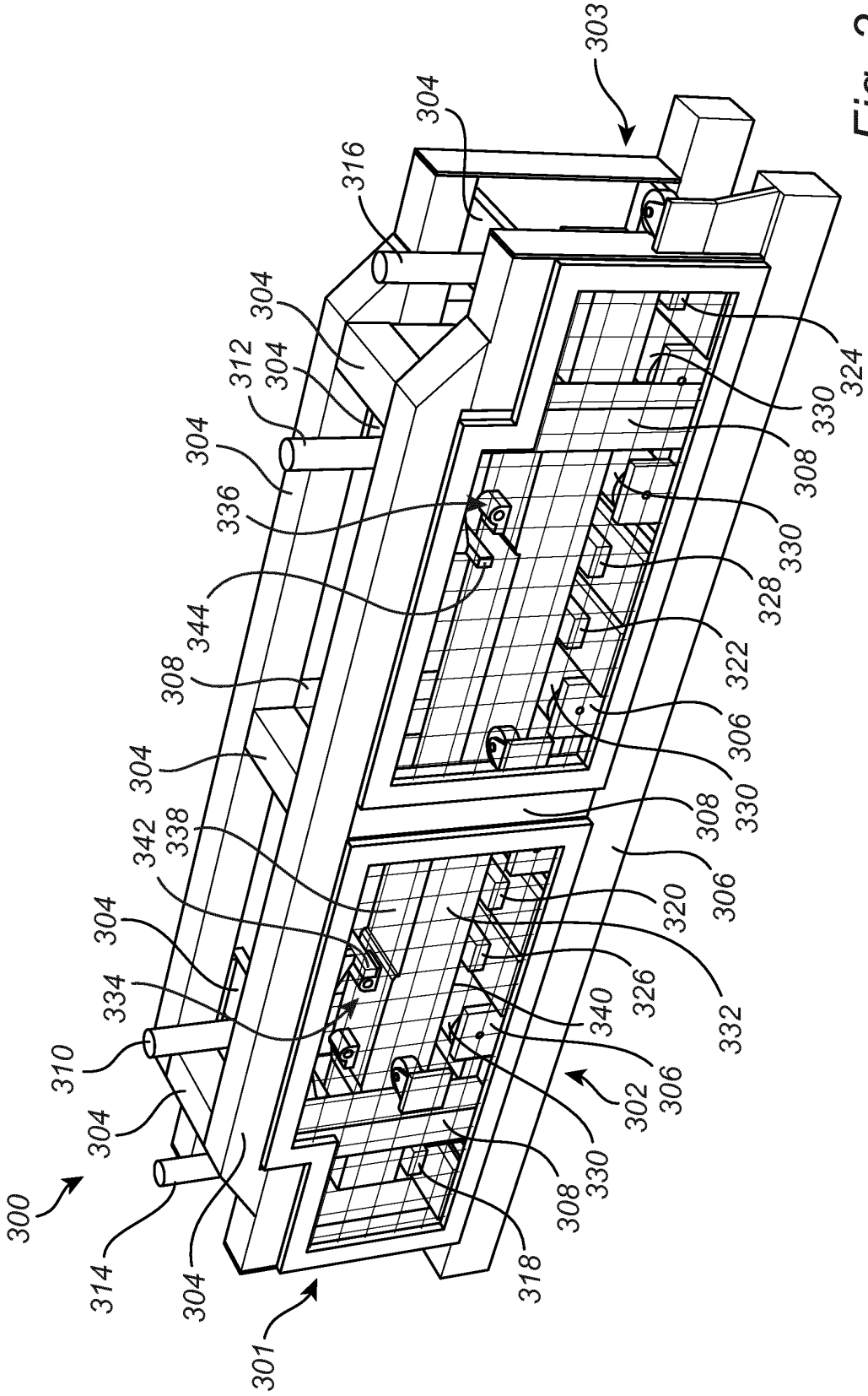
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Fig. 3

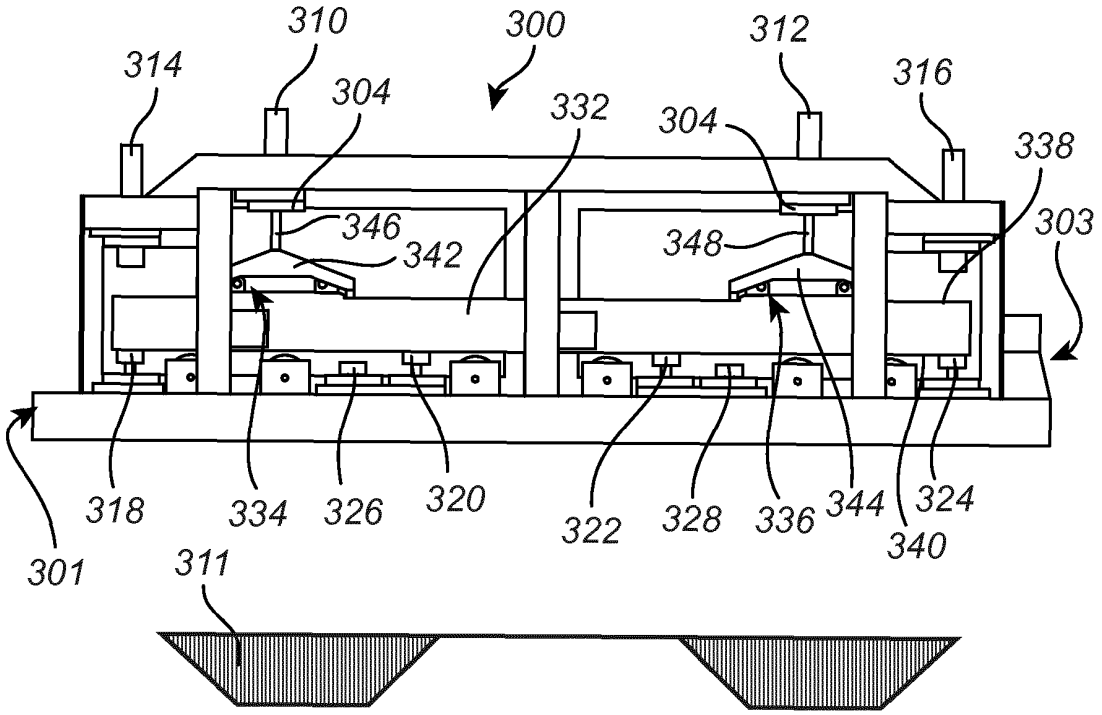
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Fig. 4

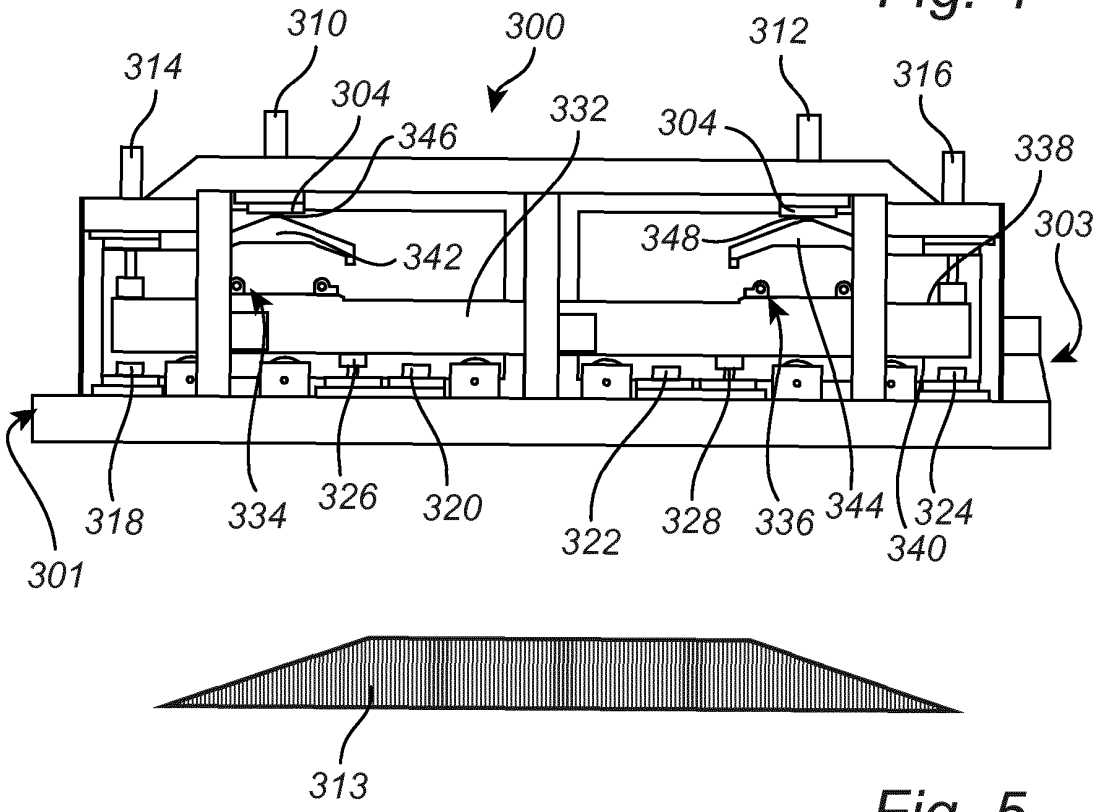
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Fig. 5

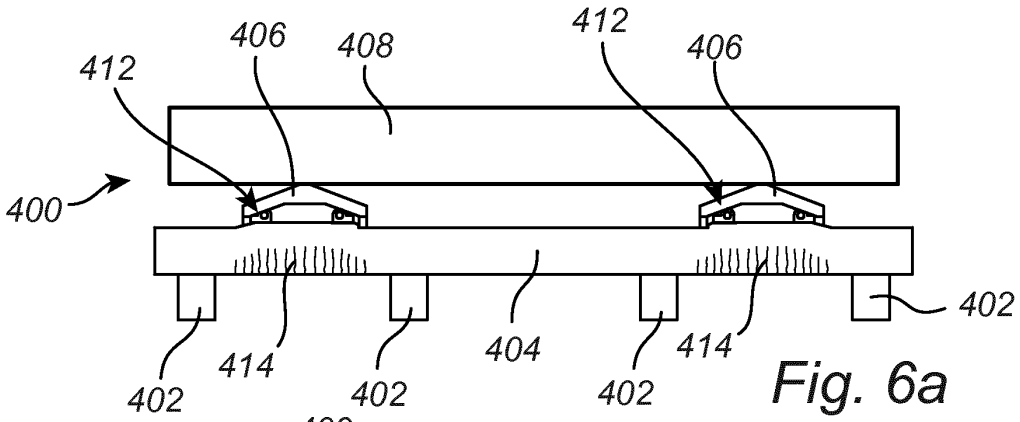

Fig. 6a

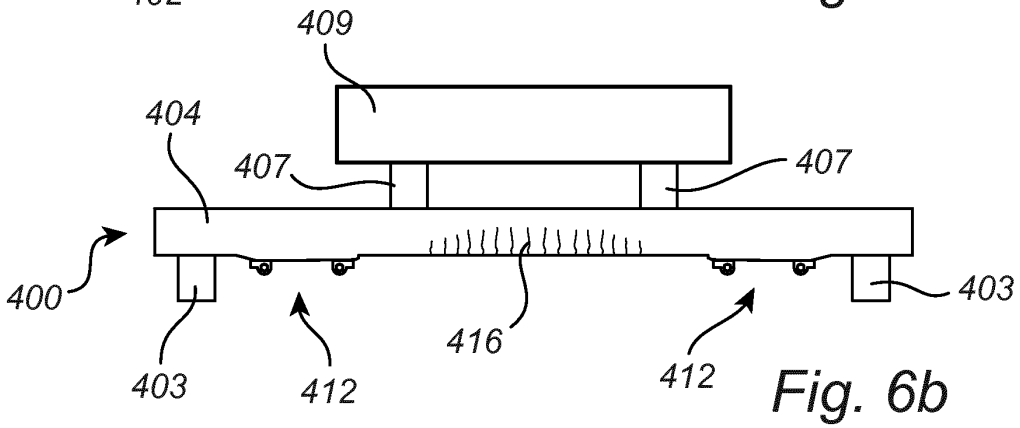

Fig. 6b

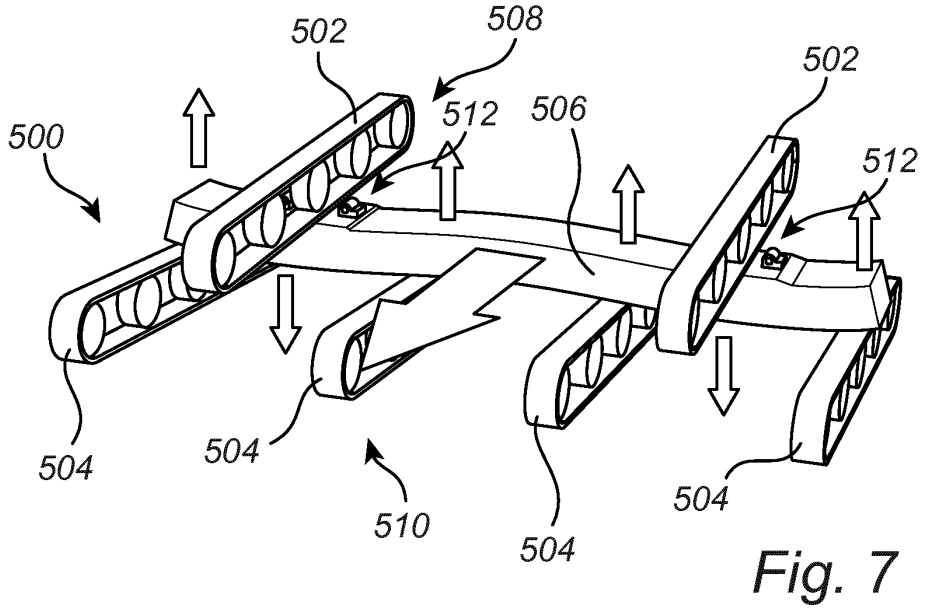

Fig. 7