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(54) **VIBRATION EXCITATION TAMPING APPARATUS**

(57) The present invention relates to a vibration excitation tamping device, which pertains to the technical field of rail transportation. The device comprises: a liftable tamping machine frame; a hydraulic vibration excitation cylinder hinged in the middle of the tamping machine frame; at least one connecting plate hinged with the piston rod end of the hydraulic vibration excitation cylinder; double-end telescopic clamping cylinders respectively connected to both sides of the connecting plate; and paired pick arms hinged on both sides of the tamping machine frame, with the upper ends thereof hinged with the corresponding double-end telescopic clamping cylinders. The present invention achieves balanced forces and symmetrical movements on the upper ends of the paired tamping picks as they are subjected to equal and opposite forces, thus ensuring centered clamping and having a very compact structure. In addition, due to the configuration of centralized vibration excitation drive and reasonable dispersed clamping drive, the number of vibration excitation devices is reduced by half, resulting in a significant cost reduction. Moreover, since two sets of

tamping picks are mounted on different pick arms along the length direction of the sleeper, when the compactness of the railway ballast varies at two corresponding positions, clamping with a uniform compaction can be achieved.

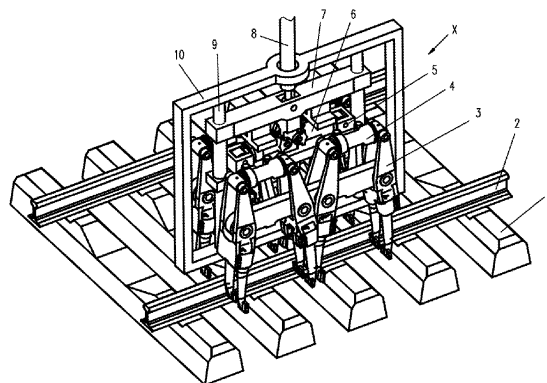


Fig. 2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a tamping device, in particular to a vibration excitation tamping device, which pertains to the technical field of rail transportation.

BACKGROUND OF THE INVENTION

[0002] Tamping device is a critical device used in the field of rail transportation for tamping operation during railway maintenance, that is, for gathering and tamping railway ballast underneath the rail. The typical structure of such a tamping device is disclosed in the Chinese patent document F (publication No. CN106414849A, application No. 20158002429.4), having support members which are guided height-adjustably with respect to a tamping device machine frame along guide members, on which paired tamping tools configured to oscillating levers are swingably mounted. The tamping tools of the paired tamping tools, which are intended to be introduced into a ballast bed, can be oppositely driven by a vibration drive and can be hydraulically fed, wherein each tamping tool of the paired tamping tools is provided with a feeding drive, and wherein a plurality of tamping tools constitute a tamping unit, and a space for surrounding the rail is provided between the tamping units. The tamping units are mechanically connected to one another, and each oscillating lever is provided with a tamping unit and a feeding drive. The guide members are arranged outside the working area of the oscillating levers, wherein the guide members act directly on the respective support member and run in fixed guide members of the tamping device frame.

[0003] The technical solution proposes a hydraulic vibration excitation double-sleeper tamping device, which drives four pick arms to perform vibration and clamping movements by four hydraulic vibration excitation cylinders, so as to perform tamping operations in the vicinity of the rail on one side located on two sleepers. The solution has the following drawbacks: 1) four hydraulic vibration excitation cylinders are required, which leads to high cost; 2) the paired pick arms are driven by hydraulic cylinders with their upper ends extending along different lines, and thus are subjected to unbalanced forces, which is not conducive to ensuring centered clamping; 3) being mounted on the same pick arm, the two sets of tamping picks in the length direction of the sleeper can only perform clamping operations synchronously, making it difficult to achieve clamping with uniform compaction when the compactness of the railway ballast varies at two corresponding positions.

SUMMARY OF THE INVENTION

[0004] In view of the drawbacks existing in the prior art, an object of the present invention is to propose a

compact, force-balanced and cost-effective vibration excitation tamping device through structural improvement, so as to achieve improved compaction effect.

[0005] In order to achieve the above object, the basic technical solution of the vibration excitation tamping device of the present invention comprises: a liftable tamping machine frame;

at least one vibration excitation device hinged in the middle of the tamping machine frame;

at least one connecting plate hinged with the vibration excitation device;

at least two double-end telescopic clamping cylinders, with cylinder bodies thereof fixedly connected to both sides of the connecting plate, respectively; and

at least two sets of paired pick arms hinged on both sides of the tamping machine frame, respectively, with upper ends thereof hinged with piston ends of the corresponding double-end telescopic clamping cylinders, respectively.

[0006] Compared with the prior art, the present invention uses a reasonable configuration solution of "centralized vibration excitation drive and dispersed clamping drive". The upper ends of the paired pick arms are hinged with two protruding ends of the piston rods of the double-end telescopic clamping cylinder, respectively, so that the upper ends of the paired tamping picks are force-balanced and their movements are symmetrical as they are subjected to equal forces in opposite directions, which can ensure centered clamping, and the structure thereof is very compact. Secondly, since the present invention uses a reasonable arrangement of fixedly connecting mutually parallel double-end telescopic clamping cylinders to both sides of the connecting plate and the inner ends thereof connecting to the vibration excitation devices, each vibration excitation device, such as a hydraulic vibration exciter or an electromagnetic vibration exciter, can simultaneously drive four pick arms to vibrate, thereby achieving a highly effective vibration excitation effect of "one drives four". In this way, the number of vibration excitation devices, such as expensive hydraulic vibration exciters, can be reduced by half in the present invention, which significantly reduces the cost, so that the problem of difficult application and promotion of hydraulic vibration excitation tamping device due to its high cost is effectively solved. In addition, the paired pick arms are separately driven by the piston rods at both ends of the double-end telescopic clamping cylinder, and two sets of tamping picks along the length direction of the sleeper are mounted on different pick arms. As a result, when the compactness of the railway ballast varies at two corresponding positions, each set of tamping picks can move by a different distance, ensuring that each

tamping position can achieve uniform compaction effect. Moreover, since the connecting plate used in the present invention can realize modular integrated connection of the double-end telescopic clamping cylinders and the vibration excitation devices, it is particularly advantageous for batch production and assembly.

[0007] The present invention is further described as follows:

The vibration excitation tamping device of the present invention comprises two vibration excitation devices and two connecting plates symmetrically hinged in the middle of the tamping machine frame, four telescopic clamping cylinders and four pairs of pick arms. The inner ends of the two connecting plates are hinged with the piston rod ends of the corresponding vibration excitation devices, respectively. The cylinder bodies of the four telescopic clamping cylinders are fixedly connected to both sides of the corresponding connecting plates, respectively. The four pairs of pick arms are respectively hinged on both sides of the tamping machine frame, with the upper ends thereof hinged with the piston ends of the corresponding double-end telescopic clamping cylinder. Tamping operations for two sleepers can be carried out synchronously, which further reflects the advantages of the tamping device, i.e., having compact structure and being subjected to balanced forces.

[0008] The hydraulic tamping device is symmetrical with respect to two vertical planes perpendicular to each other, which at least facilitates the realization of a more compact and force-balanced structure, and its manufacturing and assembly.

[0009] The double-end telescopic clamping cylinders and the vibration excitation devices are horizontally arranged, and the axes thereof are parallel to each other and located in the same plane, thereby helping to reduce the radial vibration force exerted on the double-end telescopic clamping cylinders. It is ensured that the double-end telescopic clamping cylinders are in more reasonable stress state, which effectively prolongs the service life of the double-end telescopic clamping cylinders, and reduces the probability of oil leakage, extend-retract clamping stagnation and other failures of the clamping cylinders. In addition, the tamping device being in a more stable state during operation can be further ensured, so as to reduce the impact on the stability and detection accuracy of the tamping machine.

[0010] In the paired pick arms, the upper arm of force of the pick arm on the outer side is equal to the upper arm of force of the pick arm on the inner side, and the lower arm of force of the pick arm on the outer side is equal to the lower arm of force of the pick arm on the inner side. The advantage is that the tamping picks fixedly connected with the pick arms on the inner and outer sides produce substantially equal clamping forces, which helps to counteract the reaction forces of the ballast bed at the double-end telescopic clamping cylinders, and reduce the load on the vibration excitation device, such as the hydraulic vibration excitation cylinder, so as to reduce

the technical requirements on the vibration excitation devices, such as the hydraulic vibration excitation cylinders, and further facilitate the cost reduction.

[0011] The tamping machine frame is a frame structure consisting of an upper crossbeam and a lower crossbeam fixedly connected to each other by side longitudinal columns on both sides and a middle longitudinal column, and horizontal support beams fixedly connected to both sides of the lower crossbeam by several rib plates. The horizontal support beams on both sides, the lower crossbeam, and the several rib plates form a space for accommodating the rail on one side. The upper and lower crossbeams of the tamping machine frame are arranged substantially in parallel with the axes of the hydraulic vibration excitation cylinders. Such a frame structure is simple and compact, has a space for accommodating the rail on one side, and has sufficient strength, so that the vibration excitation devices and the double-end telescopic clamping cylinders can be well mounted thereon, and the frame structure can bear various reaction forces during the tamping operations.

[0012] Each horizontal support beam is provided with four reaming holes for mounting the pick arms. The middle longitudinal column is provided with two mounting holes for hinging the vibration excitation device.

[0013] The vibration excitation device is a hydraulic vibration excitation cylinder or an electromagnetic vibration exciter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention will be described in further detail in the following with regard to the embodiments given in the accompanying drawings, wherein

FIG. 1 is a schematic view of a three-dimensional structure of an embodiment of the present invention;

FIG. 2 is a schematic view of a three-dimensional structure of the embodiment of FIG. 1 in operating state;

FIG. 3 is a schematic view of a three-dimensional structure of the tamping machine frame of the embodiment in FIG. 1;

FIG. 4 is a schematic view of a three-dimensional exploded structure of the double-end telescopic clamping cylinder assembly of the embodiment in FIG. 1 (wherein the hydraulic vibration excitation cylinder is indicated by dashed lines);

FIG. 5 is a schematic view of a three-dimensional exploded structure of a partial structure of the embodiment in FIG. 1;

FIG. 6 is a schematic view of a three-dimensional structure of the embodiment in FIG. 1 for motion anal-

ysis;

FIG. 7 is a schematic view of a plane projection structure of the embodiment in FIG. 1;

FIG. 8 is an H-H sectional view of FIG. 7;

FIG. 9 is a schematic view of a three-dimensional structure of the connecting plate of the embodiment in FIG. 1; and

FIG. 10 is a sectional view of the double-end telescopic clamping cylinder of the embodiment in FIG. 1.

DETAILED DESCRIPTION OF EMBODIMENT(S) OF THE INVENTION

Embodiment 1

[0015] The present embodiment is a double-sleeper hydraulic vibration excitation tamping device, the basic structure of which is shown in FIG. 1 (referring to FIG. 2). The hydraulic vibration excitation tamping device X mainly consists of: a liftable tamping machine frame 7, two hydraulic vibration excitation cylinders 6 symmetrically hinged in the middle of the tamping machine frame 7, two connecting plates 5 hinged with the piston rod ends of the two hydraulic vibration excitation cylinders 6, respectively, four double-end telescopic clamping cylinders 4 fixedly connected to the two connecting plates 5, respectively, and four pairs of pick arms hinged on both sides of the tamping machine frame 7, respectively, with the upper ends thereof hinged with the corresponding double-end telescopic clamping cylinders, respectively. Driven by the lift cylinder 8, the device can be raised and lowered along the guide columns 9 vertically mounted on the body frame 10, so that tamping operations can be carried out in the vicinity of the rail 2 on one side placed on two sleepers 1. The hydraulic vibration excitation cylinder 6 is a kind of cylinder whose piston rod can extend and retract at a high frequency under the control of a servo valve.

[0016] As shown in FIG. 3, the tamping machine frame 7 is a frame structure consisting of an upper crossbeam 7-1 and a lower crossbeam 7-2 connected to each other by side longitudinal columns 7-5 on both sides and a middle longitudinal column 7-4, and comprising horizontal support beams 7-3 connected to both sides of the lower crossbeam 7-2 by several rib plates 7-6. Mounting holes 7-7 for the guide column 9 vertically passing through the upper crossbeam 7-1, the lower crossbeam 7-2 and the side longitudinal columns 7-5 are provided on both sides of the tamping machine frame 7, for sheathing and sliding fitting the guide columns 9. The middle part of the upper crossbeam 7-1 is provided with a mounting hole 7-1-1 for mounting a lift cylinder 8. Each horizontal support beam 7-3 is provided with four reaming

holes 7-3-1 for mounting pick arms 3. The middle longitudinal column 7-4 is provided with two mounting holes 7-4-1 for hinging the hydraulic vibration excitation cylinders 6.

[0017] As shown in FIG. 4, two double-end telescopic clamping cylinders 4 are rigidly connected by the reaming hole bolts 11 passing through the connecting holes 4-2 of the two double-end telescopic clamping cylinders 4 and the connecting holes 5-1 of the connecting plate 5, forming a double-end telescopic clamping cylinder assembly 12. As shown in FIGS. 3 and 4, the connecting holes 5-2 of the connecting plate 5 are hinged with the piston rod hole 6-1 of the hydraulic vibration excitation cylinder 6. The connecting holes 6-2 at the tail portion of the hydraulic vibration excitation cylinder 6 are hinged with the mounting holes 7-4-1 in the middle longitudinal column 7-4 of the tamping machine frame 7.

[0018] As shown in FIG. 5, the mounting hole 4-1 at the piston rod end of the double-end telescopic clamping cylinder 4 is hinged with the upper mounting holes 3-1 of the pick arm 3. The middle mounting holes 3-2 of the pick arm 3 is hinged with the reaming hole 7-3-1 of the horizontal support beam 7-3 (the pin for the hinged connection is not shown in the figure).

[0019] As shown in FIG. 6, the tamping machine frame 7, the hydraulic vibration excitation cylinder 6, the double-end telescopic clamping cylinder assembly 12 and the pick arms 3 form a set of linkage mechanism. When the piston rod of the hydraulic vibration excitation cylinder 6 extends and retracts in a short stroke in direction C at a high frequency, the double-end telescopic clamping cylinder assembly 12 is driven to sway left and right mainly in the horizontal direction, leading the pick arms 3 to swinging, which results in a swing vibration with small amplitude at the end of the tamping picks 3-1 rigidly connected to the pick arms 3 in direction D. When the piston rods at both ends of the double-end telescopic clamping cylinder 4 stretch out in direction A, the pick arms 3 connected with them are driven to rotate around the mounting holes 3-2, resulting in the clamping action of the tamping picks 3-1 in direction B.

[0020] As shown in FIG. 7, the general arrangement of the hydraulic tamping device X is symmetrical with respect to the symmetry planes 13 and 14 in two vertical directions, and the movements of the piston rods of the hydraulic vibration excitation cylinders 6 on both sides are synchronous but in opposite directions, so that the vibration forces on the two sides can be mutually counteracted. The double-end telescopic clamping cylinders 4 and the hydraulic vibration excitation cylinders 6 are arranged horizontally, and the axes thereof are parallel to each other and optimally in the same plane, so that the radial load exerted on the double-end telescopic clamping cylinders 4 can be reduced. The upper arm of force L1 of the pick arm 3 on the outer side is substantially equal to the upper arm of force L2 of the pick arm 3 on the inner side, and the lower arm of force L3 of the pick arm 3 on the outer side is substantially equal to the lower

arm of force L4 of the pick arm 3 on the inner side. In this way, the reaction forces borne by the pick arms 3 when clamping the railway ballast can be sufficiently counteracted at the double-end telescopic clamping cylinders 4, thus reducing the impact on the hydraulic vibration excitation cylinders 6. The pick arm 3 on the outer side can also be referred to as "outside pick arm" for short, and the pick arm 3 on the inner side can also be referred to as "inside pick arm" for short.

[0021] The specific structure of the connecting plate 5 in this embodiment is shown in FIG. 9. The connecting plate 5 comprises a base plate and double ear plates protruding upward from the middle of the base plate. The double ear plates are provided with middle connecting holes 5-2, which are used for hinging with the piston rod hole 6-1 of the hydraulic vibration excitation cylinder 6. Four connecting holes 5-1 in total symmetrically arranged on both sides of the base plate are provided for rigid connection with the connecting holes 4-2 of the double-end telescopic clamping cylinders 4. The sectional structure of the double-end telescopic clamping cylinder 4 is shown in FIG. 10, comprising an integral double-chamber cylinder body 4-2, where the left and right chambers are independent of each other, and the movements of the piston rods 4-3 at both ends do not interfere with each other. In addition, it can also be formed by rigid connection of two clamping cylinders.

[0022] Tests show that the present embodiment has the following advantages:

(1) In this embodiment, an integrated double-end telescopic clamping cylinder (or two cylinders in rigid connection) is used as a clamping mechanism to drive paired pick arms to open and close, which not only has a compact structure, but also has optimal force balance and centered clamping.

(2) The present embodiment, based on a reasonable configuration of connecting the vibration excitation device to the middle part of the connecting plate and connecting the double-end telescopic clamping cylinders respectively to both sides of the connecting plate, provides a new tamping structure of "centralized vibration excitation drive and reasonable dispersed clamping drive". Each set of clamping mechanism (including the double-end telescopic clamping cylinder and the pick arms) is connected with the hydraulic vibration exciter on the tamping machine frame via the connecting plate. Each hydraulic vibration exciter can drive 4 pick arms to vibrate simultaneously, thereby achieving a highly effective vibration excitation effect of "one drives four". In this way, the number of expensive hydraulic vibration exciters can be reduced by half, which significantly reduces the equipment manufacturing cost, so the problem that it is difficult to promote wide-spread application of the hydraulic vibration excitation tamping device due to its high cost is effectively solved. On the other

hand, as the paired pick arms are separately driven by the piston rods at both ends of the double-end telescopic clamping cylinder, it can be ensured that a uniform compaction effect can be achieved at each tamping position.

Therefore, the present embodiment can not only achieve a more efficient vibration excitation transmission effect, but also achieve a more uniform compaction effect. Furthermore, the connection structure between the connecting plate, the double-end telescopic clamping cylinders and the hydraulic vibration exciter is simple, which facilitates modular assembly and batch production.

(3) The axes of the double-end telescopic clamping cylinder are horizontally arranged, and are parallel to and in the same horizontal plane with the axis of the hydraulic vibration exciter, which helps to reduce the radial vibration forces borne by the double-end telescopic clamping cylinders. It is ensured that the double-end telescopic clamping cylinders are in more reasonable stress state, which effectively prolongs the service life of the double-end telescopic clamping cylinders, and reduces the probability of oil leakage, extend-retract clamping stagnation and other failures of the clamping cylinders.

(4) The clamping arm of force of the pick arm on the outer side is equal to the clamping arm of force of the pick arm on the inner side, so that the tamping picks on the inner and outer sides of the pick arms can generate equal clamping forces, which helps to counteract the reaction forces of the ballast bed at the double-end telescopic clamping cylinders, and reduce the load of the hydraulic vibration exciter, so as to reduce the technical requirements on the hydraulic vibration exciter and the cost is further reduced.

(5) The guide column mounting holes arranged on the two side longitudinal columns on the machine frame and the lift cylinder mounting holes arranged on the upper crossbeam ensure that the tamping device carried by the entire machine frame can be raised and lowered smoothly when driven by the lift cylinder.

[0023] In conclusion, the present embodiment can provide a compact, force-balanced and cost-effective tamping device. On the one hand, it is ensured that the railway ballast can achieve a uniform compactness at each tamping position. On the other hand, based on the vibration excitation and clamping drive mechanism formed by the double-end telescopic clamping cylinders on the connecting plate and the hydraulic vibration exciter, the number of hydraulic vibration excitation cylinders is significantly reduced and the manufacturing cost is greatly reduced, which facilitates mass production and the ap-

plication and promotion.

[0024] In addition to the above embodiments, the present invention may have other implements. For example, only the left half of the above described tamping machine frame 7 together with one hydraulic vibration excitation cylinder 6, two double-end telescopic clamping cylinders 4, one connecting plate 5 and four pick arms 3 can form a single-sleeper hydraulic vibration excitation tamping unit. For another example, the hydraulic vibration excitation cylinder 6 may be replaced by an electro-magnetic vibration exciter, and so on. Any technical solution with equivalent replacements or equivalent transformations falls within the protection scope of the present invention.

Claims

1. A vibration excitation tamping device having a liftable tamping machine frame, comprising:

at least one vibration excitation device, with an inner end thereof hinged in the middle of the tamping machine frame;
at least one connecting plate hinged with an outer end of the vibration excitation device;
at least two double-end telescopic clamping cylinders, with cylinder bodies thereof fixedly connected to both sides of the connecting plate, respectively; and
at least two sets of paired pick arms hinged at both sides of the tamping machine frame, respectively, with upper ends thereof hinged with piston ends of corresponding double-end telescopic clamping cylinders, respectively.

2. The vibration excitation tamping device according to claim 1, comprising:

two vibration excitation devices and two connecting plates symmetrically hinged in the middle of the tamping machine frame, four double-end telescopic clamping cylinders, and four pairs of pick arms, wherein inner ends of the two connecting plates are hinged with piston rod ends of corresponding vibration excitation devices, respectively; cylinder bodies of the four double-end telescopic clamping cylinders are fixedly connected to both sides of corresponding connecting plates, respectively; and the four pairs of pick arms are hinged at both sides of the tamping machine frame, respectively, with upper ends thereof hinged with piston ends of corresponding double-end telescopic clamping cylinders, respectively.

3. The vibration excitation tamping device according to claim 2, wherein the hydraulic tamping device is symmetrical with respect to two vertical planes perpendicular to each other.

4. The vibration excitation tamping device according to claim 1, 2 or 3, wherein the double-end telescopic clamping cylinders and the vibration excitation devices are horizontally arranged, and axes thereof are parallel to each other and located in the same plane.

5. The vibration excitation tamping device according to claim 4, wherein in the paired pick arms, an upper arm of force of a pick arm on the outer side is equal to an upper arm of force of a pick arm on the inner side, and a lower arm of force of the pick arm on the outer side is equal to a lower arm of force of the pick arm on the inner side.

6. The vibration excitation tamping device according to claim 5, wherein the tamping machine frame consists of an upper crossbeam and a lower crossbeam fixedly connected to each other by side longitudinal columns on both sides and a middle longitudinal column, and horizontal support beams fixedly connected to both sides of the lower crossbeam by several rib plates.

7. The vibration excitation tamping device according to claim 6, wherein guide column mounting holes vertically passing through the upper crossbeam, the lower crossbeam, and the side longitudinal columns are provided on both sides of the tamping machine frame; and mounting holes for mounting a lift cylinder piston rod are provided in the middle of the upper crossbeam.

8. The vibration excitation tamping device according to claim 6, wherein the upper and lower crossbeams of the tamping machine frame are substantially parallel to an axis of a hydraulic vibration excitation cylinder.

9. The vibration excitation tamping device according to claim 7, wherein each horizontal support beam is provided with four reaming holes for mounting the pick arms, and the middle longitudinal column is provided with two mounting holes for hinging the hydraulic vibration excitation cylinder.

10. The vibration excitation tamping device according to claim 1, wherein the vibration excitation device is a hydraulic vibration excitation cylinder or an electro-magnetic vibration exciter.

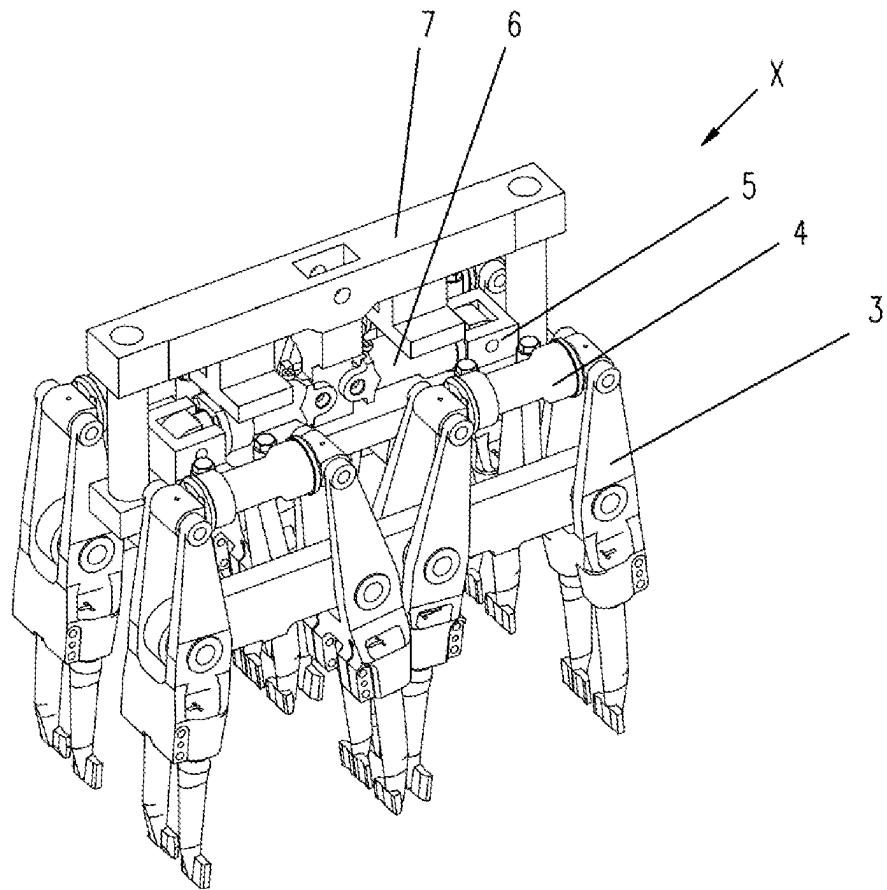


Fig. 1

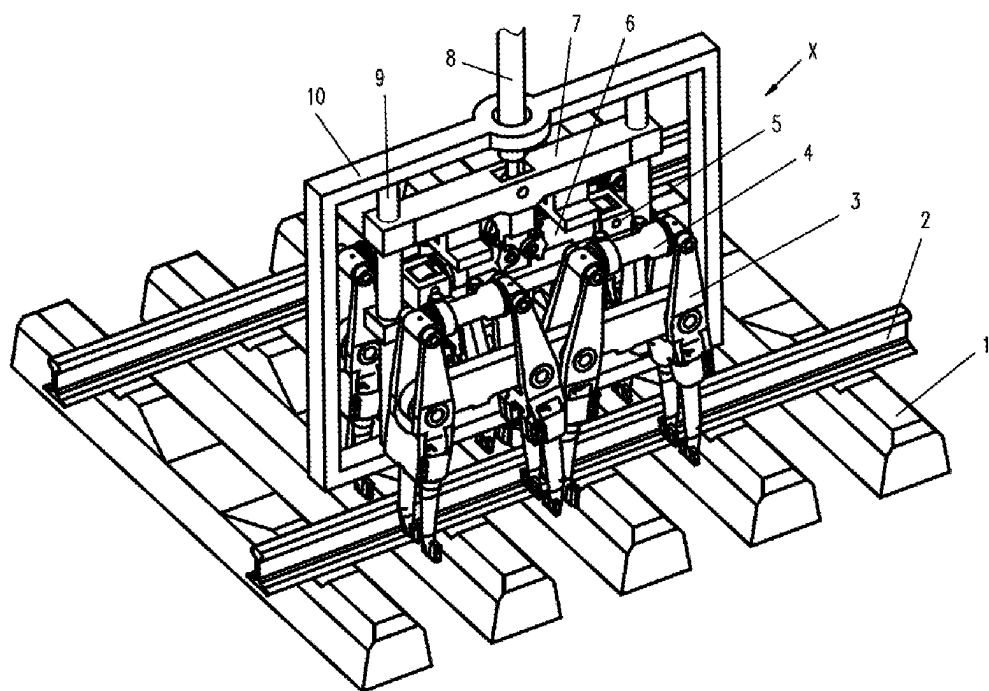


Fig. 2

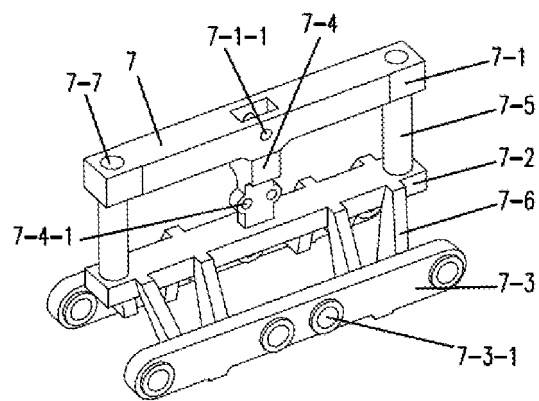


Fig. 3

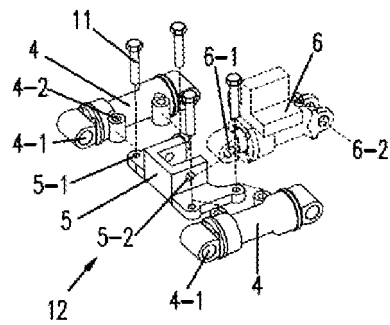


Fig. 4

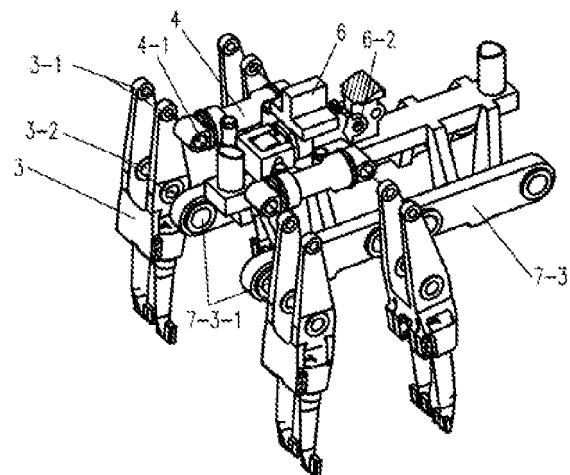


Fig. 5

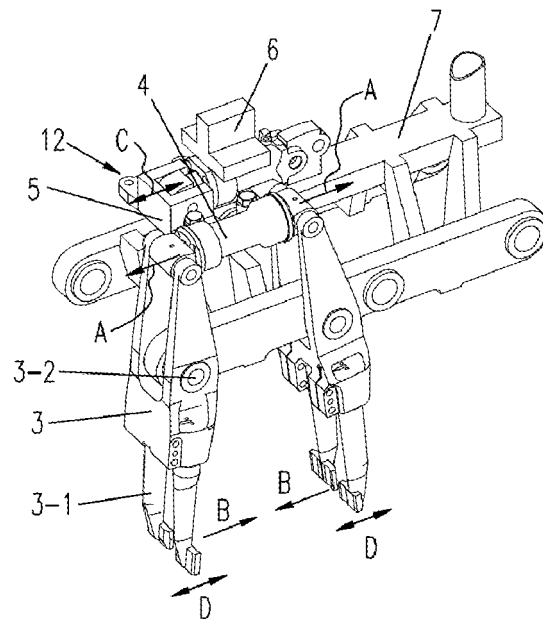


Fig. 6

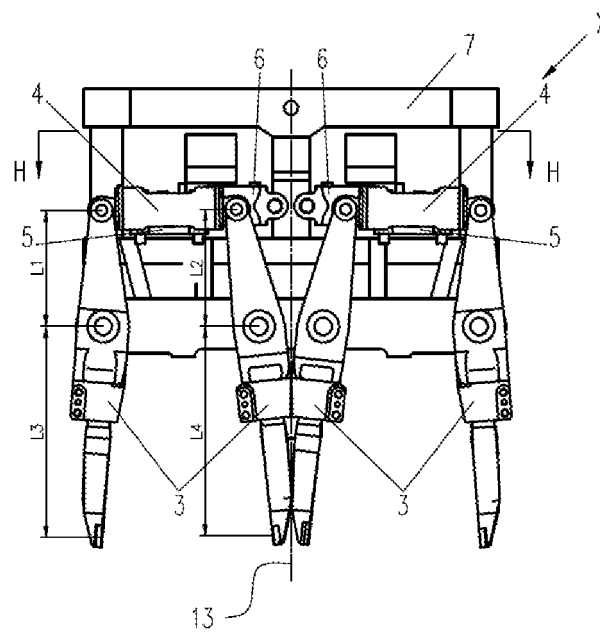


Fig. 7

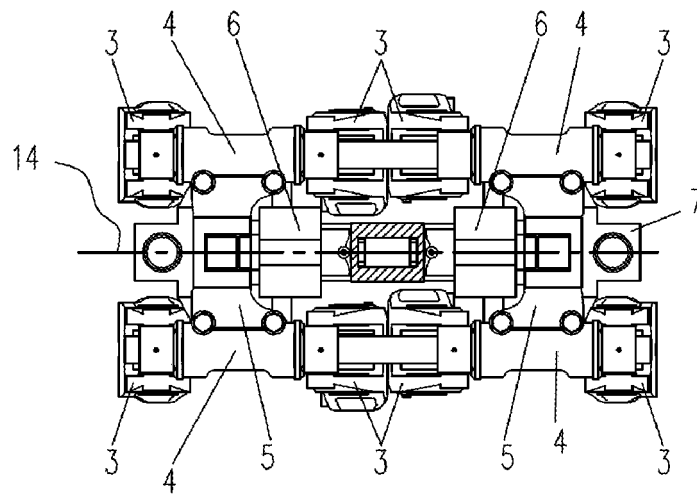


Fig. 8

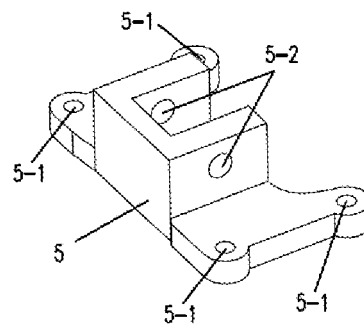


Fig. 9

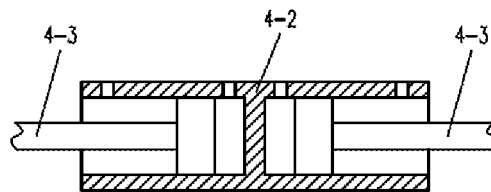


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/107124

A. CLASSIFICATION OF SUBJECT MATTER E01B 27/16(2006.01)i 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) E01B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNTXT, CNKI, DWPI, VEN: 激振捣固, 激振, 捣固臂, 伸缩, 夹持, 油缸, 机架, 力臂, 铰接, Shock, excitation, telescopic, clamping, cylinder?, hinge joint, tamping.																		
C. DOCUMENTS CONSIDERED TO BE RELEVANT																		
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 113463451 A (CHANGZHOU CRRC RUITAI EQUIPMENT TECHNOLOGY CO., LTD.; CRRC QISHUYAN INSTITUTE CO., LTD.) 01 October 2021 (2021-10-01) claims 1-10</td> <td>1-10</td> </tr> <tr> <td>X</td> <td>CN 112176791 A (CHINA RAILWAY CONSTRUCTION HIGH-TECH EQUIPMENT CO., LTD.) 05 January 2021 (2021-01-05) claims 1-13, and description, paragraphs [0005] to [0087]</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 101864707 A (CHINA RAILWAY LARGE MAINTENANCE MACHINERY CO., LTD. KUNMING) 20 October 2010 (2010-10-20) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 112160200 A (CHINA RAILWAY CONSTRUCTION HIGH-TECH EQUIPMENT CO., LTD.) 01 January 2021 (2021-01-01) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>WO 2020192251 A1 (CRCC HIGH-TECH EQUIPMENT CORP. LTD.) 01 October 2020 (2020-10-01) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 113463451 A (CHANGZHOU CRRC RUITAI EQUIPMENT TECHNOLOGY CO., LTD.; CRRC QISHUYAN INSTITUTE CO., LTD.) 01 October 2021 (2021-10-01) claims 1-10	1-10	X	CN 112176791 A (CHINA RAILWAY CONSTRUCTION HIGH-TECH EQUIPMENT CO., LTD.) 05 January 2021 (2021-01-05) claims 1-13, and description, paragraphs [0005] to [0087]	1-10	A	CN 101864707 A (CHINA RAILWAY LARGE MAINTENANCE MACHINERY CO., LTD. KUNMING) 20 October 2010 (2010-10-20) entire document	1-10	A	CN 112160200 A (CHINA RAILWAY CONSTRUCTION HIGH-TECH EQUIPMENT CO., LTD.) 01 January 2021 (2021-01-01) entire document	1-10	A	WO 2020192251 A1 (CRCC HIGH-TECH EQUIPMENT CORP. LTD.) 01 October 2020 (2020-10-01) entire document	1-10
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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