



US 20250122674A1

(19) **United States**(12) **Patent Application Publication**
KEPPLINGER(10) **Pub. No.: US 2025/0122674 A1**(43) **Pub. Date: Apr. 17, 2025**(54) **TAMPING UNIT FOR TAMPING SLEEPERS OF A TRACK**(30) **Foreign Application Priority Data**

Sep. 30, 2021 (AT) A 50775/2021

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m.b.H., Vienna (AT)****Publication Classification**(51) **Int. Cl.**
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Rohrbach-Berg (AT)(52) **U.S. Cl.**
CPC **E01B 27/16** (2013.01); **E01B 2203/125**
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m.b.H., Vienna (AT)**(57) **ABSTRACT**

The invention relates to a tamping unit for tamping sleepers of a track, comprising a tamping unit segment with opposing tamping tools tiltably mounted on a height-adjustable tool carrier, with the respective tamping tool being coupled with a vibration drive via a transmission drive. The respective transmission element is connected with the assigned tamping tool via a first joint and with a squeezing drive supported on the same tamping tool via a second joint. This design enables a space-saving arrangement of the squeezing drives, resulting in a compact design.

(21) Appl. No.: **18/685,343**(22) PCT Filed: **Sep. 28, 2022**(86) PCT No.: **PCT/EP2022/076991**

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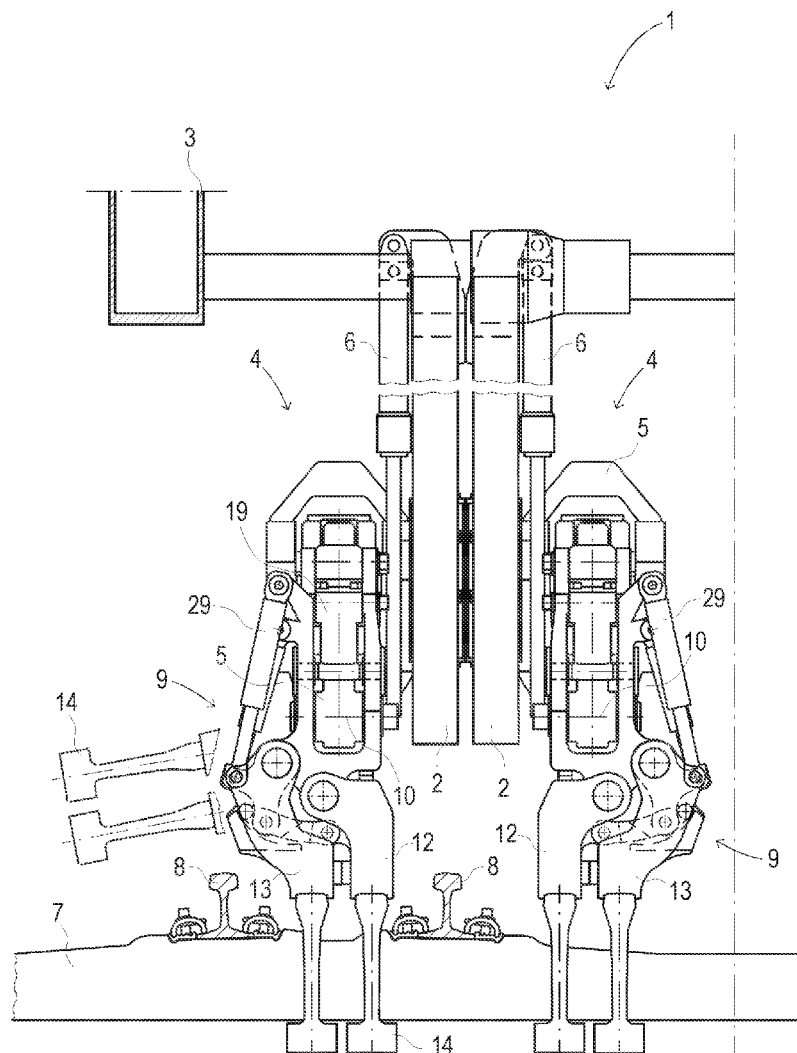
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Fig. 1

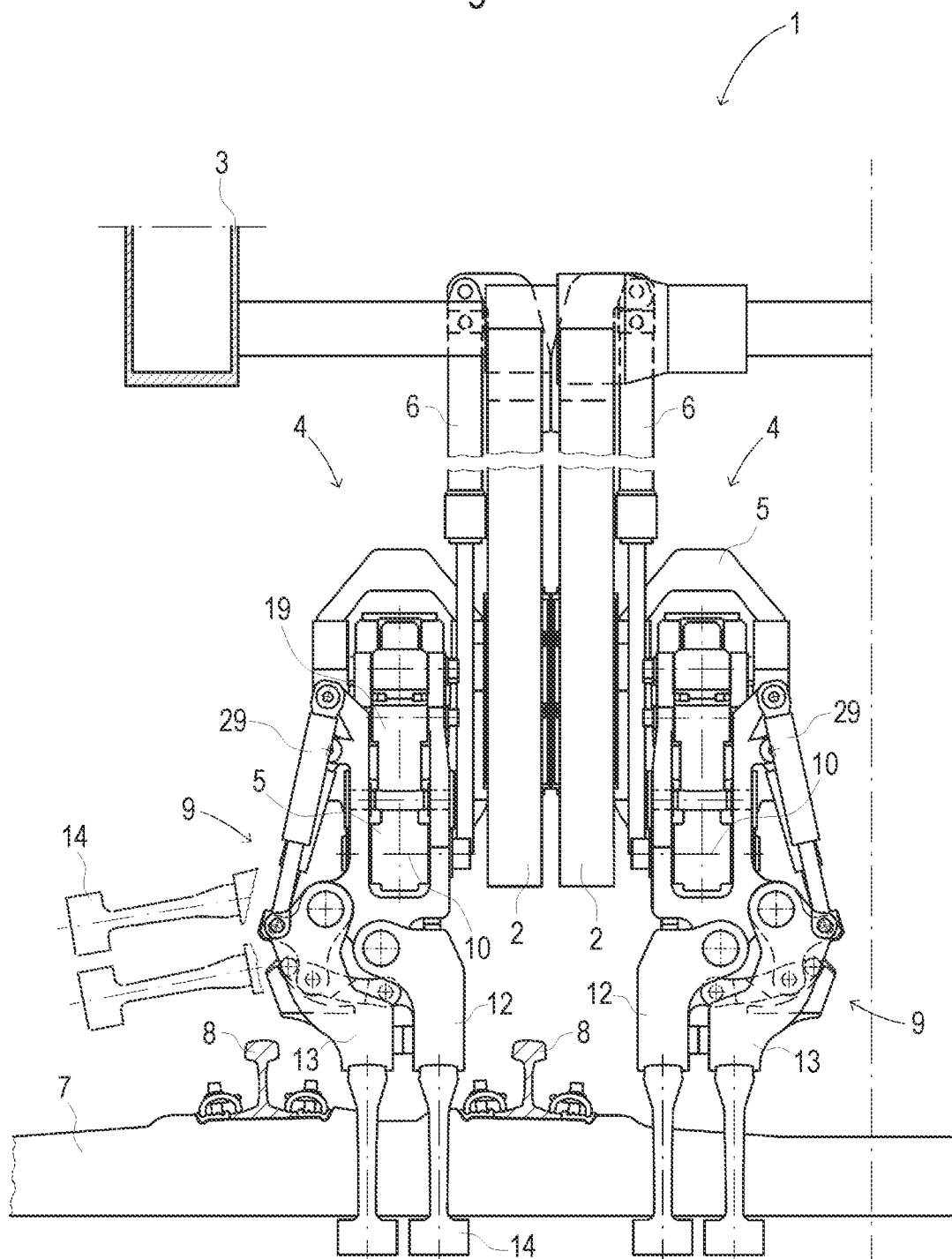
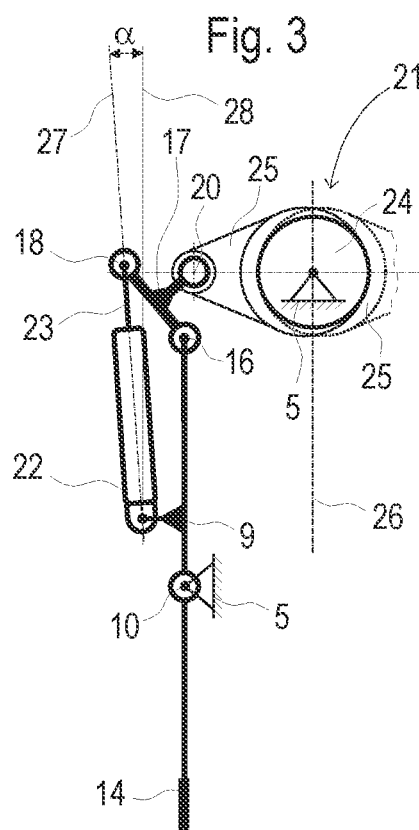
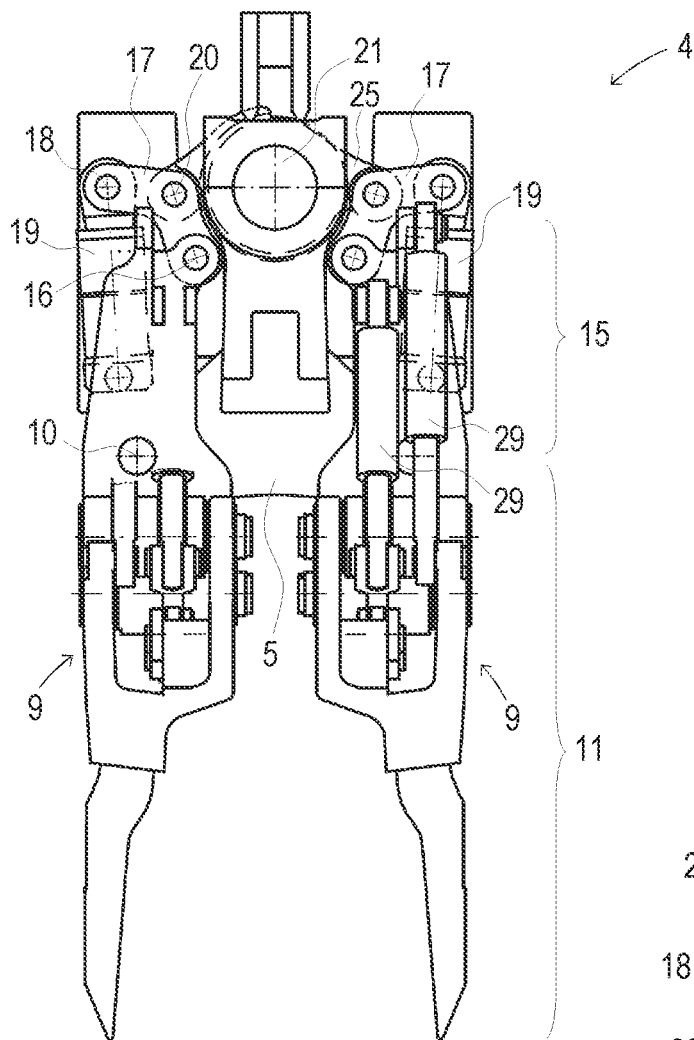


Fig. 2



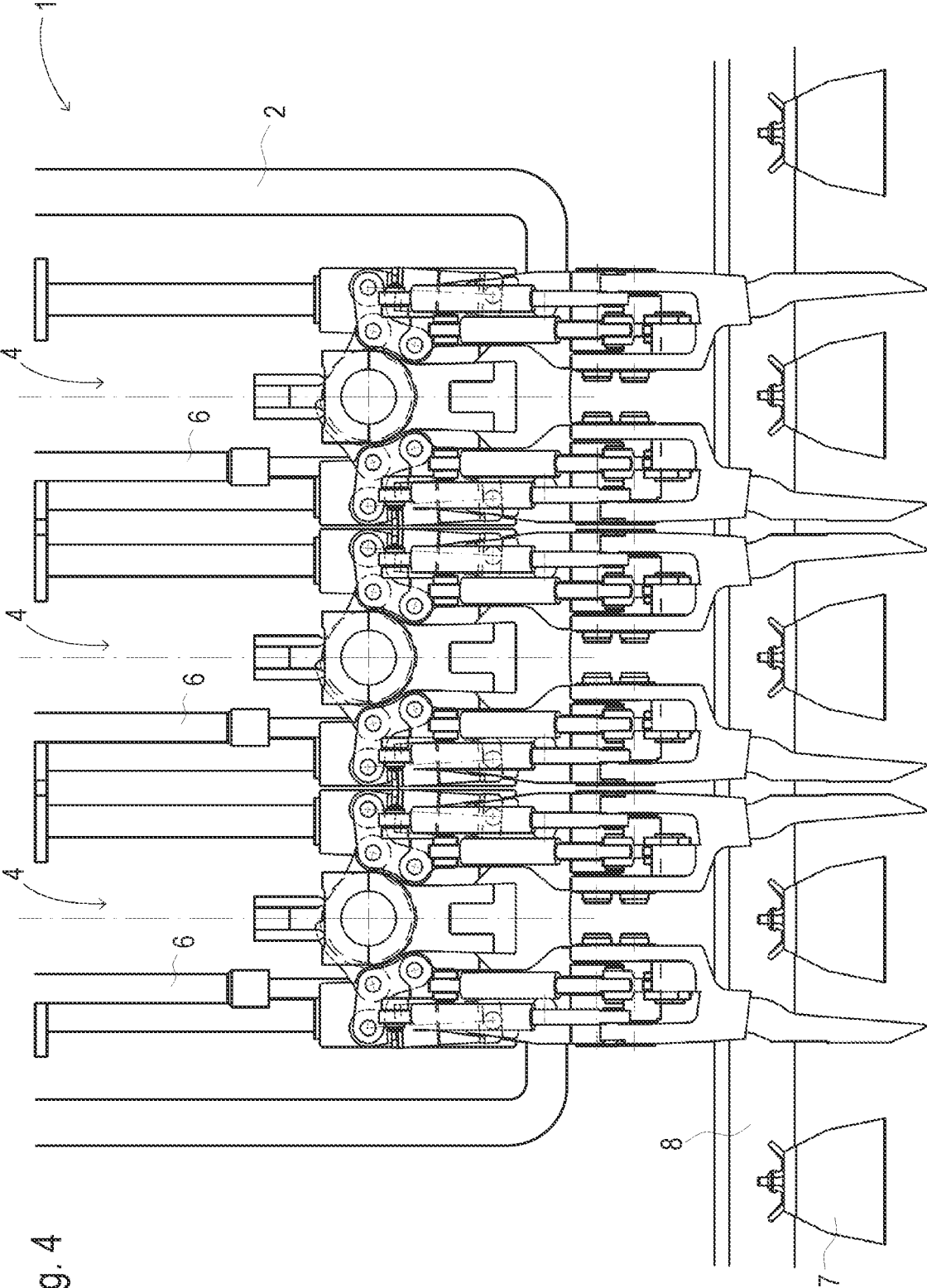


Fig. 4

TAMPING UNIT FOR TAMPING SLEEPERS OF A TRACK

FIELD OF TECHNOLOGY

[0001] The invention relates to a tamping unit for tamping sleepers of a track, comprising a tamping unit segment with opposing tamping tools tiltably mounted on a height-adjustable tool carrier, with the respective tamping tool being coupled with a vibration drive via a transmission element.

PRIOR ART

[0002] A generic tamping unit is known from AT 304606 B. The respective tamping unit segment comprises four tamping tools for the simultaneous tamping of two adjacent sleepers. In each case, two tamping tools are coupled with a vibration drive via a transmission element designed as a pivoting lever. A separate height adjustment of individual tamping tools is not possible.

[0003] Tamping unit segments for tamping individual sleepers that are height-adjustable independently of each other are disclosed in AT 520267 A1, with squeezing cylinders arranged in an interlocked manner being connected to a vibration drive via console-like transmission elements. The resulting narrow design allows several tamping unit segments to be linked together to form an inline tamping unit that can be used to tamp several adjacent sleepers simultaneously. Compared to conventional tamping units, the interlocked arrangement of the squeezing cylinders requires further design adjustments to avoid unfavourable load conditions.

PRESENTATION OF THE INVENTION

[0004] The object of the invention is to improve a tamping unit of the kind mentioned above in such a way that a low load on the work unit components and a good mass balance is achieved with a compact design compared to prior art.

[0005] According to the invention, this object is achieved by the features of independent claim 1. Dependent claims indicate advantageous embodiments of the invention.

[0006] The respective transmission element is connected with the assigned tamping tool via a first joint and with a squeezing drive supported on the same tamping tool via a second joint. In this way, the respective tamping tool forms a kinematic system together with the assigned squeezing drive and the assigned transmission element, with which a squeezing movement or a return movement of a tamping tine arranged on the tamping tool takes place. In this arrangement, the tamping tool is supported directly on the tool carrier and the assigned transmission element is supported on it via the vibration drive. The transmission element is used both as an element of the squeezing kinematics and to transmit the vibrational movement to the assigned tamping tool. This design enables a space-saving arrangement of the squeezing drives, resulting in a compact design of the tamping unit segment. Additionally, no interlocking of the drives is required. The arrangement of all force-transmitting components in a common plane results in low loads and promotes equalization of the moved masses.

[0007] In an advantageous further development, the respective transmission element is linked to the vibration drive via a third joint. This articulated connection to the vibration drive provides an additional degree of freedom for the optimal positioning of the respective transmission ele-

ment. In a simpler variant, the respective transmission element is rigidly connected with the vibration drive. This can be useful, for example, if each tamping tool is assigned its own vibration drive.

[0008] In the articulated connection of the transmission element to the assigned vibration drive, the third joint is advantageously arranged between the first joint and the second joint. The resulting leverage increases the vibration transmitted to the tamping tool. Additionally, a greater distance between the first and second joint facilitates the structural arrangement of the respective squeezing drive. Furthermore, the vibration load on the respective squeezing drive is reduced.

[0009] Advantageously, the vibration drive is designed as an eccentric drive. For tamping units, the eccentric drive is a reliable and long-proven device for generating vibration. A stable vibration amplitude is maintained during operation, even with larger counterforces due to a hard ballast bed. Compared to hydraulic vibration generators in particular, an eccentric drive offers efficient operation with low energy consumption due to the effective flywheel.

[0010] In a preferred embodiment of this variant, each transmission element is connected with an eccentric arm mounted on an eccentric section of an eccentric shaft of the eccentric drive in an articulated manner. In this way, an articulated connection of the respective transmission element to the assigned eccentric drive is achieved by simple means.

[0011] In an advantageous further development, the respective squeezing drive is designed as a hydraulic cylinder with an approximately vertically aligned cylinder axis. This vertical alignment of the squeezing drives results in a slim design of the respective tamping unit segment without restricting the squeezing distances.

[0012] Each squeezing cylinder is usefully linked to the assigned tamping tool on the cylinder side and to the assigned transmission element on the piston rod side. The narrower piston rod leaves more space for the arrangement of the transmission element. This arrangement also minimizes the vibration load on the overall system as the larger mass portion of the squeezing cylinder is located near the tilting joint of the assigned tamping tool. The acting mass moment of inertia only leads to low mechanical loads on the bearing points.

[0013] In a further improvement, an angle between the respective cylinder axis and a vertical axis is at most 20°, in particular at most 10°, during a squeezing process. In this way, the slim design of the respective tamping unit segment is retained during operation. The bearing points of the tamping tools, the squeezing cylinders, and the transmission elements are aligned in such a way that the squeezing cylinders only perform slight swivelling movements during an activation.

[0014] Advantageously, the respective tamping tool has an upper lever arm and a lower lever arm, with the lower lever arm comprising at least one tamping tine and with the upper lever arm being connected with the assigned transmission element. Respectively opposing tamping tools form a tong-like arrangement that ensures optimum force transmission and an effective squeezing movement.

[0015] In an advantageous further development, at least one tamping tine is arranged in a tamping tine support that can be tilted upwards. This enables effective treatment of turnouts and crossings. Tilting up individual tamping tines

also prevents collisions with obstacles in the track during tamping. Each tamping tool usefully has two tilting tamping tine supports for one tamping tine each, so that either only one tamping tine or both tamping tines can be tilted upwards.

[0016] In a further development of the invention, the respective tamping unit segment comprises only two tamping tools for tamping a single sleeper of the track. Each tamping unit segment has an optimum geometry and dimensioning for tamping a sleeper. For example, all tamping tines are aligned exactly vertically for a low penetration resistance during a penetration process in a ballast bed. The dimensioning of the squeezing drives is also adjusted to the squeezing distances and squeezing forces to be achieved in an optimum manner.

[0017] Advantageously, several of such tamping unit segments are arranged one behind the other for the simultaneous tamping of adjacent sleepers for a high working speed on a track line. By arranging separate tamping unit segments, such a tamping unit can also be used for an efficient and high-quality treatment in turnouts or track crossings.

[0018] Preferably, the tamping unit segments arranged one behind the other are arranged in a shared tamping unit frame, with each tamping unit segment being height-adjustable separately by means of an assigned height-adjustment drive. This ensures a high degree of flexibility when treating turnouts and track lines. For example, only individual tamping units are activated to treat a diverging track rail.

[0019] In a further development, only some of the tamping unit segments arranged one behind the other have tamping tine supports that can be tilted upwards in order to be able to optimally treat both track lines and turnouts. These tamping unit segments are used for turnout treatment. The other tamping unit segments are also activated for efficient treatment of track lines.

[0020] An improved embodiment of the tamping unit comprises at least two tamping unit segments of identical design. This results in synergy effects in manufacturing and maintenance. Furthermore, different inline tamping units can be combined in a simple manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] In the following, the invention is explained by way of example with reference to the accompanying figures. The following figures show in schematic illustrations:

[0022] FIG. 1 Tamping unit segment in a front view

[0023] FIG. 2 Tamping unit segment in a side view

[0024] FIG. 3 Kinematic model of a tamping unit segment

[0025] FIG. 4 Inline tamping unit

DESCRIPTION OF THE EMBODIMENTS

[0026] The tamping unit **1** shown in FIG. 1 comprises several tamping unit frames **2**, which are laterally shiftably mounted on a machine frame **3** of a track construction machine not described in more detail. At least one tamping unit segment **4** is arranged in the respective tamping unit frame **2**. The respective tamping unit segment **4** comprises a tool carrier **5**, which is height-adjustably guided in vertical guides of the assigned tamping unit frame **2**. A lowering or lifting movement takes place by means of an assigned height-adjustment drive **6**.

[0027] During work operation, the track construction machine travels along a track with sleepers **7** supported on

a ballast bed and rails **8** fastened to it. The sleepers **7** are tamped by means of the tamping unit **1**. Usually, each sleeper **7** is tamped by means of several tamping unit segments **4** arranged next to each other. These tamping unit segments **4** arranged next to each other are advantageously arranged so that they can be rotated about a vertical axis and shifted laterally in a turning and shifting unit in order to enable a positioning above a diverging rail of a turnout. In a tamping unit **1** for the simultaneous tamping of adjacent sleepers **7**, several tamping unit segments **4** are arranged one behind the other (FIG. 4).

[0028] On the tool carrier **5** of the respective tamping unit segment **4**, two opposing tamping tools **9** are mounted tiltably in relation to a sleeper **7** to be tamped. The respective swivelling axis **10** is aligned in the transverse direction of the track. At least one tamping tine **14** is attached to a lower lever arm **11** of the respective tamping tool **9** in a tamping tine support **12**, **13**. Swivelling movements of the tamping tools **9** about the respective swivelling axis **10** cause squeezing movements or return movements of the opposing tamping tines **14** during a tamping process.

[0029] An upper lever arm **15** of the respective tamping tool **9** is connected with a first joint **16** of a transmission element **17**. The respective transmission element **17** is connected with an assigned squeezing drive **19** via a second joint **18**. Additionally, the transmission element **17** is linked between the first and second joint **16**, **18** via a third joint **20** to a vibration drive **21** (FIG. 2). In a simpler variant, the transmission element **17** is rigidly connected with an element of the vibration drive **21**.

[0030] In the embodiment of the transmission element **17** shown, the axes of rotation of the three joints **16**, **18**, **20** are arranged at the corners of an isosceles triangle in the side view. The respective squeezing drive **19** is designed as an approximately vertically aligned hydraulic cylinder with a cylinder body **22** (cylinder tube and cover) and an upward-facing piston rod **23**. The lower end of the respective cylinder body **22** is linked to the assigned tamping tool **9** in an articulated manner. A pin with a plain bearing is arranged at the end of the piston rod **23**. This creates an articulated connection with the assigned transmission element **17** via the second joint **18**.

[0031] In the embodiment shown, the respective transmission element **17** serves as a lever for transmitting a squeezing force from the respective squeezing drive **19** to the assigned tamping tool **9**. The third joint **20** acts as the middle lever joint, which is connected with the assigned vibration drive **21**. In this way, the kinematic system consisting of tamping tool **9**, squeezing drive **19**, and transmission element **17** is set into vibration when the vibration drive **21** is active. For example, a vibration drive **21** with an electromagnetic actuator is arranged. In this, an armature is moved back and forth within an electromagnetic or magnetic field at a vibration frequency.

[0032] In the example shown, the vibration drive **21** is designed as an eccentric drive. With the eccentric drive, the rotational speed of an eccentric shaft **24** determines the vibration frequency. Several eccentric sections are arranged on the respective eccentric shaft **24**. For example, a first section with a first eccentricity is located in the centre between two eccentric shaft bearings. Two sections with a second eccentricity are designed on either side of this. A first eccentric arm **25**, which is coupled with one of the opposing tamping tools **9**, is mounted on the first eccentric section. A

second eccentric arm **25** is mounted on the two adjacent eccentric sections with two fork-shaped bearings. This second eccentric arm **25** is coupled with the other of the two opposing tamping tools **9**.

[0033] The alignment of the two eccentric arms **25** and the rotational position of the eccentric sections towards each other is chosen in such a way that vibrational movements with the desired vibration amplitudes in opposite directions occur in the third joints **20** of the connected transmission elements **17**. The length ratio of the upper and lower lever arm **11**, **15** of the respective tamping tool **9** determines the vibration amplitude effective at the tip of the assigned tamping tine **14** according to the lever principle.

[0034] FIG. 3 schematically shows the kinematic arrangement of a tamping tool **9** with the assigned transmission element **17**, the squeezing drive **19**, and the vibration drive **21**. The arrangement of the opposing tamping tool **9** is symmetrical in structure to the axis of symmetry **26**. As a result, equally large eccentricities on the eccentric shaft **24** result in equally large vibration amplitudes of the opposing tamping tools **9**.

[0035] The approximately vertical alignment of the squeezing drives **19** enables a particularly narrow design of the respective tamping unit segment **4**. During a squeezing process, the respective squeezing drive **19** only performs a small swivelling movement. An angle α between the cylinder axis **27** and a vertical axis **28** remains within a narrow range of 10° at most, in particular 5° at most, during this movement.

[0036] An extension of the piston rod **23** causes a tipping movement of the transmission element **17** about the third joint **20**, whereby the first joint **16** is shifted outwards in relation to the swivelling axis **10**. The corresponding shifting path determines the squeezing distance at the tip of the assigned tamping tine **14** according to the lever principle. If the third joint **16** is missing, the tipping movement takes place about an axis of rotation of the vibration drive **21**.

[0037] Advantageously, an inner tamping tine support **12** and an outer tamping tine support **13** are arranged on the lower lever arm **11** of the respective tamping tool **9** for fixing at least one tamping tine **14** on each support. The designations inner tamping tine support **12** and outer tamping tine support **13** refer to the position of two tamping unit segments **4** that can be lowered on both sides of a rail **8** (FIG. 1). The tamping tines **14** of the inner tamping tine supports **12** are lowered closer to the rail **8**.

[0038] Each tamping tine support **12**, **13** can be swivelled about an axis aligned in the longitudinal direction of the rail using its own swivel drive **29**. This means that each tamping tine **14** can be tilted up separately before the tamping unit segment **4** is lowered if there is no space for penetration between the sleepers **7** and rails **8**. This occurs especially when tamping turnouts or crossings, where diverging or crossing rails as well as adjusting means are obstacles. In FIG. 1, the positions of the tamping tines **14** tilted up on the left tamping unit segment **4** are drawn with dotted lines.

[0039] FIG. 4 shows a tamping unit frame **2** with three tamping unit segments **4** arranged one behind the other. With this inline tamping unit, three sleepers **7** arranged directly one behind the other can be tamped simultaneously during each tamping process. The tamping unit segments **4** can also be shifted in height individually due to the separate bearing

in the shared tamping unit frame **2**. This option is useful for avoiding collisions with obstacles or for tamping twin sleepers.

[0040] The invention comprises further tamping units **1**, which can be assembled in a simple manner due to the narrow design of the tamping unit segments **4**. For example, two tamping unit segments **4** are arranged one behind the other in the respective tamping unit frame **2**, with only the respective front or the respective rear tamping unit segment **4** comprising tamping tine supports **12**, **13** that can be tilted upwards. These tamping unit segments **4** are used in particular in turnouts. All tamping unit segments **4** together serve to efficiently treat a track line, with two sleepers **7** being tamped simultaneously during each tamping process.

[0041] In a further embodiment of an inline tamping unit, asymmetrical tamping unit segments **4** are used in the front row or in the rear row in order to realize greater squeezing distances. In such an asymmetrical tamping unit segment **4**, only one of the opposing tamping tools **9**, including the squeezing drive **19** and transmission element **17**, is of a narrow design. Here, the angle α between cylinder axis **27** and vertical axis **28** is at most 5° , for example. This applies to the side that borders on the rear or front tamping unit segments **4** of the inline tamping unit.

[0042] On the free side of the asymmetrical tamping unit segment **4**, the lower bearing of the squeezing drive **19** is moved outwards. As a result, a longer hydraulic cylinder with a increased stroke can be used as a squeezing drive **19**. In this way, the squeezing distance of the assigned tamping tool **9** increases. The angle α between the cylinder axis **27** of the longer hydraulic cylinder and the vertical axis **28** is greater than 20° , for example 40° .

1. A tamping unit for tamping sleepers of a track, comprising a tamping unit segment with opposing tamping tools tiltably mounted on a height-adjustable tool carrier, with the respective tamping tool being coupled with a vibration drive via a transmission element, wherein the respective transmission element is connected with the assigned tamping tool via a first joint and with a squeezing drive supported on the same tamping tool via a second joint.

2. The tamping unit according to claim 1, wherein the respective transmission element is linked to the vibration drive via a third joint.

3. The tamping unit according to claim 2, wherein the third joint is arranged between the first joint and the second joint.

4. The tamping unit according to claim 1, wherein the vibration drive is designed as an eccentric drive.

5. The tamping unit according to claim 4, wherein each transmission element is connected with an eccentric arm mounted on an eccentric section of an eccentric shaft of the eccentric drive in an articulated manner.

6. The tamping unit according to claim 1, wherein the respective squeezing drive is designed as a hydraulic cylinder with an approximately vertically aligned cylinder axis.

7. The tamping unit according to claim 6, wherein each squeezing cylinder is linked to the assigned tamping tool on the cylinder side and to the assigned transmission element on the piston rod side.

8. The tamping unit according to claim 6, wherein an angle (α) between the respective cylinder axis and a vertical axis is at most 20° , in particular at most 10° , during a squeezing process.

9. The tamping unit according to claim 1, wherein the respective tamping tool has an upper lever arm and a lower lever arm, that the lower lever arm comprises at least one tamping tine, and that the upper lever arm is connected with the assigned transmission element.

10. The tamping unit according to claim 9, wherein at least one tamping tine is arranged in a tamping tine support that can be tilted upwards.

11. The tamping unit according to claim 1, wherein the respective tamping unit segment comprises only two tamping tools for tamping a single sleeper of the track.

12. The tamping unit according to claim 11, wherein several tamping unit segments are arranged one behind the other for the simultaneous tamping of adjacent sleepers of the track.

13. The tamping unit according to claim 12, the tamping unit segments arranged one behind the other are arranged in a shared tamping unit frame and that each tamping unit segment is height-adjustable separately by means of an assigned height-adjustment drive.

14. The tamping unit according to claim 12, wherein only some of the tamping unit segments (4) have tamping tine supports (12, 13) that can be tilted upwards.

15. A track tamping machine according to claim 12, wherein at least two tamping unit segments are of identical design.

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