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Description

The invention relates to a tamping unit for tamping a track bed of a track system, wherein the tamping unit has a longitudinal direction which extends substantially in the direction of a longitudinal extent of the track system, wherein the tamping unit has at least one displacement device, on which at least one carrier box is arranged, wherein multiple tamping picks which can be adjusted in the direction of their longitudinal axes and which can be pivoted in the longitudinal direction are arranged on the carrier box, wherein the tamping picks are arranged in at least two rows which are spaced apart from one another and which extend transversely to the longitudinal direction, wherein at least one tamping pick of one row and at least one tamping pick of the adjacent row are substantially aligned in the longitudinal direction, and wherein at least one of the substantially aligned tamping picks can be pivoted in the longitudinal direction independently of the other substantially aligned tamping pick.

The invention further relates to a tamping machine for tamping a track bed of a track system.

Track systems generally comprise a track which is arranged on a track bed, comprising two rails which extend parallel with each other and in the longitudinal extent of the track system and which are arranged on sleepers which are spaced apart from each other and which extend transversely relative to the longitudinal extent. The track bed which is arranged below the track may comprise ballast.

When track systems in which the track bed comprises ballast are tamped or underfilled, projections and recesses and horizontal displacements of the track as a result of underpinning of the sleepers are overcome with ballast and by lifting or displacing the track.

Currently, different systems and units can be used for this purpose. Many of these systems blow air into the ballast via a nozzle which is introduced between the sleepers into the ballast, in other generic systems tamping picks penetrate into the intermediate spaces between the sleepers of the track, in order to compress the ballast of the track bed below the sleepers.

In known tamping units which are provided with tamping picks, these are arranged on carrier boxes which are lowered and raised during tamping. Consequently, all tamping picks of a carrier box are lowered at the same time or all tamping picks are introduced in the track bed at the same time. Since, in some regions of the track system, for example, at points, there is little or no space at all for the introduction of individual tamping picks, the tamping picks can be pivoted to the side, generally in pairs, using a mechanical adjustment mechanism on the carrier box. Some of the tamping picks of the carrier box are thereby not introduced in the track bed.

In order to facilitate the introduction of the tamping picks in the track bed, the tamping picks of known tamping units can be caused to vibrate in pairs using a mechanical exciter (for example, a camshaft or a hydraulic cylinder) which is connected to the adjustment mechanism - in most cases, at a frequency of 25 to 50 Hz and a deflection of from 2 to 8 mm.

Depending on the tamping machine, on which the tamping unit is arranged, the tamping is carried out in a cyclical or almost continuous manner. During cyclical tamping, the tamping machine is braked for each individual tamping operation, whereas, during continuous tamping, only the portion of the tamping machine on which the tamping unit and the operating region of the tamping unit are arranged has to be braked. The tamping machine may be a vehicle which travels on the rails but also a vehicle which travels beside the rails.

In known tamping machines, during the tamping operation, a lifting and alignment unit which is independent of the tamping unit additionally engages on the rails of the track and adapts the position of the track, based on an ACTUAL track position measured with a measuring device, to a predetermined DESIRED track position.

Tamping units having tamping picks are known, for example, from US 3,430,579A and AT 227 750 B. Other tamping units with tamping picks are known, for example, from AT 385 298 B, US 4, 369,712 A, WO 2016/054667 A1 and GB 1 358 762 A.

The disadvantage of known tamping units is that they are configured in an extremely solid manner. This is a result, on the one hand, of the fact that they have additional pivot arms for pivoting the tamping picks and, on the other hand, that the drives which are installed therein are configured to be very strong and therefore to be very heavy since the carrier boxes have to be lowered and raised as a whole including all the tamping picks and the drive devices thereof.

Furthermore, the tamping picks in known tamping units can be introduced in the track bed or pivoted only together, whereby a selective tamping which is adapted to the respective nature of the track bed is not possible.

It is also disadvantageous that the tamping unit, the lifting and alignment device and the measuring device are three operating units which are independent of each other. Furthermore, the measuring device for detecting the ACTUAL track position is arranged outside the tamping unit, whereby the correction of the track position is made more difficult.

An object of the invention is to provide an improved tamping unit, an improved tamping machine and an improved method for tamping a track bed.

This object is achieved according to the invention with a tamping unit which has the features of claim 1 and a tamping machine which has the features of claim 11.

The dependent claims relate to preferred and advantageous embodiments of the invention.

In the tamping device according to the invention, at least one of the tamping picks which are substantially in alignment can be pivoted in the longitudinal direction independently of the other tamping pick which is substantially in alignment. The ballast at both sides of the sleepers of the track can thereby be pushed to differing degrees below the sleeper so that the tamping operation can be individually adapted to the circumstances of the track bed in the region of each sleeper.

The fact that the tamping picks are substantially in alignment in the longitudinal direction means in the context of the invention that, when viewed in the longitudinal direction, they are arranged substantially in a straight line. In the context of the invention, however, tamping picks which when viewed in the longitudinal direction are arranged slightly offset from each other are also considered to be substantially in alignment.

Preferably, both tamping picks can be pivoted independently of the other respective tamping pick in the longitudinal direction and can be pivoted towards the other tamping pick or away from the other tamping pick depending on requirements. The track bed can thereby be compressed in a more selective and effective manner.

Since, with a tamping unit according to the invention, at least one of the tamping picks can be adjusted independently of other tamping picks in the direction of the longitudinal axis thereof, individual regions on the track system can be omitted during the tamping operation. Furthermore, weight can be saved on the tamping unit since the requirement for pivoting the tamping picks to the side is dispensed with. Furthermore, the entire mass of the carrier body does not have to be lowered and raised during the tamping operation.

According to the invention, in the context of the invention, all the tamping picks of the tamping unit can be adjusted independently of each other in the direction of the longitudinal axis thereof so that during the tamping operation any number of tamping picks which are adapted to the present circumstances can be introduced in the track bed. It is thereby possible for the tamping operation to be carried out in a particularly effective manner in all regions of the track system, for example, even at points.

It is particularly advantageous in the context of the invention for multiple, particularly all tamping picks of a row to be arranged substantially aligned in the longitudinal direction with a respective tamping pick of an adjacent row, and for at least one of the substantially aligned tamping picks to be able to be pivoted in the longitudinal direction independently of the other substantially aligned tamping pick, respectively. In a particularly preferred manner, both substantially aligned tamping picks can be pivoted independently of each other in the longitudinal direction. A tamping unit which is configured in this manner can consequently compress the track bed in a more selective and effective manner over the entire length of the rows.

According to the invention, the tamping picks are guided in the direction of the longitudinal axis thereof in each case in a carrier which is arranged on the carrier box and on which a first drive for adjusting the tamping pick is arranged. The carrier preferably has sliding or roller bearings for guiding the tamping pick. In the event that the first drive is a hydraulic or pneumatic drive, the pressure cylinder may also be configured at the same time as a carrier. Alternatively or additionally, the carrier may have magnetic bearings or act as a magnetic guide so that the tamping pick can be moved up and down in a friction-free manner.

In another preferred embodiment, there is provision for the tamping picks to be connected to their first respective drive by means of a preferably shock-absorbing coupling element. The coupling element has damping properties, in particular in the direction of the longitudinal axis, in a particularly preferred manner also transversely relative to the longitudinal axis, and is, for example, produced from plastics material. The risk can thereby be reduced of the first drive being damaged by impacts which occur in particular when the tamping pick is introduced in the track bed.

According to the invention, each of the carriers is pivotably supported on the carrier box and the tamping picks can be pivoted about a transverse axis in the longitudinal direction by means of additional drives which are in particular connected to the carriers on the carrier box. Preferably, each of the carriers is supported on the carrier box in a lower region, for example, by means of a pivot pin, and connected to the carrier box in an upper region which is spaced apart therefrom by means of the additional drive. The carrier thereby acts as a lever arm so that a reduced force has to be applied by the additional drive in order to pivot the carrier, and consequently the tamping pick which is introduced or has been introduced in the track bed.

In the context of the invention, it is possible to connect each carrier to a separate additional drive. In a particularly preferred manner, however, a plurality of, in particular in each case two or three carriers of a row are connected to a common additional drive. Consequently, space and weight can be saved. In another embodiment which is possible in the context of the invention, all carriers of a row are connected to a common additional drive.

Also in the context of the invention, embodiments are possible and preferred in which the tamping pick(s) can be pivoted not only in the longitudinal direction, but also obliquely relative thereto. During the tamping operation, the tamping pick(s) can thereby be pivoted obliquely relative to the longitudinal direction and consequently also in the direction of the closest rail in order to push the ballast in the direction of a region of the track bed below the intersection location of the rail and sleeper. Consequently, the track bed can be compressed to a particularly significant extent in the region or regions to which the highest pressure is applied by passing rail vehicles.

In order to be able to pivot at least one, preferably a plurality or even all of the tamping picks in an oblique manner, for example, in a preferred embodiment with carriers, each of these carriers may be arranged on the carrier box by means of an adjustment device. Using such an adjustment device, the carriers can also be pivoted on the carrier box transversely relative to the longitudinal direction and consequently on the whole obliquely relative to the longitudinal direction.

The adjustment devices are in a preferred embodiment, for example, formed in that in an upper region, in particular in an upper end region of the first drive, an adjustment drive engages on each of the carriers, and in that the carriers are additionally supported on the carrier box by means of spherical joints, spherical heads, ball joints, or other similar movable connections and connected to the additional drive. By moving the adjustment drive in or out, the upper region of the carrier is moved transversely relative to the longitudinal extent and the carrier which is pivotably supported on the carrier box in the lower region is pivoted transversely relative to the longitudinal extent. With simultaneous activation of the additional drive, which brings about the pivoting of the carrier about a pivot axis which extends transversely relative to the longitudinal extent, and the adjustment drive, which brings about the pivoting of the carrier about a pivot axis which extends in the direction of the longitudinal extent, the carrier or the tamping pick which is received therein can be pivoted obliquely relative to the longitudinal direction.

In a preferred embodiment, the tamping picks can be caused to vibrate by means of the first and/or an additional drive in and/or transversely relative to the direction of the longitudinal axis thereof. On the one hand, less force thereby has to be applied in order to introduce the tamping picks into the track bed and, on the other hand, the ballast can thereby be compressed below the sleepers in an even more effective manner. In contrast to conventional tamping units, with the tamping unit according to the invention each tamping pick can be caused to vibrate at a different amplitude and frequency.

In the context of the invention, it is possible or preferable for at least one of the tamping picks, preferably all the tamping picks, to have sliding elements in the region of the/their surface. These sliding elements are, for example, produced from plastics material, preferably an elastomer material, in particular a thermoplastic elastomer material based on urethane. The sliding elements may be configured as ribs which are received with bases in grooves which extend on the tamping pick in the direction of the longitudinal axis and which protrude with a head from the surface of the tamping pick. As a result of the sliding elements, the noise which is produced when the tamping picks are introduced into the track bed or when the ballast of the track bed is compressed can be reduced and the tamping pick can be protected from wear.

In the context of the invention, an embodiment is preferred in which the carrier box can be adjusted transversely to the longitudinal direction along at least one transverse guide of the displacement device. As a result of the transverse guide, the tamping unit can advantageously be adapted to different track widths or a secant offset which occurs when the track system is tamped on bends can be corrected. The adjustment can be carried out manually, for example, by means of an adjustment thread, or automatically by means of a drive which preferably connects the carrier box to the displacement device.

In a preferred embodiment, the displacement device can be adjusted along at least one longitudinal guide in the longitudinal direction. It is thereby possible for the tamping operation to be carried out with the tamping unit according to the invention, whilst the tamping machine on which the tamping unit is arranged is moved continuously along the track system. In this instance, the displacement device is displaced with the tamping picks introduced or lowered along the longitudinal guide counter to the movement direction of the tamping machine so that the displacement device during the tamping remains at the same location in the track system and after the operational intervention has been completed can be rapidly moved forward in the movement direction of the tamping machine. The displacement of the displacement device in the longitudinal direction is preferably carried out automatically by means of a drive, for example, by means of a hydraulic drive.

In another preferred embodiment, there is provision for there to be arranged on the displacement device an aligning unit which can also be referred to as a lifting and aligning unit and which has means which can be adjusted vertically and/or transversely relative to the longitudinal direction, preferably independently of each other, in particular rollers and/or wheels which can be arranged on a track of the track system and by means of which the track of the track system can be aligned vertically and/or transversely relative to the longitudinal direction. To this end, the aligning unit may, for example, have an axle on the ends of which wheels are arranged with a fixed spacing with respect to each other which is adapted to the track width. In order to be able to compensate for the vertical position of the track, but also compensate for differences in the vertical position between the two rails of the track, the axle of the aligning unit can be vertically adjusted at both ends independently of the respective other end by means of a drive.

A particularly advantageous aspect in the embodiment of the tamping unit with an integrated aligning unit is that the track can be aligned directly in the direction in which the tamping operation is carried out. As a result of this arrangement, a higher working speed is possible since the aligning unit can constantly retain the rails of the track. During a continuous tamping operation, that is to say, during continuous forward movement of the tamping machine on which the tamping unit is arranged, the displacement device remains together with the aligning unit during introduction of the tamping picks locally at the engagement location. If the working intervention is complete, the alignment unit which has been displaced into a floating position moves forwards on the track together with the displacement device without releasing the track.

It is particularly preferable in the context of the invention for each row of tamping picks to comprise at least two, preferably at least four, or more than four tamping picks. Two rows which are associated with each other and which are adjacent to each other have a spacing from each other which is greater than the sleepers of the track are wide so that, when viewed during tamping in the longitudinal direction, one of the rows is introduced in front of a sleeper and the other row is introduced behind the sleeper in the ballast of the track bed.

In a preferred embodiment, in which the rows of tamping picks have at least two, preferably four or more, tamping picks, at least one tamping pick, preferably two or more tamping picks, can be arranged at both sides of a rail of the track in each case. This enables a selective compression of the ballast in the region below the sleeper in which the rail is mounted. In the context of the invention, the tamping picks in the case of two or more than two tamping picks per row do not have to be introduced at both sides of the rail in the track bed, but instead can also be arranged or introduced during tamping only at one side of the rail.

In the context of the invention, there may be provision for the longitudinal guide to be able to be adjusted along a main guide which extends transversely relative to the longitudinal direction. Consequently, the entire tamping unit on which it is arranged can be displaced transversely to the tamping machine, whereby the introduction position of the tamping picks can be adapted transversely relative to the longitudinal direction. It is thereby possible, for example, for a secant offset which occurs on bends to be corrected.

In the context of the invention, there may be provision for two or more than two tamping picks to be able to be adjusted in groups, for example, in pairs, independently of the other tamping picks using a common drive. The two or more than two tamping picks may have a common first drive for adjustment in the direction of the longitudinal axis thereof and/or a common additional drive for pivoting in the longitudinal direction of the track system.

In a particularly preferred embodiment, the displacement device has at least two carrier boxes which can each be arranged above one of the rails of the track. The tamping unit can thus be adapted in a particularly simple manner to track systems having a different track width by only the spacing between the carrier boxes being changed. In the context of the invention, however, there may also be provided an individual carrier box which is, for example, configured to be so wide that the tamping picks which are arranged therein can be introduced in the track bed in the region of both rails of the track. Preferably, the tamping unit on a displacement device has two carrier boxes each with sixteen tamping picks since a particularly effective and universally adaptable operation is thereby possible.

It is particularly preferable in the context of the invention for at least one, preferably each, of the drives to be an electrical, pneumatic or hydraulic drive. The drives may in this instance all be of the same type, for example, hydraulic drives, but also of different types of drives. In a particularly preferred manner, the first and the additional drives are hydraulic drives. In the context of the invention, for all drives or for some of the drives, a common control or regulation device may be provided. It is also possible in the context of the invention for the movements of individual or all drives to be detected by means of sensors.

Preferably, the tamping unit in the context of the invention may have at least one means for measuring the resistance against the adjustment and/or pivoting of the at least one tamping pick. The measurement means may be provided to measure the resistance against the adjustment in the direction of the longitudinal axis of the tamping pick and/or the resistance against the pivoting in a longitudinal direction. In a particularly preferred manner, the tamping unit has a plurality of such means so that the resistance against the adjustment of a plurality, in particular all of the tamping picks can be measured. The presence of such a means or such measurement means affords the advantage that the force which has to be applied for adjusting or pivoting can be adapted dynamically, preferably in a manner controlled by means of a control unit to the prevailing conditions. It is thereby possible using the tamping unit according to the invention to carry out a tamping operation in a particularly effective, in particular energy-saving and/or low-noise manner.

In a particularly preferred manner, the measurement means is a sensor which is preferably arranged on a drive. The measurement means may, for example, be a pressure sensor, or a pressure measurement cell or a force measurement sensor or a force measurement cell which is arranged directly on or in the drive or in the region of the drive. If the tamping picks have coupling elements, for example, the measurement means, in particular a pressure measurement cell, may be arranged between the tamping pick and the coupling element. As a result of an arrangement of the measurement means directly on the drive, the resistance against the adjustment can be measured to the greatest possible extent free from external influences.

In the context of the invention, there may be provision for two or more than two displacement devices to be arranged in the longitudinal direction, preferably on a common longitudinal guide. Consequently, it is possible to work more rapidly since at the same time in the region of two, three or more than three sleepers which are arranged beside each other in the longitudinal extent of the track system can be tamped. Of course, between two or more sleepers, below which the track bed is tamped, there may also be one or more sleepers which are already underfilled or which are only subsequently underfilled. The displacement devices each have at least one, but preferably two carrier box(es) and can be introduced synchronously with the tamping picks in the track bed, compress the ballast and subsequently move forwards, or operate in a time-staggered operating cycle.

In a preferred embodiment, the aligning unit, in particular with the adjustable means thereof, and/or a measuring device is/are arranged when viewed in the longitudinal direction centrally between two of the rows of tamping picks. If the tamping unit has two or more than two displacement devices, but only one aligning unit or a measuring device, there may in particular be provision for the aligning unit with the adjustable means thereof and/or the measuring device to be arranged when viewed in the longitudinal direction centrally between two of the displacement devices.

The measuring device which is preferably provided and which is arranged between two of the rows of tamping picks or between two displacement devices serves in particular to measure an ACTUAL track position. An ACTUAL track position which is established with a measuring device which is arranged in such a manner can be compared in a particularly effective manner with a predetermined DESIRED track position since few or no correction factors have to be taken into account. The arrangement of the aligning device between two of the rows of tamping picks or between two displacement devices is also particularly advantageous since the track is consequently also orientated directly in the region in which it is underfilled. Deviations of the ACTUAL track position from the DESIRED track position which are produced as a result of the underfilling, and/or displacements of the track bed which occur as a result of the orientation can thereby be prevented. The measurement of the ACTUAL track position can be carried out with sensors, for example, optical sensors, and/or supported by satellite, in particular by means of GPS position detection.

If the tamping unit according to the invention has two carrier boxes, the measuring device when viewed transversely relative to the longitudinal direction is preferably arranged between the carrier boxes. Also as a result of these structural measures, the ACTUAL track position can be compared in a particularly effective manner with a predetermined DESIRED track position, wherein only a few or no correction factors have to be taken into account.

The tamping machine according to the invention for tamping a track bed of a track system has a machine frame which is arranged on two rail chassis and which extends in a longitudinal machine direction. Furthermore, the tamping machine has a tamping unit which, when viewed in the longitudinal machine direction, is preferably arranged on the machine frame between the rail chassis and/or over a main guide of the tamping unit which extends transversely relative to the longitudinal machine direction. In the context of the invention, there is provision for the tamping unit to be a tamping unit according to one of the embodiments described above.

It is particularly preferable for, with the tamping machine, the operating station, from which an operator can control or monitor the underfilling and/or the alignment of the track to be decoupled from the movement or adjustment of the tamping unit in the direction of the longitudinal extent and transversely relative thereto.

In a method for tamping a track bed of a track system having a longitudinal extent, in which at least two tamping picks which can be pivoted in the direction of the longitudinal extent are arranged substantially in alignment in the direction of the longitudinal extent, at least one of the tamping picks which are substantially in alignment is pivoted independently of the other substantially aligned tamping pick in the longitudinal direction. In a particularly preferred manner, however, both of the substantially aligned tamping picks are pivoted independently of each other.

As a result of the independent pivoting of one or both tamping picks, the ballast at both sides in the track bed can be compressed to differing degrees or be pushed under a sleeper positioned on the track bed. The tamping operation can consequently be adapted individually to the circumstances of the track bed in the region of each sleeper.

It is preferable in the method for at least one of the substantially aligned tamping picks to be moved alternately with a head over a first distance towards the other substantially aligned tamping pick and over a second distance away from the other substantially aligned tamping pick. The oscillating movement which is carried out in this instance is in the context of the invention referred to as a tamping stroke. The first distance is greater than the second distance so that the head with each tamping stroke moves closer to the other substantially aligned tamping pick. As a result of this oscillating movement, during which the tamping picks are moved towards each other, the oscillating tamping pick can be introduced into the track bed in a particularly low-noise and low-resistance manner.

The distances may remain the same during the method so that the first distance and second distance are of the same length for each tamping stroke. The distances, for example, as a result of known data relating to the nature of the track bed, may consequently be preadjusted and no longer have to be adjusted during the tamping of the track system.

However, it is also possible for the distances to be varied and to have different lengths with some or all tamping strokes. Preferably, the distances are varied in accordance with a measurement of the resistance against the adjustment of at least one the substantially aligned tamping picks, which measurement is carried out in parallel with the tamping operation, wherein a control may be provided for this purpose.

For the method, the tamping unit which has been described above or the tamping machine which has been described is used.

Other details, features and advantages of the invention will be appreciated from the following description with reference to the appended drawings, in which preferred embodiments of the invention are illustrated. In the drawings:
Figure 1 is an isometric view of a tamping unit according to the invention, in a state arranged on a track system,
Figure 2 is a side view of the tamping unit according to the invention from Figure 1,
Figure 3 is another side view of the tamping unit according to the invention from Figure 1,
Figure 4 is a section through the tamping unit according to the invention from Figure 1 along a plane of section IV-IV,
Figure 5 is an isometric view of a tamping pick having a carrier,
Figure 6 is a side view of another embodiment of a tamping pick,
Figure 7 is an enlarged view of the tamping pick from Figure 6 along the plane of section VII-VII,
Figure 8 is a schematic side view of a carrier having a tamping pick during a method, and
Figure 9 is an isometric view of the tamping unit according to the invention according to another embodiment.

Figures 1, 2 and 3 show a tamping unit 1 according to the invention which is arranged on a track system 2 having a longitudinal extent 3. The tamping unit 1 is illustrated in Figure 1 as an isometric view, in Figure 2 as a side view, when viewed in the direction of the longitudinal extent 3, and in Figure 3 as a side view, when viewed in the direction transverse relative to the longitudinal extent 3. Figure 4 is a sectioned view of the tamping unit according to the invention along a plane of section IV-IV illustrated in Figure 3.

The track system 2 illustrated in Figures 1 to 4 comprises a track 4 which is arranged on a track bed 5 made of ballast. The track 4 has two rails 6 which extend parallel with each other and in a longitudinal extent 3 and which are secured to sleepers

7 which are spaced apart from each other and which extend transversely relative to the longitudinal extent 3.

The tamping unit 1 has a longitudinal direction 8 which extends substantially in the direction of the longitudinal extent 3 of the track system 2 and has a displacement device 9 on which two carrier boxes 11 are arranged.

Each carrier box 11 has plate elements 12 which extend substantially vertically and in the longitudinal direction 8 of the tamping unit 1. The plate elements 12 are connected to each other by means of rod elements 13 which extend substantially transversely relative to the longitudinal direction 8.

On each of the carrier boxes 11, a total of eight tamping picks 15 are arranged in two rows 16 which extend transversely relative to the longitudinal direction 8, each having four tamping picks 15. Each tamping pick 15 is guided in a carrier 17 and can be adjusted with a first drive 18 in a linear manner in the direction of the longitudinal axis 19 thereof.

The carriers 17 are connected to each other at a lower end 21 and at an upper end 22 in pairs by means of lower and upper rod-like connection elements 14a, 14b. At the lower end 21, the carriers 11 are pivotably arranged on the carrier box 11 by means of the lower rod-like connection elements 14a so that the carriers 17 – and consequently the tamping picks 15 – can be pivoted by means of an additional drive 23, which engages via the upper rod-like connection elements 14b on the upper end 22 and which is connected to the rod element 13, about a pivot axis which extends transversely relative to the longitudinal direction 8.

The plate elements 12 of the carrier boxes 11 have through-holes through which two transverse guides 24 which are supported on or in the displacement device 9 are guided. The carrier boxes 11 are spaced apart from each other on the transverse guides 24 in such a manner that one of the rails 6 is arranged in each case below both carrier boxes 11. The displacement device 9 is arranged in the centre between the carrier boxes 11.

In the carrier boxes 11, preferably independently of each other, two of the tamping picks 15 of each row 16 may be introduced outside and the other two tamping picks 15 of each row 16 may be introduced inside the rails 6 in the track bed 5.

Preferably, there are provided drives which are not illustrated and by means of which the carrier boxes 11 can be adjusted along the transverse guides 24 or by means of which the position of each of the carrier boxes 11 on the transverse guides 24 can be determined. The spacing between the carrier boxes 11 is generally orientated in accordance with the track width of the track 4 of the track system 2 which is intended to be tamped.

Alternatively or additionally, there may be provided in the context of the invention retention means by means of which the carrier boxes 11 can be secured with a predetermined, where applicable manually adjusted, spacing with respect to each other on the transverse guides 24.

The displacement device 9 has guide bushes 28 by means of which they are arranged on longitudinal guides 26 which extend in the longitudinal direction 8 and which can be adjusted or displaced along the longitudinal guides 26 by means of an adjustment drive 27.

The longitudinal guides 26 are received at the ends thereof in each case in a front and a rear retention member 29 when viewed in the longitudinal direction 8. Via these retention members 29, the longitudinal guides 26 are supported on a main guide 30 and can be adjusted or displaced along the main guide 30 transversely relative to the longitudinal direction 8. The displacement of the longitudinal guides 26 with the displacement device 9 which is arranged thereon along the main guide 30 is carried out by means of a drive which is not illustrated.

There is arranged on the displacement device 9 an aligning unit 31 which has means for detecting the rails 6 of the track 4. In the embodiment illustrated, these means are wheels 32 which are arranged at ends of an axle 33 and rollers 34. The wheels 32 and rollers 34 abut the rails 6 or detect them in such a manner that the aligning unit 3 can be moved in the direction of the longitudinal extent 3 freely along the track 4 but is fixed transversely relative to the longitudinal extent 3 on the rails 6 of the track 4.

The axle 33 is received in the region of each of the ends thereof in a bush 25, wherein each of the bushes 35 is pivotably connected to an arm of an associated anchor-like pivot element 36. Another arm of the pivot element 36 is pivotably arranged on the displacement device 9 and a third arm of each pivot element 36 is connected by means of an alignment drive 37 to another guide bush 38. Each of these additional guide bushes 38 is displaceably arranged on a respective additional longitudinal guide 39 which extends parallel with the longitudinal guide 26. The pivot elements 36 are, when viewed in the longitudinal direction 8, arranged substantially between the transverse guides 24.

By activating one of the aligning drives 37, the associated pivot element 36 is pivoted and the bush 35 which is connected thereto is raised or lowered. Both ends of the axle 35 can thereby be moved independently of each other and the corresponding rails 6 can be orientated vertically with respect to the longitudinal extent 3.

As a result of a displacement of the longitudinal guide 26 and the displacement device 9 which is arranged thereon with the aligning unit 31 transversely relative to the longitudinal extent 3, the track 4 can be orientated in the region of the aligning unit 31 which engages thereon transversely relative to the longitudinal extent 3.

There is arranged on the displacement device 9 a measuring device 41 which is located centrally between the carrier boxes 11 and consequently centrally between the rails 6 of the track 4. The measuring device 41 has sensors which are not illustrated in greater detail, such as, for example, optical sensors, and a radio device. Using the measuring device 41, an ACTUAL track position can be established and can be adapted by means of the aligning unit 41 during the tamping operation to a DESIRED track position.

The axle 33 of the aligning unit 31 is guided above the measuring device 41 by the displacement device 9 and is in this instance, for example, received in a through-hole, a recess or a pivot lug of the displacement device 9.

Figure 5 shows one of the tamping picks 15 of the tamping unit 1 according to the invention, which tamping pick has a head 42, a shaft 43 and the longitudinal axis 19. There is associated with the tamping pick 15 a carrier 17 whose lower end 21 faces the track system 2 during the tamping operation and whose upper end 22 faces away from the track system 2 during the tamping operation.

The tamping pick 15 is displaceably guided with the shaft 43 thereof in the carrier 17 in the longitudinal direction 8. The movement of the tamping pick 15 is carried out using the first drive 18 which is arranged at the upper end 22 of the carrier 17. In the embodiment illustrated, the first drive 18 is a hydraulic actuation drive having a cylinder, a piston which is guided therein, a control member and having hydraulic lines.

The piston of the first drive 18 is connected to the shaft 43 of the tamping pick 15 by means of a coupling element which is not illustrated, wherein this coupling element may also be configured in such a manner that it can damp the transmission of impacts between the tamping pick 15 and the first drive 18.

At the lower end 21 and at the upper end 22, the carrier 17 has recesses 44 for arranging the lower and upper rod-like connection elements 14a, 14b by means of which adjacent carriers 17 are connected to each other in pairs or to the carrier box 11.

Figures 6 and 7 show another embodiment of the tamping pick 15 of the tamping unit 1, wherein the tamping pick 15 is illustrated in Figure 6 as a side view and in Figure 7 as an enlarged section through the tamping pick 15 along the plane of section VII-VII illustrated in Figure 6.

In this embodiment, the tamping pick 15 has a large number of T-shaped grooves 45 which extend with spacing from each other in a uniform manner along a surface 46 of the shaft 43 of the tamping pick 15. At the surface 46, the grooves 45 are narrower than at the base thereof. Sliding elements 47 are in each case received with a base region 48 in the grooves 45, protrude from the shaft 43 and have an expanded head region 49. The head region 49 of the sliding elements 47 preferably adjoins the head region 49 of the adjacent sliding elements 47 so that the shaft 43 of the tamping pick 15 is shielded externally completely from the sliding elements 47. The sliding elements 47 are preferably produced from plastics material and act as noise and wear protection.

Figure 8 is a schematic illustration of the sequence of a method for tamping a track bed 5 using a tamping pick 15 of the tamping unit 1 according to the invention.

The tamping pick 15 is during the tamping operation continuously adjusted in the direction of the longitudinal axis 19 thereof, wherein the shaft 43 is pushed out of the carrier 17 and the free length L of the tamping pick 15 is increased. In addition, the head 42 is caused to vibrate SL via the first drive 18 which is not illustrated in the direction of the longitudinal axis 19.

The head 42, whilst it is driven forward by a depth T into the ballast of the track bed 5, is moved alternately about a first distance D_1 towards the substantially aligned tamping pick 15 (not illustrated) of the adjacent row 16 (in Figure 8, to the right) and about a second distance D_2 away from it (to the left in Figure 8). To this end, the carrier 17 on the carrier box 11 is pivoted about the lower rod-like connection element 14a in the longitudinal direction 8. A single pivoting about the first distance D_1, followed by a pivoting away about the second distance D_2 is considered to be a tamping stroke in the context of the invention.

The first distance D_1 is greater than the second distance D_2 so that the head 42 with every single tamping stroke and when viewed over the entire tamping operation (in Figure 8, to the right) is moved closer to the substantially aligned tamping pick 15 (not illustrated) of the adjacent row 16.

Preferably, the first distance D_1 is approximately from 2 mm to 8 mm, whilst the second distance D_2 is shorter, in particular from 1 mm to 7 mm, shorter than the first distance D_1. However, it is also possible in the context of the invention for the first distance D_1 and/or the second distance D_2 to be constant during a tamping operation for all tamping strokes or, however, for both or one of the distances D_1, D_2, to vary between the tamping strokes during a tamping operation.

If measurement means for the resistance against the adjustment of the tamping pick 15 are provided, it is possible for the distances D_1, D_2 to be changed in accordance with the measured resistance during the introduction into the track bed 5 so that the introduction is to the greatest possible extent energy efficient and/or low-noise.

It is also possible in the context of the invention for the head 42 of the tamping pick 15 in addition to and during the tamping strokes during the tamping operation to be caused to vibrate SQ in the longitudinal direction 8, wherein deflections as a result of this vibration are significantly smaller than the distances D_1, D_2.

After reaching a predetermined depth T, the head 42 is drawn and pulled out of the track bed 5 by the tamping pick 15 being adjusted in the direction of the longitudinal axis 19 and being introduced into the carrier 17. When the tamping pick 15 is pulled out, the tamping pick 15 can be pivoted as during the lowering operation or in the opposite direction or, however, not pivoted or only caused to vibrate SL about the longitudinal axis 19 until the head 42 has been removed from the ballast of the track bed 5.

Figure 9 shows the tamping unit 1 according to the invention according to another embodiment, in which the tamping picks 15 can be pivoted obliquely relative to the longitudinal extent 3.

Each carrier 17 is connected in an upper region, in particular in an upper end region 50 of the first drive 18, via an actuation drive 51 to a frame 52. In addition, the carriers 17 are supported by means of spherical joints 53, spherical heads, ball joints or similar movable connection 45 at the lower end 21 thereof on the carrier box 11 and connected at the upper end 22 thereof in each case to the additional drive 23.

The additional drives 23 are also preferably connected to the carrier box 11 by means of spherical joints 53, spherical heads, ball joints or similar movable connections.

By activating, that is to say, retracting or extending the actuation drive 51, the upper region of the carrier 17 is moved transversely relative to the longitudinal extent 3. A pivoting of the carrier 17 which is pivotably supported with the lower end 21 thereof about a pivot axis which extends substantially in the direction of the longitudinal extent 3 thereby takes place in the direction of the double-headed arrow VQ transversely relative to the longitudinal extent 3. When the additional drive 23 is activated at the same time, which brings about the pivoting of the carrier 17 about a pivot axis which extends transversely relative to the longitudinal extent 3 in the direction of the double-headed arrow VL, the carrier 17 or the tamping pick 15 which is received therein is pivoted obliquely relative to the longitudinal extent 3.

With the tamping unit 1 of this additional embodiment according to the invention, it is therefore possible to move the head 42 of each tamping pick 15 at the same time or in time sequence in the direction of the longitudinal extent 3, transversely relative to the longitudinal extent 3 in a vertical direction and transversely relative to the longitudinal extent 3 in a horizontal direction.

In the context of the invention, it is possible to also have embodiments of the tamping unit 1 according to the invention which are not illustrated and in which not all the carriers 17 are connected to an individual actuation drive 51, but instead in which a plurality of carriers 17 together or some carriers 18 are not connected at all to an actuation drive 51.

List of reference numerals

1. Tamping unit
2. Track system
3. Longitudinal extent (track system)
4. Track
5. Track bed
6. Rail
7. Sleeper
8. Longitudinal direction (tamping unit)
9. Displacement device
10. ---
11. Carrier box
12. Plate element
13. Rod element
14. (a, b) lower, upper connection elements
15. Tamping pick
16. Row of tamping picks
17. Carrier
18. First drive
19. Longitudinal axis
20. ---
21. Lower end
22. Upper end
23. Additional drive
24. Transverse guide
25. ---
26. Longitudinal guide
27. Actuation drive
28. Guide bushes
29. Retention member
30. Main guide
31. Aligning unit
32. Wheels
33. Axle
34. Rollers
35. Bush (on axle)
36. Pivot element

37. Aligning drive
38. Additional guiding bush (on additional longitudinal guide)
39. Additional longitudinal guide
40. ---
41. Measuring device
42. Head
43. Shaft
44. Recess
45. Groove
46. Surface
47. Sliding element
48. Base region
49. Head region
50. Upper end region
51. Actuation drive
52. Frame
53. Spherical joint

SL Vibration (in the direction of the longitudinal axis)
SQ Vibration (transversely relative to the longitudinal axis)
L Free length
T Depth
D_1 First distance
D_2 Second distance
D3 Third distance
D4 Fourth distance
VL Double-headed arrow (pivoting in the direction of the longitudinal extent)
VH Double-headed arrow (pivoting transversely relative to the longitudinal extent)

Patentkrav

1. Stoppeaggregat (1) til understopning af en sporkasse (5) i et sporlegeme (2), hvor stoppeaggregatet (1) har en længderetning (8), der i det væsentlige forløber i retning af en længdeudstrækning (3) af sporlegemet (2), hvor stoppeaggregatet (1) indbefatter mindst én rangeringsanordning (9), på hvilken der er placeret mindst én bærekasse (11), hvor der på bærekassen (11) er placeret flere stoppehakker (15), der kan indstilles i retning af deres længdeakser (19) og kan svinges i længderetningen (8), hvor stoppehakkerne (15) er placeret i mindst to rækker (16), der har en indbyrdes afstand og forløber på tværs af længderetningen (8), hvor mindst én stoppehakke (15) i en af rækkerne (16) og mindst én stoppehakke (15) i en tilstødende række (16) i længderetningen (8) i det væsentlige flugter med hinanden, hvor mindst en af stoppehakkerne (15), der i det væsentlige flugter med hinanden, kan svinges i længderetningen (8) uafhængigt af den anden i det væsentlige flugtende stoppehakke (15), kendetegnet ved, at stoppehakkerne (15) i retning af deres længdeakse (19) hver især er ført i en holder (17), som er placeret på bærekassen (11), og på hvilken der er placeret et første drev (18) til indstilling af stoppehakken (18) i retning af dens længdeakse (19), og kan indstilles uafhængigt af hinanden i retning af deres længdeakse (19), og at hver af holderne (17) er lejret svingbart på bærekassen (11), og at stoppehakkerne (15) kan svinges i længderetningen (8) ved hjælp af yderligere drev (23), der er forbundet med holderne.

2. Stoppeaggregat ifølge krav 1, kendetegnet ved, at flere, særligt alle, stoppehakker (15) i en række (16) er placeret således, at de i det væsentlige flugter med i hvert enkelt tilfælde en stoppehakke (15) i en tilstødende række (16) i længderetningen (8), og at i det mindste en af stoppehakkerne (15), der i det væsentlige flugter med hinanden, i hvert enkelt tilfælde kan svinges uafhængigt af den anden i det væsentlige flugtende stoppehakke (15) i længderetningen (8).

3. Stoppeaggregat ifølge krav 1 eller 2, kendetegnet ved, at holdere (17) er forbundet med et separat yderligere drev (23), og/eller at flere, særligt i hvert enkelt tilfælde to eller tre, holdere (17) i en række (16) er forbundet med et fælles yderligere drev (23), eller at alle holdere (17) i en række (16) er forbundet med et fælles yderligere drev (23).

4. Stoppeaggregat ifølge et af kravene 1 til 3, kendetegnet ved, at der på rangeringsanordningen (9) er placeret en indstillingsenhed (31), der indbefatter midler, der kan indstilles i vertikal og/eller horisontal retning på tværs af længderetningen (8), særligt ruller (34) og/eller hjul (32), som kan anbringes på skinnerne (6) i sporlegemet (2), og ved hjælp af hvilke sporet (4) i sporlegemet (2) kan justeres i vertikal og/eller horisontal retning på tværs af længdeudstrækningen (3), hvor indstillingsanordningen (31), særligt med sine indstillelige midler, og/eller en måleanordning (41) særligt foretrukket er placeret midt imellem to af rækkerne (16) af stoppehakker (15) set i længderetningen (8).

5. Stoppeaggregat ifølge et af kravene 1 til 4, kendetegnet ved, at rangeringsanordningen (9) kan indstilles langs i det mindste en længdeføring (26) i længderetningen (8) og/eller bærekassen (11) langs i det mindste en tværføring (24) til rangeringsanordningen (9) på tværs af længderetningen (8).

6. Stoppeaggregat ifølge et af kravene 1 til 5, kendetegnet ved, at der i længderetningen (8) er placeret to eller flere rangeringsanordninger (9), fortrinsvis ved en fælles længdeføring (26), hvor særligt foretrukket den eventuelt tilvejebragte indstillingsenhed (31), særligt med sine indstillelige midler, og/eller den eventuelt tilvejebragte måleanordning (41) er placeret midt imellem to rangeringsanordninger (9) set i længderetningen (8).

7. Stoppeaggregat ifølge et af kravene 1 til 6, kendetegnet ved, at hver af rækkerne (16) omfatter mindst to, fortrinsvis mindst fire stoppehakker (15), hvor der fortrinsvis på begge

sider af en skinne (6) i sporet (4) i sporlegemet (2) i hvert enkelt tilfælde kan placeres mindst én stoppehakke (15).

8. Stoppeaggregat ifølge et af kravene 1 til 7, kendetegnet ved, at to eller flere af stoppehakkerne (15) kan indstilles i grupper, eksempelvis parvist, uafhængigt af andre stoppehakker (15) ved hjælp af et fælles drev (18, 23).

9. Stoppeaggregat ifølge et af kravene 1 til 8, kendetegnet ved, at rangeringsanordningen (9) indbefatter mindst to bærekasser (11), der hver især kan placeres over en skinne (6) i sporlegemet (4), hvor fortrinsvis den eventuelt tilvejebragte måleanordning (41) set på tværs af længderetningen (8) kan placeres mellem de i det mindste to bærekasser (11).

10. Stoppeaggregat ifølge et af kravene 1 til 9, kendetegnet ved, at stoppeaggregatet (1) indbefatter mindst ét middel til måling af modstanden mod indstillingen og/eller svingningen af den i det mindste ene stoppehakke (15), hvor midlet til måling fortrinsvis er en sensor, særligt en tryksensor eller en kraftmålesensor, der særligt foretrukket er placeret på et drev (18, 23, 27, 37).

11. Stoppemaskine til understopning af en sporkasse (5) i et sporlegeme (2) med en maskinramme, der er placeret på to skinnechassiser og strækker sig i en maskinlængderetning, og et stoppeaggregat (1), der set i maskinens længderetning fortrinsvis er placeret mellem skinnechassiserne og/eller via en hovedføring (30), der forløber på tværs af maskinens længderetning, til stoppeaggregatet (1) på maskinrammen, kendetegnet ved, at stoppeaggregat (1) er udført ifølge et af kravene 1 til 10.

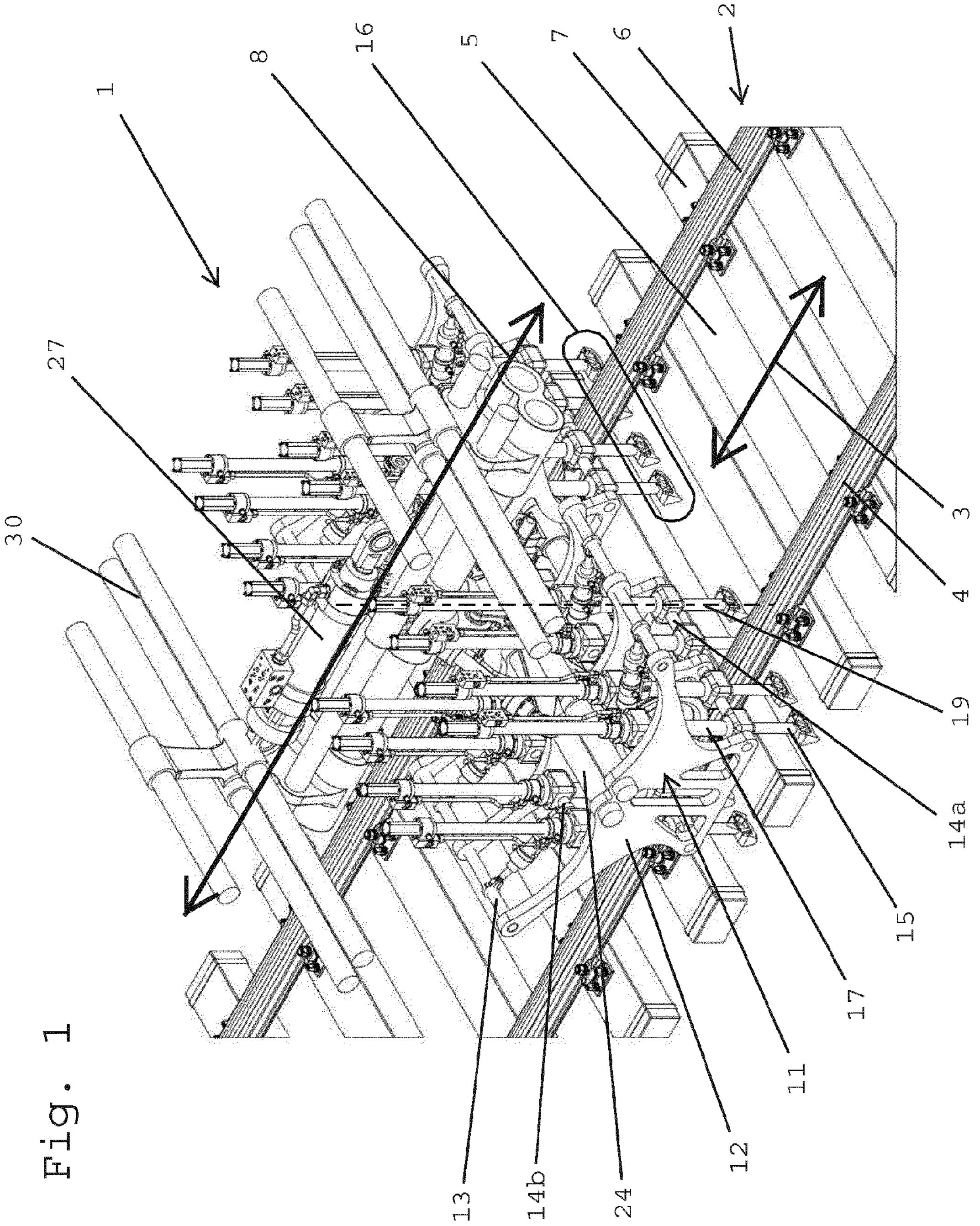
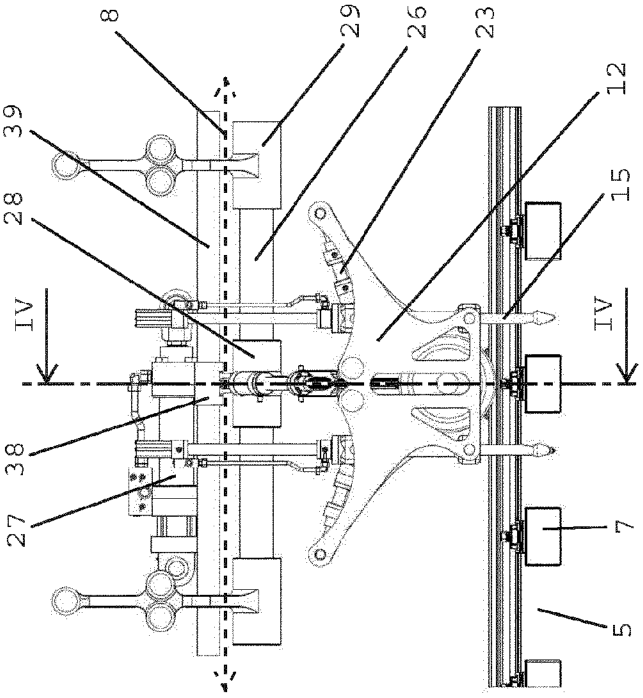


Fig. 1

Fig. 3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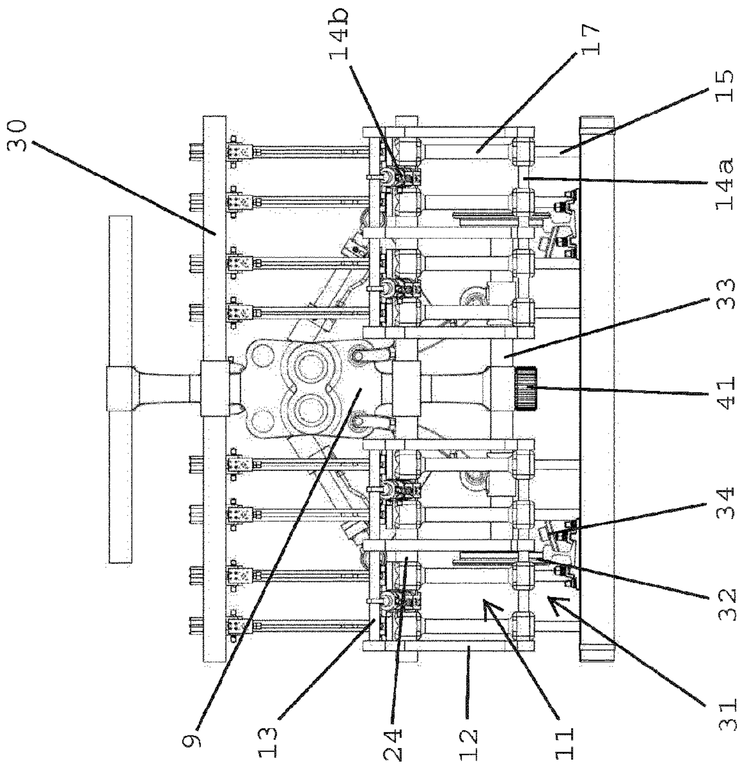
29
26
23
12
39
28
IV
15
38
27
7
5
IV

Fig. 2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14b
17
15
14a
33
41
34
32
31
11
12
24
13
9

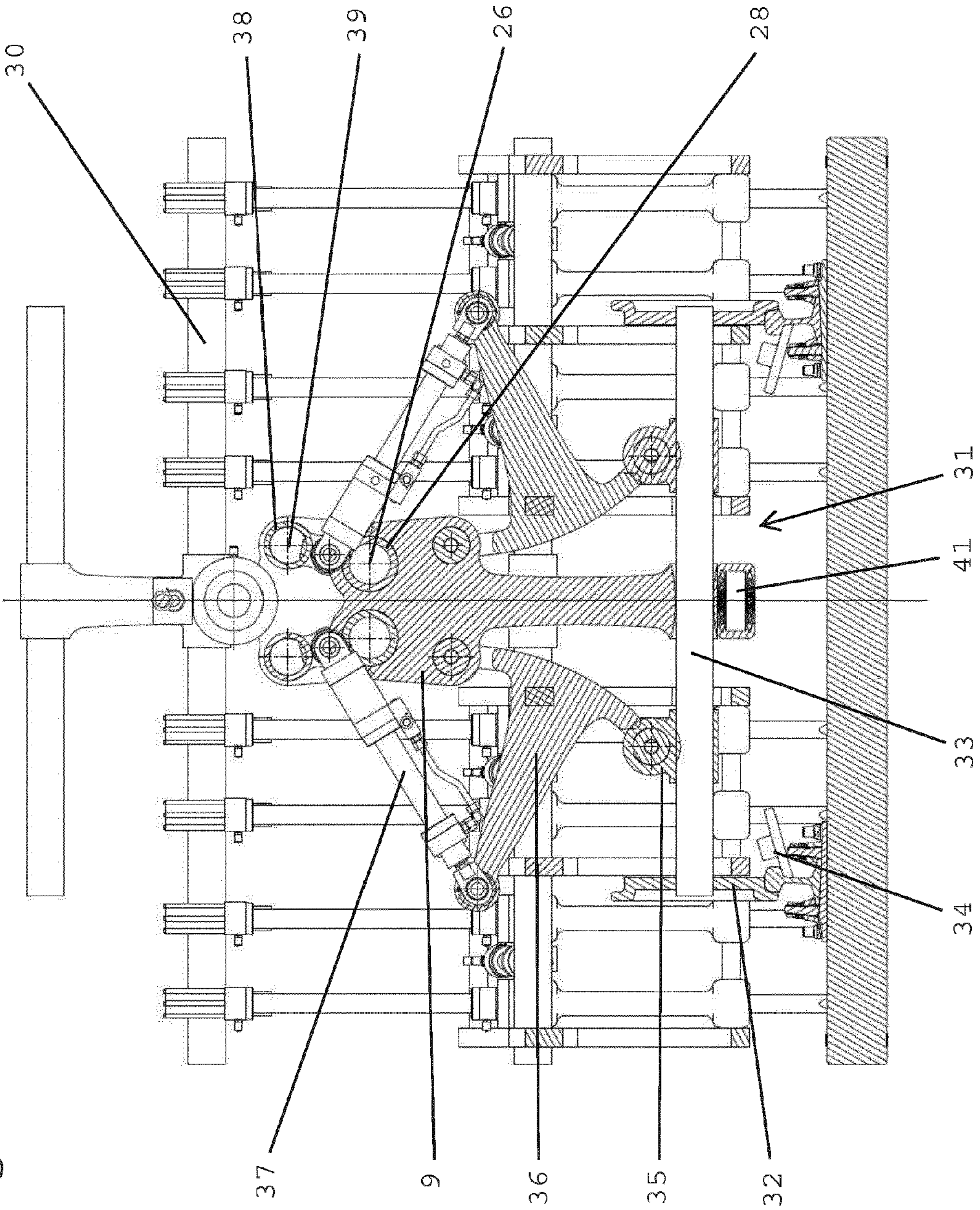


Fig. 4

Fig. 5

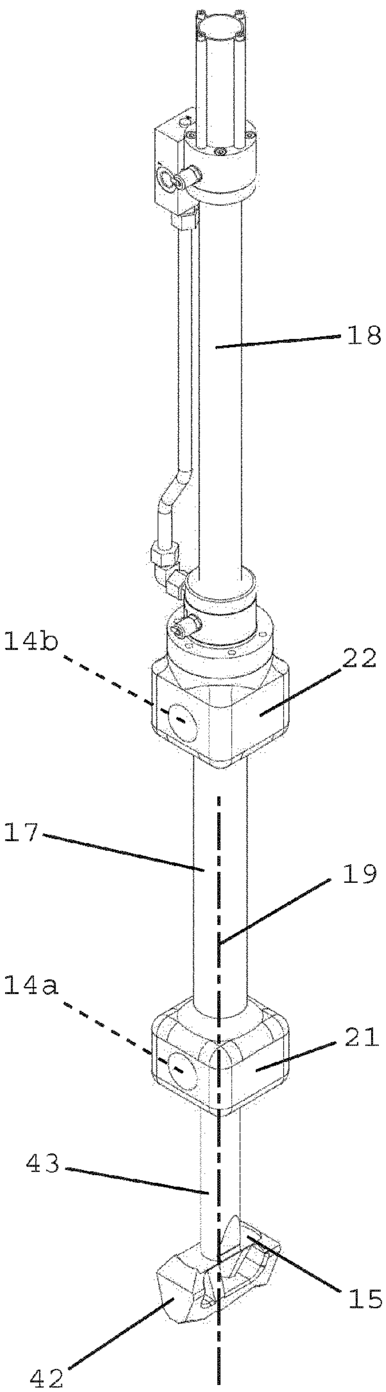


Fig. 6

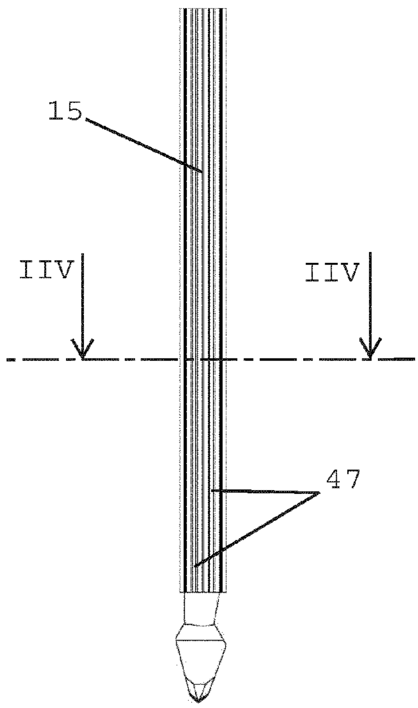


Fig. 7

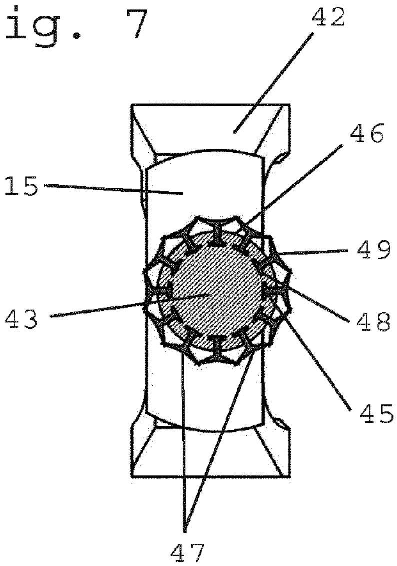
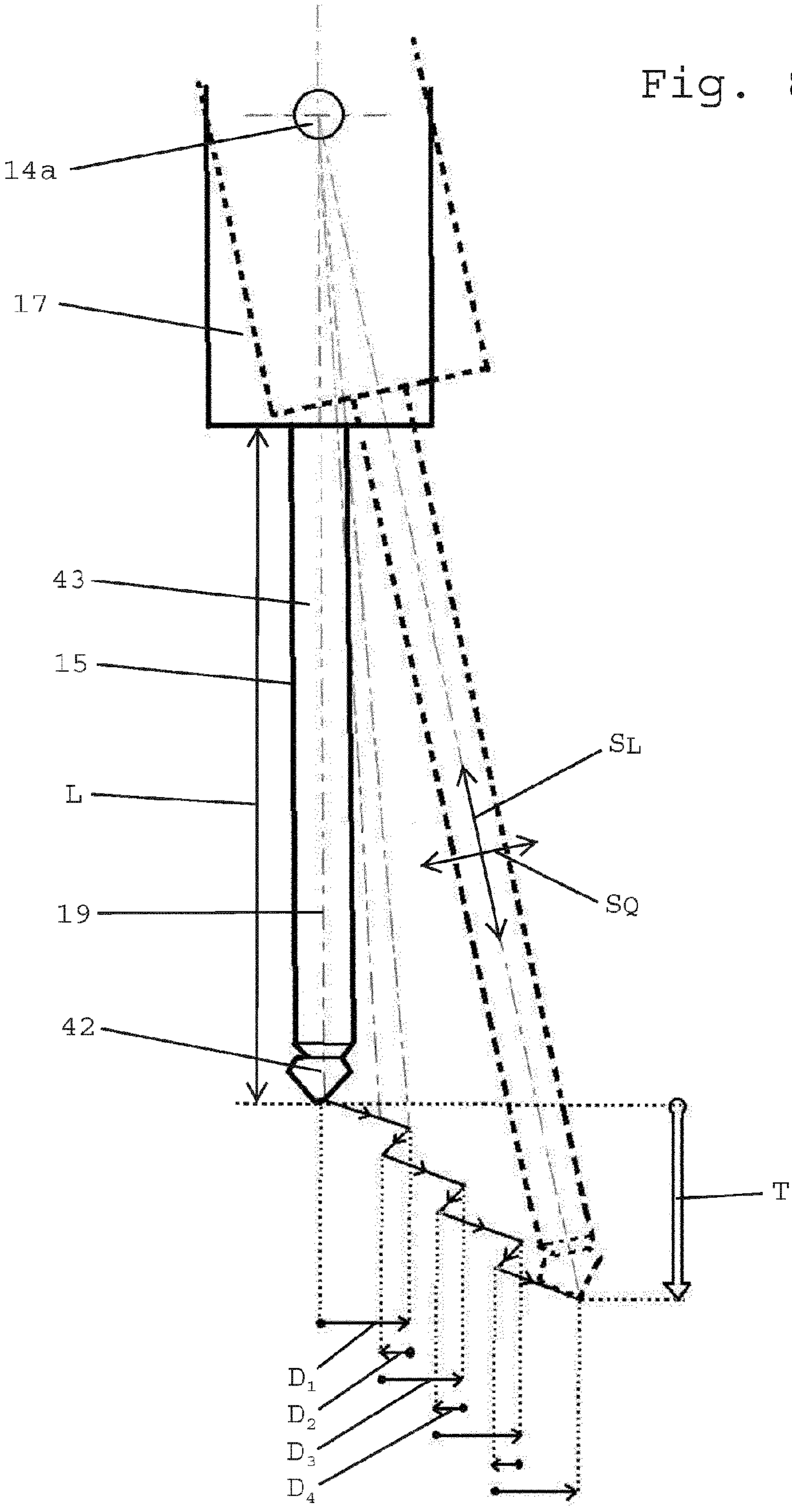


Fig. 8



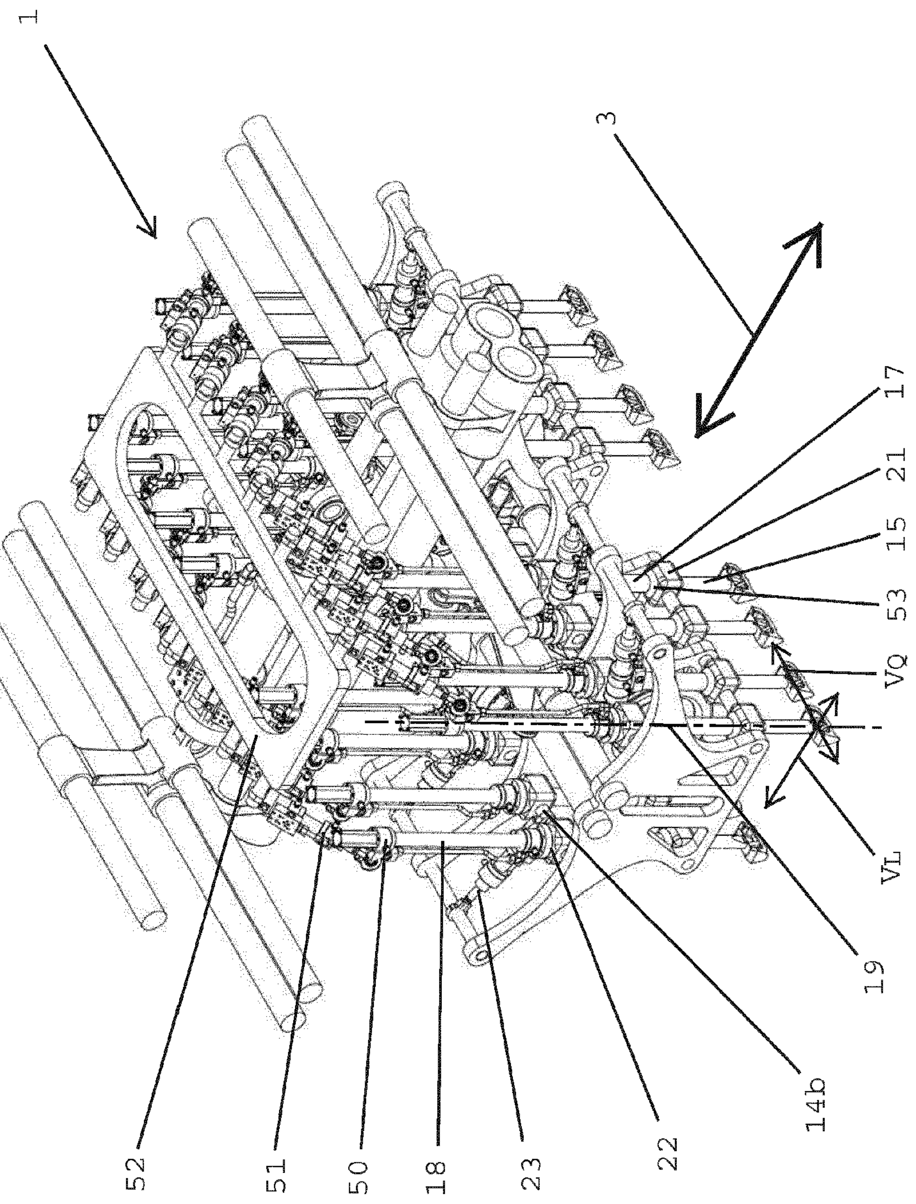


Fig. 9