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(54) **APPARATUS AND METHOD FOR APPLICATION OF A PAD TO A RAILWAY SLEEPER**

(57) An apparatus (1) for application of a pad (92) to a base of a railway sleeper made of concrete, said apparatus comprising:
- a form (2) in turn comprising at least a first tank (21) intended to receive a cast of concrete to form the sleeper;
- means (3) for detecting a parameter associated to a vertical component of a distance between at least one predetermined point and at least a point of the free surface of the concrete located in the first tank (21) of the form (2), preferably a laser measuring system (31);
- means (4) for positioning the pad (92) in the first tank (21) at a height that is a function of an input coming from the detection means (3).The positioning means (4) suitably comprise pad gripping means (5), e.g. suction cups, which can adjust the inclination of the rubber pad (92) with respect to a horizontal plane.

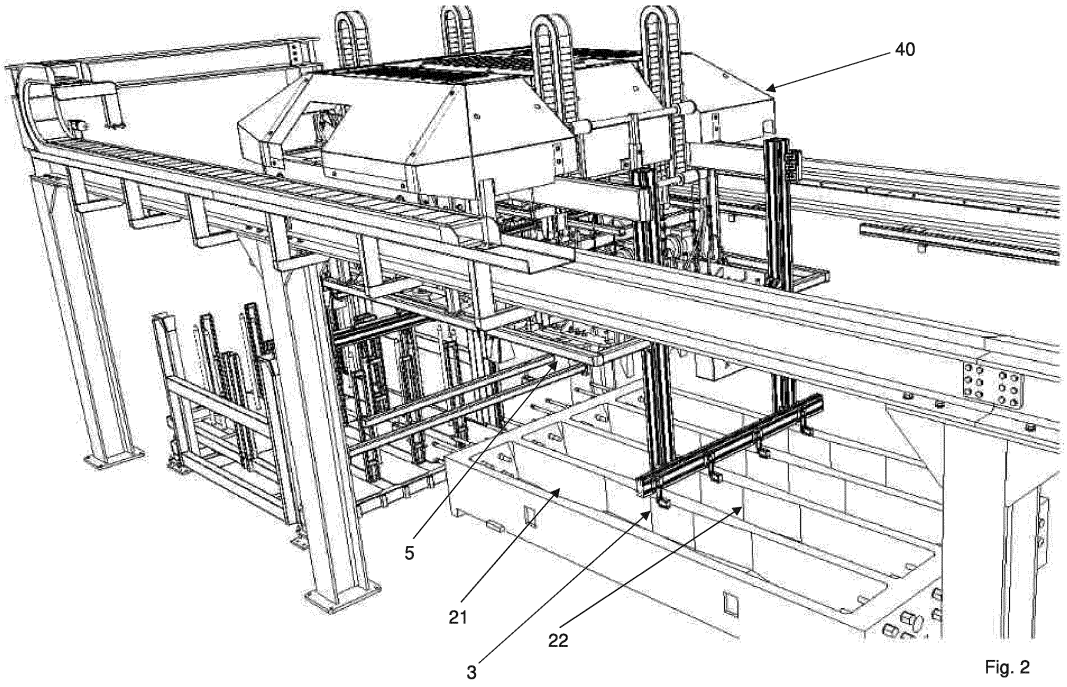

Fig. 2

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Description

[0001] The present invention relates to an apparatus and a method for application of a pad to a railway sleeper.

[0002] Rails intended for the transit of railway vehicles are known. The rails have a main longitudinal extension and rest on elements known as sleepers which follow one after the other at predetermined intervals.

[0003] As suggested by the name, the sleepers extend transversely to the longitudinal extension of the rails. One of the most common materials for the manufacture of sleepers is concrete.

[0004] A rubber pad is usually placed below the concrete sleeper which allows to better absorb the vibrations and facilitates the correct positioning of the sleeper, compensating for any irregularities of the support surface.

[0005] It is known to constrain the rubber pad to the concrete sleeper during the creation of the sleeper. In particular, a method for application of the pad to the sleeper comprises the steps of:

- introducing the concrete from above into a tank (form);
- positioning the pad above the tank at a predetermined height;
- lowering the pad from the top for a predetermined length, taking into account the (known and predetermined) height at which the form is located; this occurs before the solidification of the concrete;
- vibrating the concrete thus establishing the stable connection of the rubber pad with the concrete sleeper.

[0006] A drawback of such an embodiment solution is related to the fact that the level of concrete in the tank can vary slightly. This could be due to an error in dosing the concrete inside the tank or to an imperfect levelling of the concrete. Consequently, in some cases the pad is positioned inside the concrete too much or too little (penalising its function), making the connection with the concrete unstable.

[0007] In this context, the technical task underpinning the present invention is to provide an apparatus and a method for application of a pad to a railway sleeper which obviates the drawbacks of the prior art cited above. In particular, it is an object of the present invention to provide an apparatus and a method for application of a pad to a railway sleeper which allows a correct connection, minimising the connection unevenness detectable in sleepers made one after the other.

[0008] The technical task set and the objects specified are substantially attained by an apparatus and a method for application of a pad to a railway sleeper, comprising the technical features as set out in one or more of the accompanying claims.

[0009] Further features and advantages of the present invention will become more apparent from the indicative and thus non-limiting description of a preferred but not exclusive embodiment of an apparatus and a method for application of a pad to a railway sleeper, as schematically illustrated in the appended drawings, in which:

- figure 1 shows a perspective view of an apparatus according to the present invention;
- figures 2-7 show perspective views of details of the apparatus of figure 1;
- figure 9 shows a perspective view of a pad for sleepers to be used in the present invention;
- figure 8 shows a perspective view of a sleeper integrating the pad according to the present invention.

[0010] In the appended figures, the reference number 1 denotes an apparatus for application of a pad to a base of a railway sleeper made of concrete. Such a pad allows, for example, to better absorb vibrations and facilitates the correct positioning of the sleeper, compensating for any irregularities of the support surface. The pad can be in a single body or an assembly of several parts. Suitably, the pad is for example made of rubber, or of elastomeric or plastic material or a polyurethane foam (for example, it could be made of a material whose trade name is "Silomer"). The pad is a flexible element which is suitable for extending in a plane. Suitably, it has a thickness comprised between 0.5 and 3 centimetres. Preferably, when it is constrained to the concrete, it is intended to cover at least 90% of the base of the sleeper.

[0011] The apparatus 1 comprises a form 2 in turn comprising at least a first tank 21 intended to receive a cast of concrete to form the sleeper.

[0012] The form 2 could possibly comprise a plurality of tanks each intended for forming a sleeper (the first tank 21 is part of said plurality of tanks). Suitably, the same form 2 comprises a single body which defines a plurality of said tanks. The tanks are suitably placed side by side. Suitably, the tanks of the same form 2 are identical to each other in geometry. In the preferred and illustrated solution, the form 2 can, for example, comprise four side-by-side tanks.

[0013] The apparatus 1 suitably comprises means 3 for detecting a parameter associated to a vertical component of a distance between at least one predetermined point and at least one point of the free surface of the concrete located in the first tank 21 of the form 2. Therefore, such a parameter is associated to the height (elevation) at which at least one point of the free surface of the concrete located in the form 2 is located. For example, such a parameter can be a distance of the point of the free surface from the detection means 3 (the height of the detection means 3 is known and/or could be taken as a reference level). Such a predetermined point can advantageously be the position of the pad located above the first tank 21. The free surface suitably defines an interface surface of the concrete cast with the air located in the external environment.

[0014] For example, the detection means 3 comprise a contactless sensor 30 for measuring the distance be-

tween said sensor 30 and a point of the free surface of the concrete. For example, the detection means 3 (in particular the sensor 30) comprise a laser system 31 for measuring the distance from a point of the free surface of the concrete.

[0015] However, alternative systems such as ultrasounds or other vision systems could be used instead of a laser system.

[0016] The apparatus 1 suitably comprises means 4 for at least partially positioning the pad in the first tank 21 at a height that is a function of an input coming from the detection means 3. In fact, the pad must be positioned so that a part (suitably predetermined) of its thickness is below the previously defined height of the free surface of the concrete and a part (suitably predetermined) of its thickness protrudes outside of the concrete. The means 4 for positioning the pad comprise means 41 for nearing/moving away the pad with respect to the first tank 21.

[0017] The nearing/moving away means 41 are movable between up and down. Suitably, the nearing/moving away means 41 allow a substantially vertical movement of the pad. The nearing/moving away means 41 advantageously comprise a first and a second hoist 411, 412. Suitably, the first and the second hoist 411, 412 are controlled by corresponding motors, typically of the brushless type. Suitably, the first and the second hoist 411, 412 comprise a longitudinally extending flexible element (a cable, a chain, etc.) that can be moved by the corresponding motor. The use of such a flexible element is useful as it allows to perform a vibration of the concrete-pad block with the pad still associated to the first and to the second hoist 411, 412. Such a vibration is important to speed up the solidification of the sleeper and the presence of flexible elements in the hoists allows to minimise the risk of damage attributable to vibrations. Suitably, the apparatus 1 comprises at least one area for accumulating 6 pads to be collected to be able to be applied to the concrete present in the form.

[0018] The positioning means 4 suitably comprise pad gripping means 5. The gripping means 5 allow the pad to be moved in a planar configuration. For example, such gripping means 5 could be of a mechanical type (grippers or the like) or a suction type (for example, suction cups) or still other type. In the preferred solution illustrated for example in figure 7, the gripping means 5 comprise suction cups. Suitably, the gripping means 5 constrain the pad in a plurality of areas. Suitably, the positioning means 4 comprise a frame 50 in which the gripping means 5 are obtained. The frame 50 is supported by the nearing/moving away means 41, in particular it is supported by the hoists described above. Therefore, the frame 50 is suspended from the nearing/moving away means 41 or rather from the hoists. Therefore, the nearing/moving away means 41 allow a lifting/lowering of the frame 50 and therefore of the gripping means 5. More generally, the nearing/moving away means 41 can comprise at least one motor which moves a system that moves the gripping means 5 up or down.

[0019] Therefore, the positioning means 4 allow the gripping means 5 to be moved. The positioning means 4 suitably comprise a carriage 40 to which nearing/moving away means 41 are constrained. Therefore, the frame 50 is suspended below the carriage 40 by means of the nearing/moving away means 41. The nearing/moving away means 41 move together with the carriage 40. Suitably, also the frame 50 and the gripping means 5 move together with the carriage 40. Suitably, the carriage 40 translates along guide means, suitably the guide means are horizontal. Therefore, the positioning means 4 allow (by means of the carriage 40) to move the gripping means 5 between a first position in which they surmount a pad accumulation area 6 and a second position in which they surmount the form 2 (in particular the first tank 21). Suitably, the detection means 3 are (possibly at least in part) integral with the positioning means 4. Thus, the sensor 30 can move together with the positioning means 4. In particular, the sensor 30 moves integrally with the carriage 40.

[0020] In light of what has been described above, in the preferred solution the positioning means 4 act on the gripping means 5 and the form 2 remains substantially stationary.

[0021] In an alternative non-preferred solution, the positioning means 4 could comprise form movement means which bring the form 2 closer to the gripping means 5 which remain stationary. In a further solution, the positioning means 4 act by moving both the form 2 and the gripping means 5 to allow the connection of the pad to the concrete present in the first tank 21.

[0022] In a particular solution, the pad nearing/moving away means 41 define means for adjusting the inclination of the pad (or of the gripping means 5) with respect to a horizontal plane as a function of a signal coming from the detection means 3.

[0023] In this regard, the gripping means 5 define at least a first and a second gripping area 51, 52. The nearing/moving away means 41 comprise a plurality of movable actuators (which are suitably capable of acting independently of each other). Suitably, a first of such actuators (for example the first hoist 411) allows to move the first gripping area 51 and a second of such actuators (for example the second hoist 412) allows to move the second gripping area 52. Thereby, the first actuator 411 allows the first gripping area 51 to be positioned at a first predefined height while the second actuator 412 allows the second gripping area 52 to be positioned at a second height different from the first (therefore, the first and the second gripping area 51, 52 are at different heights). For example, the movable actuators could comprise a plurality of brushless motors which control corresponding systems for the movement of the first or the second gripping area 51, 52. For example, as mentioned above, a first brushless motor can control the first hoist 411 and a second brushless motor can control a second hoist 412 that respectively raise/lower the first and the second gripping area 51, 52 (allowing the first and the second grip-

ping area 51, 52 to be positioned at different heights; this, for example, can occur by means of an independent movement of the first and the second brushless motor). In light of the above, the gripping means 5 allow the pad to be inclined (or the gripping means 5 which suitably comprise a flat area for accommodating the pad) by inclining it with respect to a horizontal plane (so as to extend along a plane which is inclined with respect to the horizontal plane). This allows to compensate for any problems related to an imperfect planarity of the free surface of the concrete located in the first tank 21. This could be attributable to a planarity defect in the positioning of the form 2 or to a defect linked to the process of filling the first tank 21 with a viscous product such as concrete. As mentioned above, the form 2 suitably comprises a plurality of tanks (for example the first tank 21 and a second tank 22). In particular, the apparatus 1 comprises a plurality of detection means 3, each intended to detect a height of at least one point of the free surface of concrete located in a corresponding tank. Therefore, there are distinct and independent detection means 3 each associated to a corresponding tank. Similarly, the apparatus 1 comprises a plurality of means 4 for positioning a corresponding pad in the corresponding tanks 21, 22 at a height that is a function of an input from the corresponding detection means 3. In this case, the positioning means 4 are associated to corresponding detection means 3. Each of said detection means 3 is capable of controlling corresponding positioning means 4. Thereby, the positioning means 4 operate independently of each other.

[0024] An object of the present invention is further an application method for applying a pad to a base of a railway sleeper made of concrete. Suitably, the method is implemented by means of an apparatus 1 having one or more of the features described above.

[0025] The method comprises the step of introducing concrete into a first tank 21 obtained in a form 2. The first tank 21 has an opening. The concrete is inserted with said opening facing upwards. The first tank 21 further comprises a bottom and a side wall which connects the bottom and the opening. The bottom and the side wall close the first tank 21 at the bottom. The first tank 21 is a single monolithic body.

[0026] The method comprises a step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete placed in the first tank 21 is located. Such a parameter is for example the distance of said at least one point from a sensor 30 suitable for measuring said distance. The expression "at least one point" implies that such a point could be one or more points. Such points can be in the same area (so as to be able to perform a plurality of measurements and then extract an average value) or in distant areas (for example in two opposite halves of the first tank 21). The step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is done via a contactless sensor 30 which is not placed in contact with the concrete. Suitably, such a step occurs by means of a laser sensor (even if it could be of another type).

[0027] The method comprises the step of coupling the pad 92 to the concrete placed in the first tank 21, positioning the pad 92 at a height defined at least as a function of an input coming from the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is located. Thereby, the pad 92 is positioned correctly with respect to the free surface of the concrete (the amount of concrete may not always be exactly the same in the first tank 21 or the level may be uneven due to problems in the filling step). This avoids inserting the pad too deep or positioning it at a height that does not allow a stable connection with the concrete. Suitably, the pad has a first and a second opposite surface between which it extends in thickness. Suitably, the first surface is positioned in the concrete at a lower height than the free surface of the concrete (or rather at a lower height than the previously detected height of the free surface of the concrete). Suitably, the second surface is positioned at a higher height than the previously detected height of the free surface of the concrete.

[0028] The step of coupling the pad 92 to the concrete placed in the first tank 21 comprises the sub-steps of:

- collecting the pad 92; typically the pad 92 is collected from one or more pad accumulation areas 6; suitably the pad 92 can be collected by gripping means 5 which could be mechanical or operating by suction (preferred solution);
- positioning the pad 92 above the first tank 21; in particular this involves positioning the pad not only at a higher height than the first tank 21, but also at a vertical projection of the first tank 21 upwards; suitably the form 2 (in particular the first tank 21 is located between two pad accumulation areas 6 and the gripping means 5 move alternately between said form 2 and at least one of the two accumulation areas 6);
- lowering the pad 92 to said height defined at least as a function of said input. Typically, such a height defined as a function of said input is evaluated as a function of the distance between a sensor used to detect said input and the first point of the free surface; in such a case the sensor 30 is located at a known height during the measurement.

[0029] The step of lowering the pad 92 to the height defined at least as a function of said input involves bringing the pad into contact with the concrete placed in the first tank 21. Suitably, the step of lowering the pad 92 involves introducing the pad at least partially below the height of the free surface of the concrete (determined previously). Therefore, the step of lowering the pad 92 involves introducing the pad 92 at least in part into the first tank 21. Suitably, during the step of coupling the pad 92 to the concrete, it occurs while the first tank 21 is facing upwards.

[0030] Suitably, the step of detecting a parameter associated to a height at which at least one point of the free

surface of the concrete is located occurs by means of a sensor 30 which during the step of positioning the pad 92 above the first tank 21 transits (preferably integrally with the pad 92) above the first tank 21. Suitably, such a sensor 30 transits over the first tank 21 integrally with the pad gripping means 5. Suitably, during the step of positioning the pad 92 above (or rather on the vertical plane) of the first tank 21, the sensor 30 transits above the first tank 21 moving at least for a stretch parallel to a longitudinal extension direction of the first tank 21. The first tank 21 in the longitudinal direction (main extension direction) can be fictitiously divided into a first and a second half. In particular, the sensor 30 during the step of positioning the pad 92 above (or rather on the vertical plane) of the first tank 21 is positioned first on the vertical plane of the first half and then on the vertical plane of the second half. Suitably, in fact, the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is placed comprises measuring a parameter associated to a height at which at least a first and a second point of the free surface which are located respectively in two opposite halves of the concrete which is located in the first tank 21 are located. The step of coupling the pad 92 to the concrete is preceded/accompanied by the step of modifying the inclination of the pad (or in any case of the gripping means 5) with respect to a horizontal plane before the step of coupling the pad 92 to the concrete according to the difference in height of the first and the second point.

[0031] Suitably, the application method for applying a pad to a base of a railway sleeper made of concrete can comprise the steps of:

- introducing concrete into a second tank 22 obtained in the form 2; the first and the second tank 21, 22 being separate and independent, but advantageously made in a single monolithic body;
- detecting a parameter associated to a height at which at least one point of the free surface of the concrete placed in the second first tank 22 is located;
- coupling an additional pad 920 to the concrete placed in the second tank 22, positioning the additional pad 920 at a height defined at least as a function of an input coming from the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete placed in the second tank 22 is located.

[0032] Suitably, the step of coupling the additional pad 920 to the second tank 22 is independent of the step of coupling the pad 92 to the first tank 21. This implies that the additional pad 920 can be connected with the concrete present in the second tank 22 at a lower height than the height with which the pad 92 is connected with the concrete present in the first tank 21.

[0033] The present invention achieves important advantages.

[0034] First of all, it allows to realize a method and an apparatus which allow a correct positioning of the pad with respect to the concrete of the sleeper regardless of small problems which can affect upstream steps (such as a possible variability in the amount of concrete which is delivered in the form or a partial unevenness in the distribution of the concrete). Thereby, the pad is embedded by the correct amount inside the concrete.

[0035] The invention as it is conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept characterised thereby. Furthermore, all the details can be replaced with other technically equivalent elements. In practice, all the materials used, as well as the dimensions, can be any whatsoever, according to need.

Claims

1. An apparatus for application of a pad to a base of a railway sleeper made of concrete; said apparatus comprising:

   - a form (2) in turn comprising at least a first tank (21) intended to receive a cast of concrete to form the sleeper;
   - means (3) for detecting a parameter, associated to a vertical component, of a distance between at least a predetermined point and at least a point of the free surface of the concrete located in the first tank (21) of the form (2);
   - means (4) for positioning the pad in the first tank (21) at a height that is a function of an input coming from the detection means (3).

2. The apparatus according to claim 1, **characterised in that** the detection means (3) comprise a contactless sensor (30) for measuring the distance between the sensor (30) and a point of the free surface of the concrete.

3. The apparatus according to claim 1 or 2, **characterised in that** the detection means (3) comprise a laser measuring system (31) for measuring the distance from a point of the free surface of the concrete.

4. The apparatus according to any of the previous claims, **characterised in that** the means (4) for positioning the pad comprise means (41) for nearing/moving away the pad with respect to the first tank (21), said nearing/moving away means (41) being movable between up and down.

5. The apparatus according to claim 4, **characterised in that** the means (41) for nearing/moving away the pad define means for adjusting the inclination of the pad with respect to a horizontal plane as a function of a signal coming from the detection means (3).

6. An application method for applying a pad to a base of a railway sleeper made of concrete comprising the steps of:

    - introducing concrete into a first tank (21) formed in a form (2);
    - detecting a parameter associated to a height at which at least one point of the free surface of the concrete placed in the first tank (21) is located;
    - coupling the pad (92) to the concrete placed in the first tank (21) positioning the pad (92) at a height defined at least as a function of an input coming from the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is located.

7. The method according to claim 6, **characterised in that** the step of coupling the pad (92) to the concrete placed in the first tank (21) comprises the sub-steps of:

    - collecting the pad (92);
    - positioning the pad (92) above the first tank (21);
    - lowering the pad (92) to said height defined at least as a function of said input.

8. The method according to claim 7, **characterised in that** the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is located is done via a sensor (30) which during the step of positioning the pad (92) above the first tank (21) transits solidly with the pad (92) above the first tank (21).

9. The method according to any one of claims 6 to 8, **characterised in that** the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is located is done via a contactless sensor (30) which is not placed in contact with the concrete.

10. The method according to any one of claims 6 to 9, **characterised in that** the step of detecting a parameter associated to a height at which at least one point of the free surface of the concrete is located comprises measuring a parameter associated to a height at which at least a first and a second point of the free surface are located which are in two opposite halves of the concrete placed in the first tank (21); the step of coupling the pad (92) to the concrete is preceded/accompanied by the step of modifying the inclination of the pad with respect to a horizontal plane before the step of coupling the pad (92) to the concrete as a function of the height difference of the first and second point.

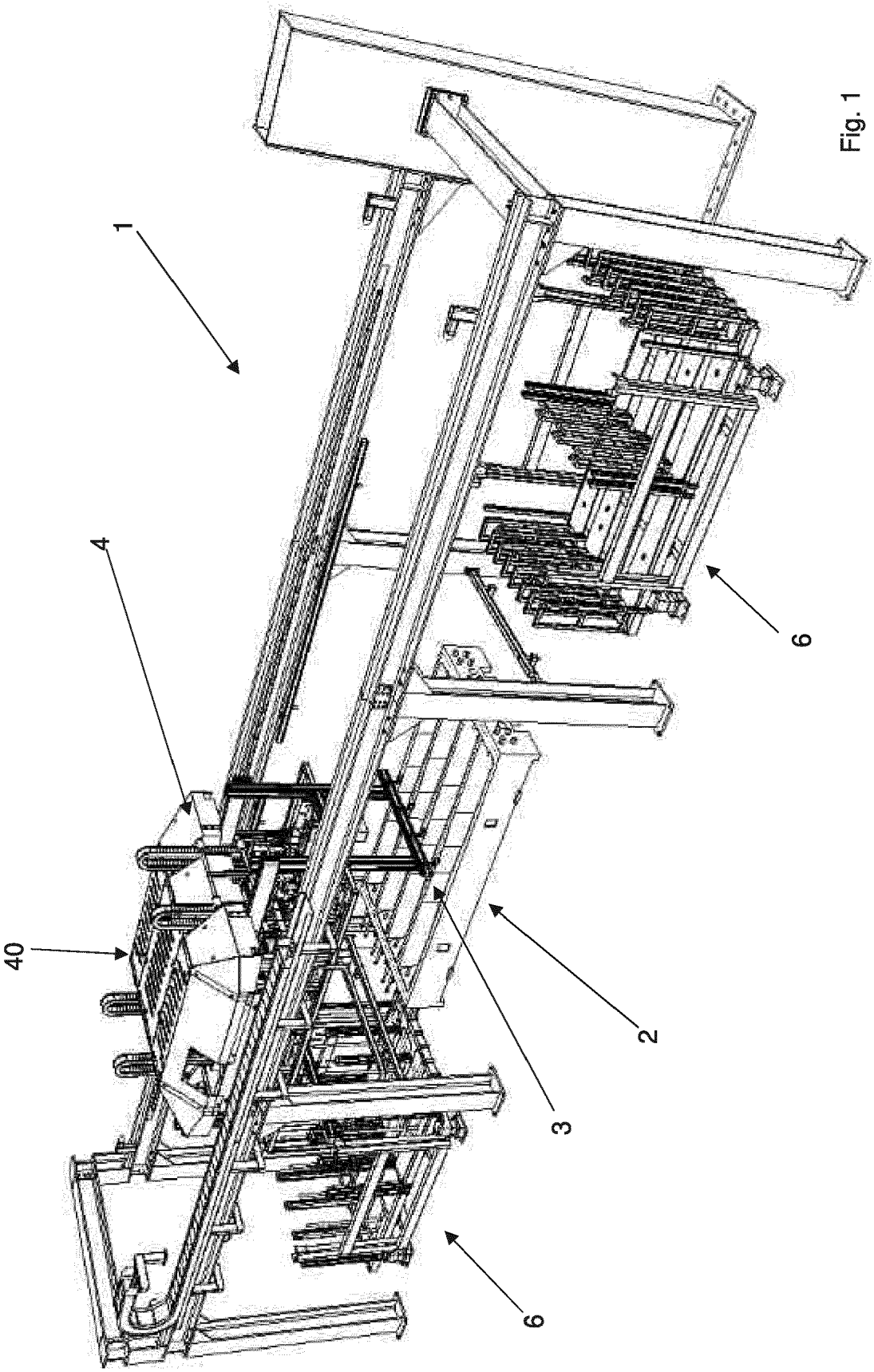


Fig. 1

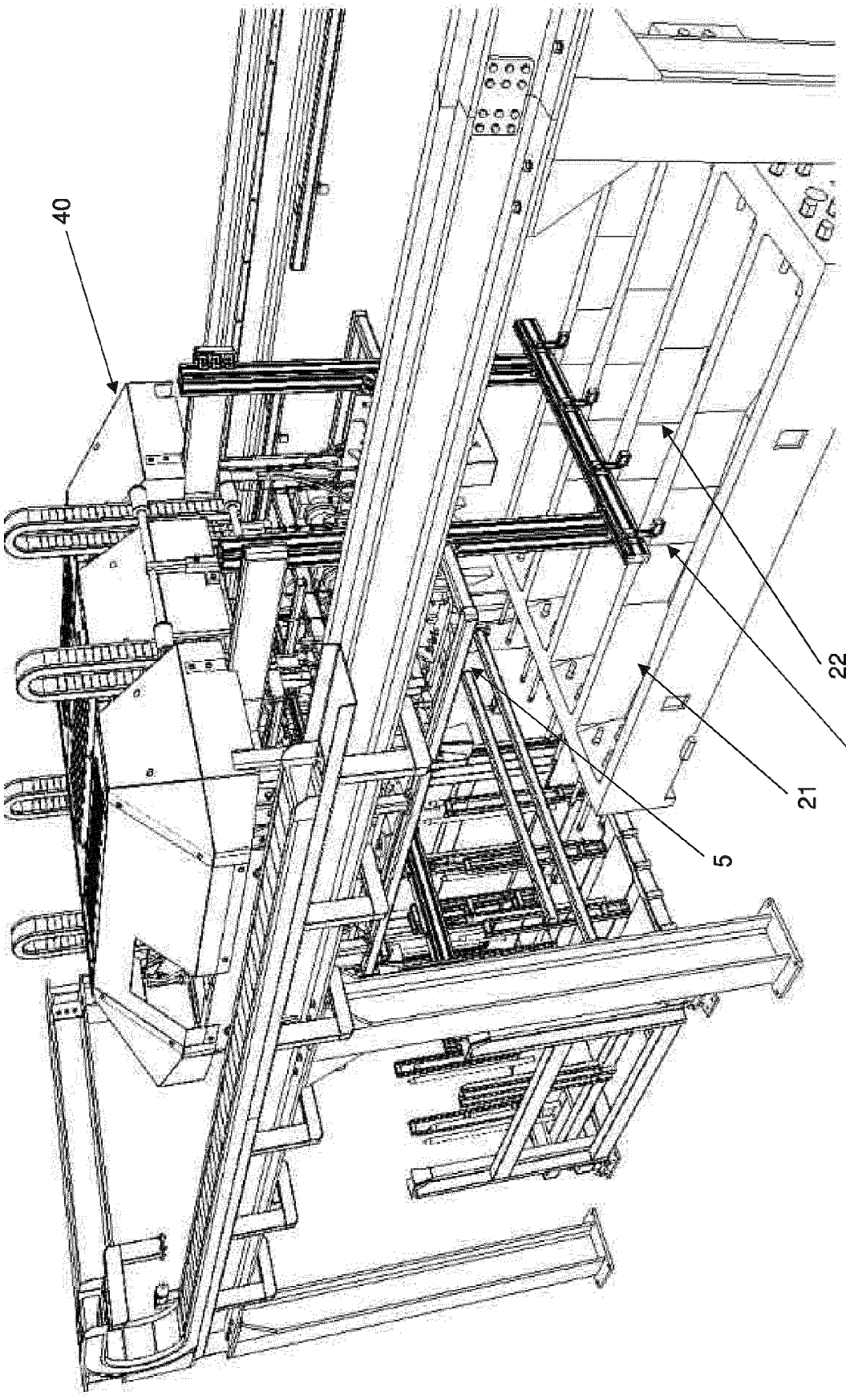


Fig. 2

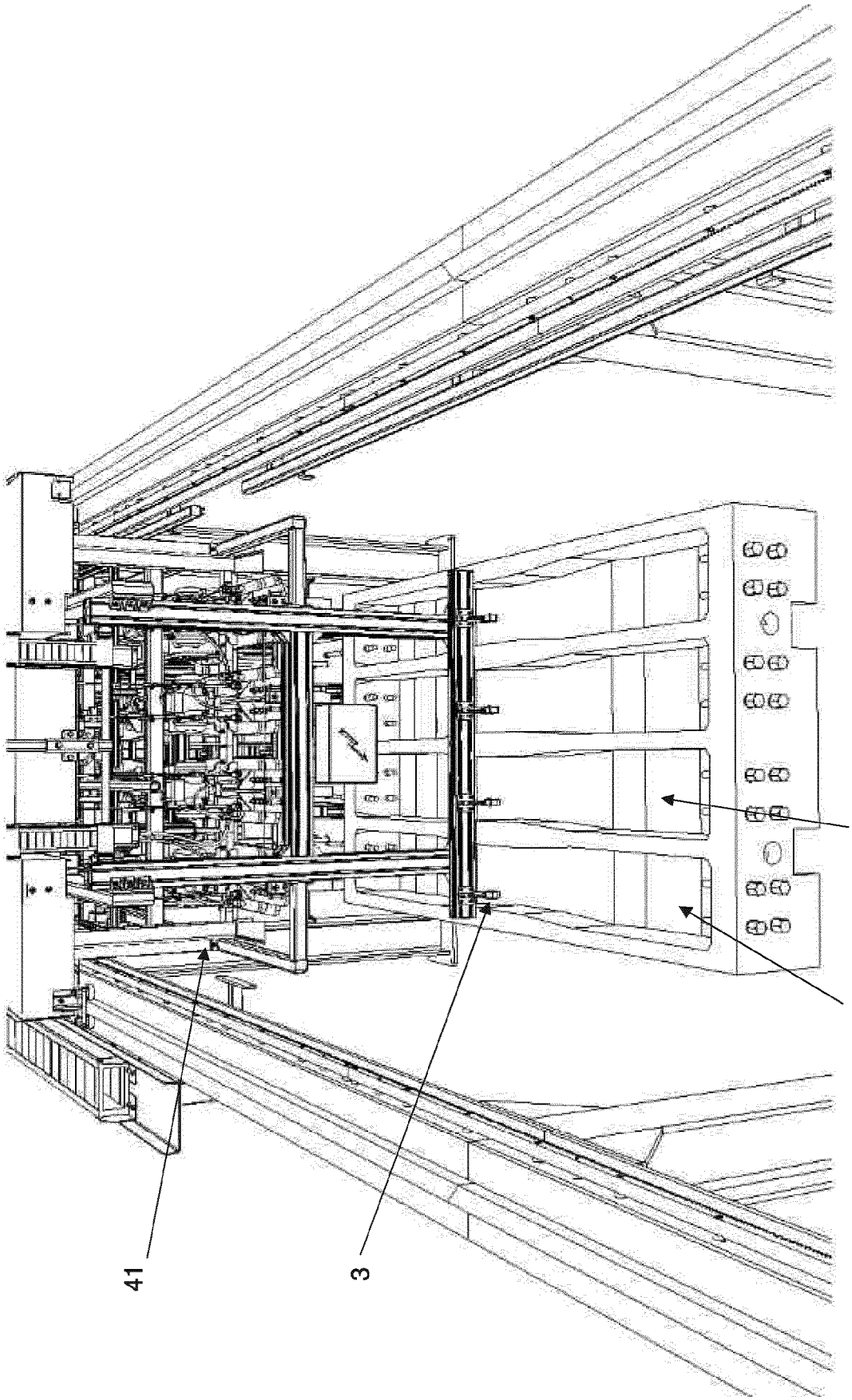


Fig. 3

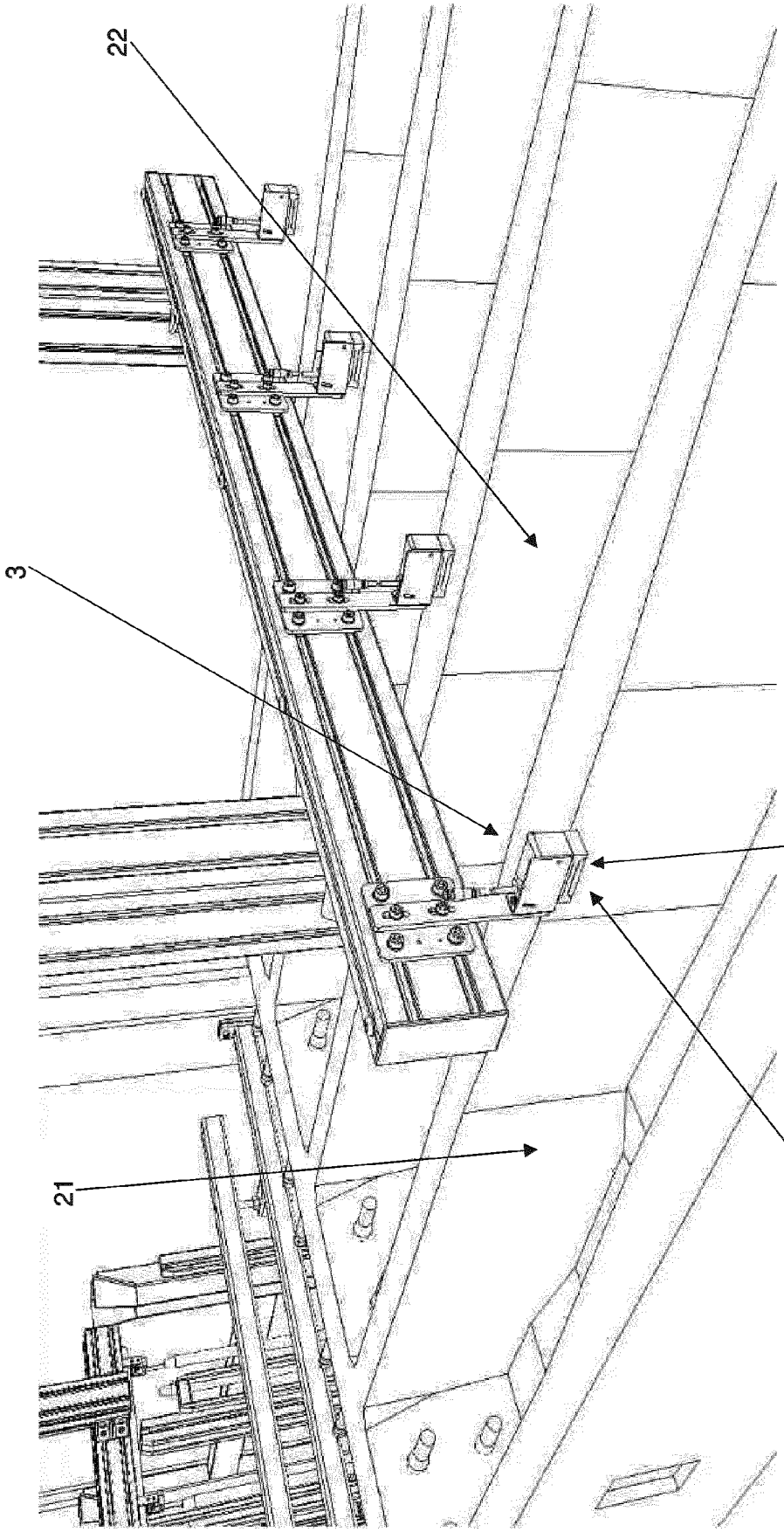


Fig. 4

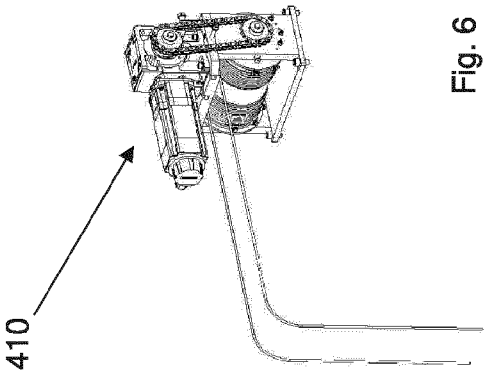


Fig. 6

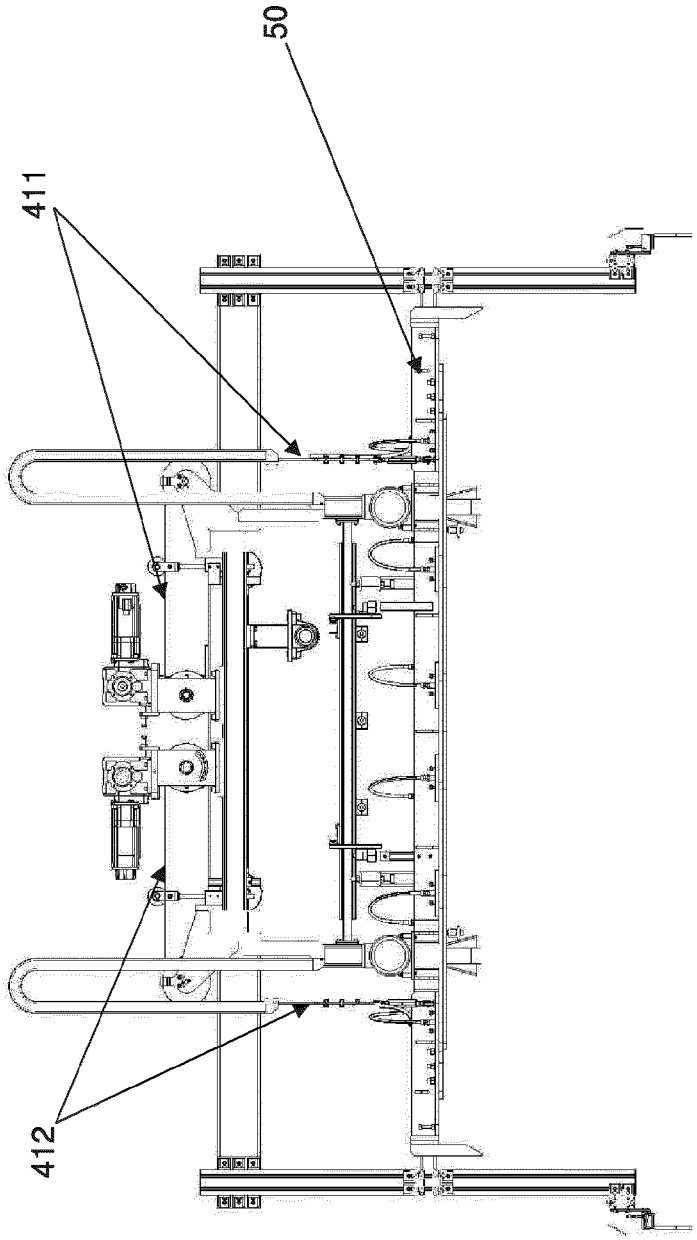


Fig. 5

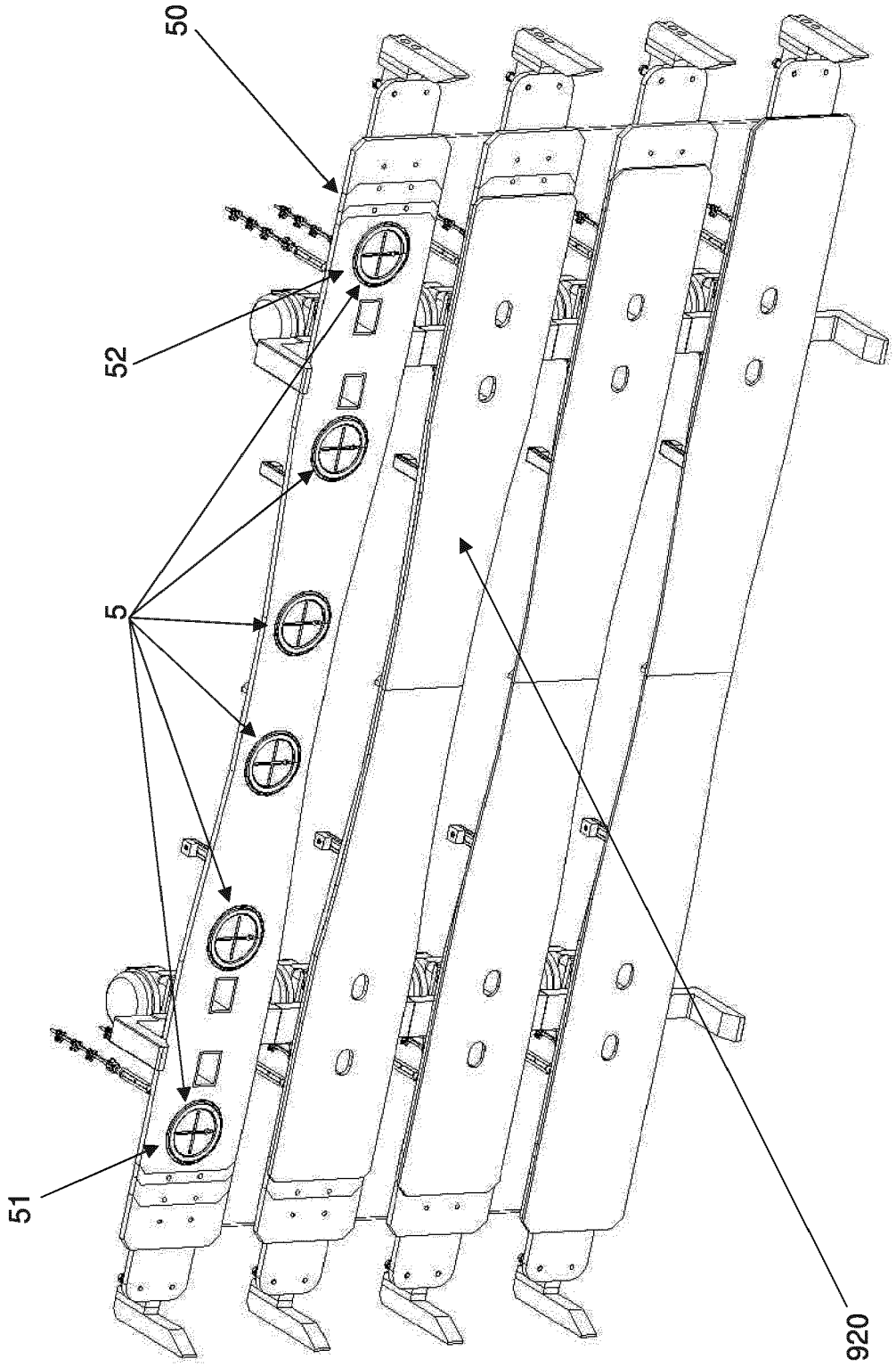


Fig. 7

Fig. 8

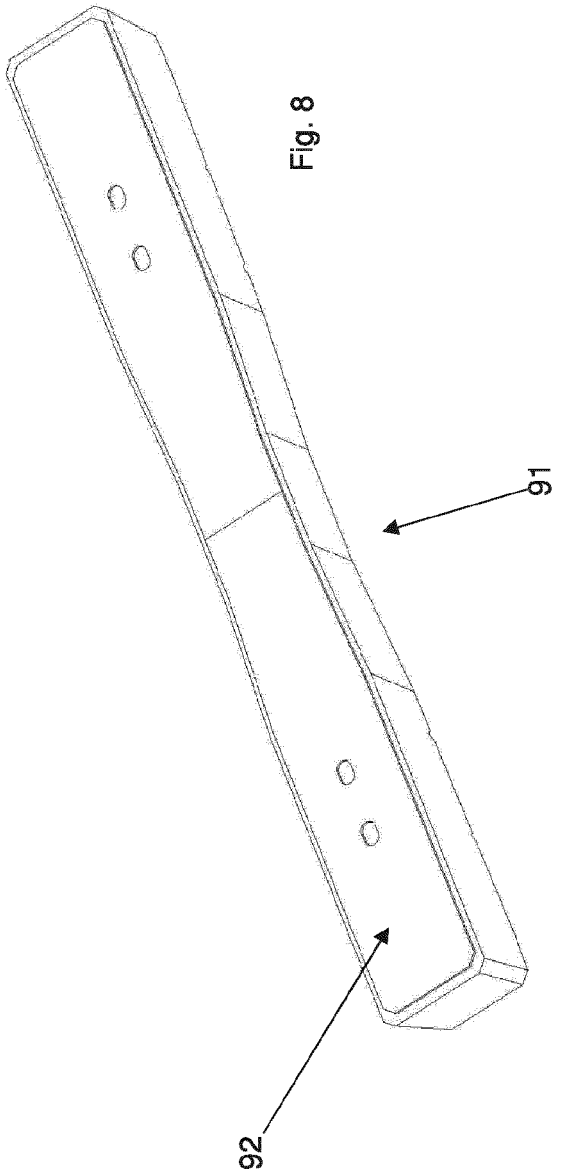
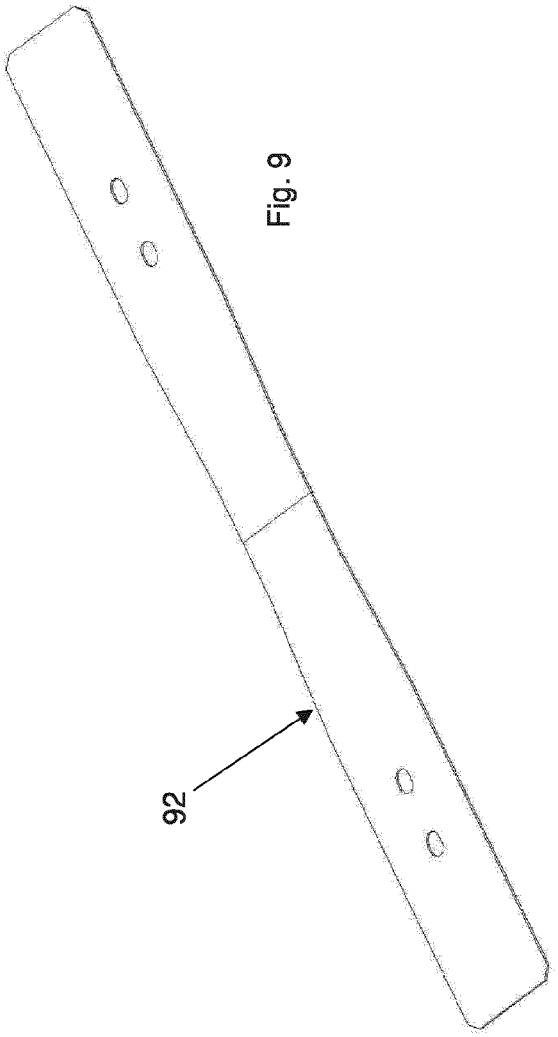


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 3405

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 055 708 B1 (A BETONG AB [SE]; SABEMA MATERIAL AB [SE]) 15 August 1984 (1984-08-15) * column 1, lines 4-10, 31-37 * * column 3, lines 52-59 * * column 7, lines 18-30, 62-65 * * column 8, lines 1-5, 13-17 * * figures 2, 9, 10 *	1-10	INV. B28B7/24 B28B23/00 B28B17/00 B28B15/00
A	CN 108 772 942 A (CHINA RAILWAY NO 3 ENG GROUP ET AL.) 9 November 2018 (2018-11-09) * the whole document *	1-10	
A	CN 212 554 380 U (LANGFANG HESS MACHINERY CO LTD) 19 February 2021 (2021-02-19) * the whole document *	1-10	
A	CN 110 076 903 A (GOOD LUCK INNOVATIVE INTELLIGENCE TECH CO LTD) 2 August 2019 (2019-08-02) * the whole document *	1-10	TECHNICAL FIELDS SEARCHED (IPC)
A	CN 212 241 537 U (CHINA RAILWAY NO 3 ENG GROUP ET AL.) 29 December 2020 (2020-12-29) * the whole document *	1-10	B28B E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 June 2022	Papakostas, Ioannis

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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