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(71) Applicant: **Scanclimber Oy**
33960 Pirkkala (FI)

(72) Inventors:
- **Matikainen, Pekka**
20760 Piispanristi (FI)
- **Koskensalo, Kimmo**
37550 Lempäälä (FI)

(74) Representative: **Berggren Oy, Tampere**
Visiokatu 1
33720 Tampere (FI)

(54) **WORK PLATFORM SYSTEM WITH AN ADJUSTING BRIDGE**

(57) An adjusting bridge (03) suitable for connecting a first and second work platforms (02a, 02b) of a work platform systems and connected to a first and the second masts (01a, 01b), respectively (03), the first and second work platforms (02a, 02b) being capable of climbing up and down along the first and the second masts (01a, 01b) and moving simultaneously in such a way that the first and second work platforms (02a, 02b) stay substantially at the same height in relation to each other. The adjusting bridge (03) comprises opposite first and second ends (04a, 04b) adapted to be move on the first and second work platforms (02a, 02b), respectively. The adjusting bridge (03) is moved by an actuator or the adjusting bridge (03) comprises a motion transmitting mechanism (05a, 05b, 05c) adapted to automatically synchronize movements of the first and second ends (04a, 04b) when the first and second work platforms (02a, 02b) are moving up or down. The motion transmitting mechanism (05a, 05b, 05c) is adapted to be driven mechanically by the movement of the first and second work platforms (02a, 02b) in relation to each other.

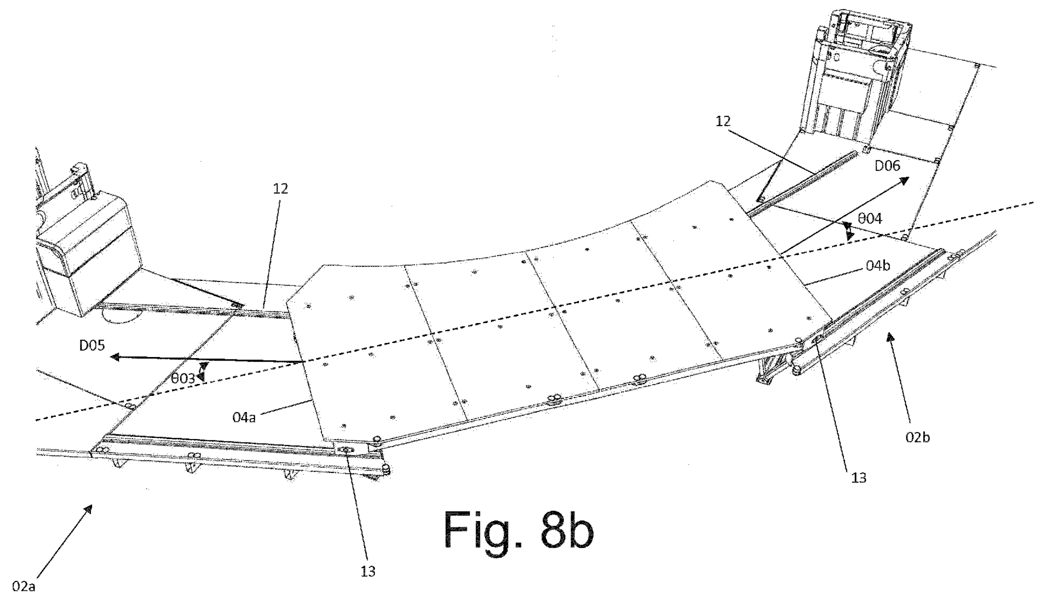

Fig. 8b

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Description

Technical field of the solution

[0001] The presented solution relates to a work platform system with mast climbing work platforms. The presented solution also relates to an adjusting bridge suitable for use in a work platform system.

Background of the solution

[0002] Aerial access platforms, such as elevating work platforms supported by a mast, and structures of them, are known and applied, for example, at various sites of construction and renovation of buildings, as well as when performing various maintenance or repair operations. Work platforms normally comprise a horizontal frame structure, by means of which workers, tools and other equipment and materials needed can be elevated to a desired height for performing work. The work platform is typically solid and elongated, but the work platform may also have a deflected shape, it may comprise protrusions or even have a circular shape, depending on the needs of the worksite. Normally, the work platform has a rectangular shape and the flooring belonging to its frame structure is delimited by railings for safety. The workers move on the flooring.

[0003] The work platform is moved along a vertical mast structure comprising of, for example, a lattice structure which normally has a square cross-section. The mast structure remains stationary and it may be free standing, but typically, the mast structure is supported in place by means of fasteners. The mast structure may also be supported at several different points, for example, to a building, by means of fasteners. Yet, the fasteners make it possible that the work platform can move past them up and down along the mast structure. The bottom end of the mast structure may be supported to a particular footing or the like, but the work platform may also be movable, in which case the mast structure stands on a movable base. The movable base is formed, for example, by a carriage on wheels, which can be connected to a hauling vehicle. The bottom part of the mast structure and the work platform are placed on the movable base. The rest of the mast structure can be dismounted and transported separately. Typically, the movable base comprises several supporting feet whose position can be changed, and which support the mast structure when the work platform is in use.

[0004] There may also be several mast structures for a single work platform. It is also possible to connect two work platforms, each of which is supported by one mast structure. In this way, it is possible to provide a larger work area or a greater loading capacity.

[0005] The work platform is moved along the mast structure by means of a lifting and lowering device provided between the mast structure and the work platform, connected to both of them or integrated in the frame structure of the work platform, for example its lifting frame. The lifting and lowering device comprises actuators, for example an electric motor and a transmission that is coupled by means of one or more drive pinions to a gear rack in the mast structure. The pinion ascends along the gear rack, and simultaneously the whole work platform moves along the mast structure. Furthermore, the lifting and lowering device comprises a control system which is also provided with the necessary control means for controlling its operation, for example manually. The control means are normally placed in such a way that a person on the work platform can move the work platform to a desired height or all the way down, wherein it is possible to exit the work platform or load goods. If necessary, a single control system can be used for controlling several lifting and lowering devices.

[0006] Some examples of mast climbing work platforms are shown in documents EP 2489622 A1, EP 2345623 A1 and EP 3336037 A1.

[0007] For the sake of safety and convince for workers, it is important that the work platform is close to the building structure. It is, however, challenging at construction and renovation sites where the building structure varies in shape along its height, for example in the case where the diameter of a tapered/tower-like structure changes along its height, such as a chimney or the like.

[0008] Patent document JP 2017031681 A discloses a typically arrangement of mast-climbing work platforms for such a tapered building structure. The masts are installed vertically so that the work platforms are as close as possible around the building structure at the bottom. It follows that, when the work platforms are moving upwards, the distance between the work platforms and the edge of the structure increases, and it is compulsory to use an overhand system, wherein an extra floor can be extended or retracted in the direction of adjusting the distance between the work platform and the edge of the structure, which is troublesome to adjust. Further, the work platforms cannot be lowered down before the overhands are unloaded or pulled in. Furthermore, the length of anchors needed for anchoring the masts to the structure changes. It is not only inconvenient to prepare anchors with different length, but also difficult to attach the anchors.

[0009] In patent document JP 2004176403 A, a plurality of work floors is arranged circumferentially at predetermined intervals along the outer wall surface of a chimney. The work floors are supported by a unit frame which is fixed to the outer wall of the chimney and is adjustable according to the diameter of the chimney. There are movable floors arranged between two work floors. One end of a movable floor is connected to one end of an adjacent work floor via a pin, and the other end of the movable floor, being a free end, is movably placed on the other adjacent work floor. When the diameter of the chimney reduces and the unit frame is adjusted accordingly, two work floors approach each other, and the overlapping area of the free end of the movable floor and the work floors, on which the movable floor is placed, increases. The work floors are brought close to the structure conveniently. However, there is a gap between the movable floor and the structure and the gap changes while the work floors move up and down.

Summary of the solution

[0010] The work platform system according to the solution is presented in claim 1. The adjusting bridge according to the solution is presented in claim 15.

[0011] According to the presented solution, an adjusting bridge connecting two work platforms is adjusted automatically in such a way that, when the work platforms move up and down along masts, a distance between the adjusting bridge and an adjacent structure, e.g. a building, may be controlled or kept constant when necessary. In other words, the presented work platform system guarantees the safety of the workers in such a way that, the entire work area formed by the work platforms and the adjusting bridge is close to the structure all the time while the platforms move up and down.

[0012] The work platform system according to the presented solution comprises a first mast and a second mast, each of which is substantially upright, the first and second masts being at an angle in relation to each other; a first movable work platform and a second movable work platform, each of which is connected to the first and second masts, respectively, in such a way that the work platform is capable of climbing up and down along the mast, and the first and second work platforms are configured to move simultaneously in such a way that the work platforms stay substantially at the same height in relation to each other.

[0013] The work platform system further comprises an adjusting bridge having opposite first and second ends in a longitudinal direction of the adjusting bridge, said adjusting bridge being adapted to connect the first and second work platforms, the first end being movably placed on the first work platform and the second end being movably placed on the second work platform.

[0014] The adjusting bridge further comprises a motion transmitting mechanism adapted to automatically synchronize movements of the first and second ends in such a way that i) when the first and second work platforms are approaching each other because of climbing along the first and second masts, the first end is adapted to horizontally move along the first work platform towards the first work platform and simultaneously the second end is adapted to horizontally move along the second work platform towards the second work platform; and ii) when the first and second work platforms are departing from each other because of climbing along the first and second masts, the first end is adapted to horizontally move along the first work platform away from the first work platform and simultaneously the second end is adapted to horizontally move along the second work platform away from the second work platform.

[0015] The adjusting bridge comprising a motion transmitting mechanism achieves the above-mentioned advantages.

[0016] According to an example, the adjusting bridge comprises a motion transmitting mechanism that is driven mechanically by the movement of the two work platforms in relation to each other. Thus, there is no need for actuators requiring an external power.

[0017] According to an example, the adjusting bridge further comprises a guiding mechanism adapted to guide the adjusting bridge to move along the first and second work platforms.

Brief description of the drawings

[0018]

Fig. 1 shows an example of the presented work platform system.

Fig. 2 shows a bottom view of the work platform system shown in Fig. 1, which comprises an adjusting bridge having a motion transmitting mechanism according to an example.

Fig. 3 shows a perspective view of another example of an adjusting bridge for use in the work platform system.

Figs. 4 shows a perspective view of yet another example of the adjusting bridge for use in the work platform system.

Fig. 5 shows a perspective view of an example of the work platform system with the adjusting bride of Fig. 3 at a height wherefrom the work platform system may move downwards.

Fig. 6 shows a perspective view of an example of the work platform system with the adjusting bride of Fig. 3 at a height wherefrom the work platform system may move upwards.

Fig. 7 shows a bottom view of the example of the work platform system in Fig. 3,

Fig. 8a and Fig. 8b show a perspective view of an example of the work platform system including an adjusting bridge.

Fig. 9a and Fig. 9b show the relative positions of the work platforms and the adjusting bridge when the work platform system is at the heights corresponding to Figs. 5 and 6.

Detailed description of the solution

[0019] Reference will now be made to the examples of which are illustrated in the accompanying drawings. Wherever possible, the same or corresponding reference numbers will be used throughout the drawings to refer to the same or corresponding parts or features.

[0020] The figures are intended for illustrating examples of the presented solution. Therefore, the figures are not in scale or suggestive of a definite layout of system components.

[0021] Fig. 1 shows a work platform system in which the presented solution is applied. The work platform system may be used for built or constructed structures, including buildings, with a curved and inclined wall, e.g. a chimney, a tower, or a mast.

[0022] The work platform system may have two or more work platforms and each pair of the work platforms may apply the presented solution. The work platform system may include a number of work platforms enough to cover the perimeter of the structure.

[0023] The work platform system comprises at least a first mast 01a and a second mast 01b, each of which is upright and includes a lower end and an upper end, a first movable work platform 02a connected to the first mast 01a and a second movable work platform 02b connected to the second mast 01b. The work platforms 02a, 02b are capable of climbing up and down along the masts 01a, 01b, and the work platforms 02a, 02b are configured to move simultaneously in such a way that the work platforms 02a, 02b stay substantially at the same height in relation to each other.

[0024] As shown in Fig. 1, the masts 01a, 01b may be installed substantially upright and close to a wall of the structure in such a way that at any point along the longitudinal axis of the masts 01a, 01b, the distance between the mast 01a, 01b and the structure is substantially constant. Since the structure may be tampered or with a curved and inclined wall, the masts 01a, 01b are therefore tilted towards or away from each other. In a special case, in which the structure has a wall that is both straight and vertically oriented, the masts 01a, 01b may anyhow be tilted towards or away from each other only, or alternatively, one of the masts 01a, 01b is tilted towards or away from the other one only.

[0025] In other words, the masts 01a, 01b, each having the lower and upper ends, are at an angle in relation to each other in such a way that the upper ends are closer to each other than their lower ends. That is, the distance between the masts 01a, 01b decreases when going upwards along the masts 01a and 01b, and increases when going downwards along the masts 01a, 01b. In this example, the masts 01a, 01b are tilted towards each other and the structure has a curved and inward inclined wall. According to an alternative example, the lower ends are closer to each other than the upper ends. That is, the distance between the masts 01a, 01 b decreases when going downwards along the masts 01a, 01b and increases when going upwards along the masts 01a, 01b. In this example, the masts 01a, 01b are tilted away from each other and the structure has a curved and outward inclined wall.

[0026] The work platform system according to the presented solution further comprises an adjusting bridge 03 that is adapted to connect the first and the second work platforms 02a, 02b. The adjusting bridge 03 has opposite first and second ends 04a, 04b in a longitudinal direction of the adjusting bridge 03.

[0027] As shown in Fig. 1, the first end 04a of the adjusting bridge 03 is movably placed on the first work platform 02a and the second end 04b is movably placed on the second work platform 02b. By "movably placed" it is meant that the first and second ends 04a, 04b are not fixed at a location of the work platforms 02a, 02b, but rather, the ends 04a, 04b may move on the work platforms 02a, 02b without making the adjusting bridge detach from the work platforms 02a, 02b. In other words, both ends 04a, 04b of the adjusting bridge 03 may move, preferably simultaneously, along the work platforms 02a, 02b, respectively.

[0028] The adjusting bridge 03 comprises a motion transmitting mechanism 05a, 05b, 05c, as illustrated in detail in Fig. 2, Fig. 3 and Fig. 4.

[0029] In the examples below, the motion transmitting mechanism 05a, 05b, 05c is driven mechanically by the movement of the first and second work platforms 02a, 02b in relation to each other, away from and towards each other, so that there is no need of extra electrical driver for the adjusting bridge 03. That is, the movement of the work platforms 02a, 02b provides forces necessary to drive the motion transmitting mechanism 05a, 05b, 05c that is attached to the work platforms 02a, 02b and makes use of the movement of the first and second work platforms 02a, 02b in relation to each other.

[0030] The motion transmitting mechanism 05a, 05b, 05c is adapted to synchronize movements of the first and second ends 04a, 04b in such a way that, when the first and second work platforms 02a, 02b are moving and approaching each other, the first end 04a is adapted to horizontally move along the first work platform 02a towards the first work platform 02a, i.e. closer to the first mast 01a, and simultaneously the second end 04b is adapted to horizontally move along the second work platform 02b towards the second work platform 02b, i.e. closer to the second mast 01b; and when the first and second work platforms 02a, 02b are moving and departing from each other, the first end 04a is adapted to horizontally move along the first work platform 02a away from the first work platform 02a, i.e. away from the first mast 01a, and simultaneously the second end 04b is adapted to horizontally move along the second work platform 02b away from the second work platform 02b, i.e. away from the second mast 01b.

[0031] The synchronizing functionality of the motion transmitting mechanism 05a, 05b, 05c of the adjusting bridge 03 makes it possible that the work area formed by the work platforms together with the adjusting platform is adjusted automatically by means of the movement of the adjusting bridge 03 while the work platforms are moving up and down.

[0032] Further, thanks to the motion transmitting mechanism, the movements of the first and second ends 04a, 04b may be different to adapt to different shapes of the wall of the structure, for example in such a case where the first mast 01a and the second mast 01b are tilted towards the structure in different angles because the inclination angle and/or the curvature of the wall of the structure is different at different places. In other words, the movements of the first and second ends 04a, 04b may be asymmetrical, according to the actual need in the applications. It is advantageous as the work platform system would be operated in a simpler, more convenient and more versatile way.

[0033] According to the examples shown in Figs. 1 to 9b, the motion transmitting mechanism 05a, 05b, 05c of the adjusting bridge 03 is adapted to synchronize movements of the first and second ends 04a, 04b in such a way that a distance moved by the first end 04a along the first work platform is substantially equal to a distance simultaneously moved by the second end 04b along the second work platform 02b. In other words, the first and second ends 04a, 04b move symmetrically on the work platforms 02a, 02b.

[0034] The weight of the adjusting bridge 03 is thus evenly supported by the work platforms 02a, 02b, and it contributes a more reliable construction of the system. Furthermore, when the movements of the first and second ends 04a, 04b are symmetrical, the work platform system is especially advantageous for the applications where the inclination angle and/or the curvature of the wall of the structure is the same at different places, for example in a chimney structure.

[0035] The adjusting bridge 03 is, according to an example, a steel beam structure. The adjusting bridge 03 has e.g. a rectangular shape. The adjusting bridge 03 has a deck as shown in Fig. 8b. The deck is attached to e.g. the steel beam structure. The deck may be formed by one or more sections made of sheets of suitable material, e.g. plywood or metal. In the other figures, the adjusting bridge 03 is presented with the deck removed to make the structure of the adjusting bridge 03 more visible.

[0036] In the figures, the adjusting bridge 03 and the first and second work platforms 02a, 02b are shown without safety railings. The first and second work platforms 02a, 02b have decks formed e.g. by one or more sections made of sheets of suitable material. The first and second work platforms 02a, 02b may have a curved shape as shown in Figs. 9a, 9b.

[0037] Reference is made to Fig. 3 and Fig. 4, where examples of the motion transmitting mechanism, herein referenced as the motion transmitting mechanism 05b or 05c, are illustrated in more detail. The motion transmitting mechanism 05b, 05c in these examples comprises a first idler wheel 06a attached to the first end 04a of the adjusting bridge 03; a second idler wheel 06b attached to the second end 04b of the adjusting bridge 03; a first flexible linear element 07a having two opposite ends, which first flexible linear element is connected, at a first attachment point 08a, to the first work platform 02a by one end, going around the first idler wheel 06a, and connected, at a second attachment point 08b, to the second platform 02b by the other end; and a second flexible linear element 07b having two opposite ends, which second flexible linear element is connected, at the second attachment point 08b, to the second work platform 02b by one end, going around the second idler wheel 06b, and connected, at the first attachment point 08a, to the first work platform 02a by the other end.

[0038] The first and second linear elements 07a, 07b may be connected to the attachment points 08a, 08b by means of spring elements allowing adjustment of the tension of the linear elements 07a, 07b.

[0039] Each attachment point 08a, 08b may include a bracket to be attached to one of the first and second work platforms 02a, 02b and to which the first and second linear elements 07a, 07b are attached.

[0040] The first and second linear elements 07a, 07b form a loop which loops over the first and the second idler wheels 06a, 06b. The first and second linear elements 07a, 07b are forced to move along the loop when the work platforms 02a, 02b are moving up and down. The first and second linear elements 07a, 07b are driven mechanically by the movement of the first and second work platforms 02a, 02b, i.e. the movement of the first and second attachment points 08a, 08b in relation to each other. Additionally, the lengths of the first and second linear elements 07a, 07b being fixed has the effect that the linear elements 07a, 07b pull the idler wheels 06a, 06b when running past them.

[0041] Therefore, the loop formed by the first and second linear elements 07a, 07b is connected to the work platforms 02a, 02b via the attachment points 08a, 08b. and the first and second idler wheels 06a, 06b guide the first and second linear elements 07a, 07b running past them.

[0042] The location of the first and second idler wheels 06a, 06b may be arranged according to the actual applications. For example, a line representing the shortest distance between the first idler wheel 06a and the second idler wheel 06b may be parallel or not parallel to the longitudinal direction of the adjusting bridge 03.

[0043] When the work platforms are moving and approaching each other, the attachment points 08a, 08b on the work platforms are also approaching each other, and the loop formed by the linear elements 07a and 07b is pulled to move clockwise or counterclockwise, depending on the relative locations of the idler wheels 06a, 06b and the attachment points 08a and 08b. The first attachment point 08a moves away from the first idler wheel 06a so that the first end 04a is forced by the first linear element 07a to move horizontally along the first work platform 02a towards the first work platform 02a and simultaneously, as the second attachment point 08b is moving away from the second idler wheel 06b, the second end 04b is forced by the second linear element 07b to move horizontally along the second work platform 02b towards the second work platform 02b.

[0044] When the work platforms are moving and departing from each other, the attachment points 08a, 08b on the work platforms are also departing from each other, and the loop formed by the linear elements 07a and 07b is pulled to move clockwise or counterclockwise, depending on the relative locations of the idler wheels 061, 06b and the attachment points 08a and 08b. The second attachment point 08b moves away from the first idler wheel 06a so that the first end 04a is forced by the first linear element 07a to move horizontally along the first work platform 02a away from the first work platform 02a and simultaneously, as the first attachment point 08a is moving away from the second idler wheel 06ab, the second end 04b is forced by the second linear element 07b to move horizontally along the second work platform 02b away from the second work platform 02b.

[0045] The motion transmitting mechanism is not limited to the examples as shown in Fig. 3, i.e. a chain, and Fig. 4, i.e. a cable or wire. The linear elements 07a, 07b may be ropes, cables, wires, belts, chains or any similar elements, or a combination of them, that can realize the concept of the motion transmitting mechanism. Preferably, the linear element 07a, 07b provides a fixed length, is able to transmit pulling forces, and is flexible in such a way that the linear element 07a, 07b is able to form linear and arched shapes.

[0046] The idler wheels 06a, 06b may be chain wheels, gearwheels, or any similar wheels that can realize the concept of the motion transmitting mechanism. According to an example, the linear elements 07a, 07b are flexible both horizontally and vertically, i.e. in two perpendicular directions, such as those of ropes, cables, wires or the like, so that the linear elements 07a, 07b allow a slight difference in height between two work platforms 02a, 02b, the difference causing the linear elements 07a, 07b to be slightly bent, particularly at the idler wheels 06a, 06b.

[0047] Hereunder it is explained how the motion transmitting mechanism according to the above-mentioned examples works. The first linear element 07a is led from the first attachment point 08a to the first idler wheel 06a in a substantially horizontal first direction D01 away from the second work platform 02b, and additionally the first linear element 07a is led from the first idler wheel 06a in a substantially horizontal second direction D02 towards the second work platform 02b in such a way that the first and second directions D01, D02 are opposite directions.

[0048] Likewise, the second linear element 07b is led from the second attachment point 08b to the second idler wheel 06b in a substantially horizontal third direction D03 away from the first work platform 02a, and additionally the second linear element 07b is led from the second idler wheel 06b in a substantially horizontal fourth direction D04 towards the first work platform 02a in such a way that the third and fourth directions D03, D04 are opposite directions.

[0049] The locations of the first and second attachment points 08a, 08b may be arranged according to the actual applications. Preferably, the first and second idler wheels 06a, 06b move within a space between the first and second attachment points 08a, 08b. According to an example, the first attachment point 08a is close to the edge of the first work platform 02a and the second attachment point 08b is close to the edge of the second work platform 02b.

[0050] According to the examples shown in Figs. 1 to 9b, the first and second directions D01 and D02, in a horizontal plane, define substantially equal angles θ01 in relation to the third and fourth directions D03 and D04. The angles θ01 are preferably less than 180°, or less than 160°, 140°, or 120°. The angle θ01 may be selected according to the actual applications, for example in relation to the angle between the two work platforms 02a, 02b, taking into account the inclination angles of the masts 01a and 01b.

[0051] For the structure with the curved and inclined wall, it is advantageous that the angle θ01 is less than 180°. In the examples illustrated in Figs. 4 and 5, the angle θ01 is around 120°. For the above-mentioned special case, the angle θ01 is 180°.

[0052] Additionally, according to an example, as illustrated in Figs. 4 and 5, the first, second, third and fourth directions D01, D02, D03 and D04, in a horizontal plane, define substantially equal angles θ02 in relation to the longitudinal direction of the adjusting bridge 03. The angles θ02 are preferably more than 0°, or more than 10°, 20°, or 30°. In other words, the loop formed by the linear elements 07a, 07b may be divided into two symmetrical parts, which are mirror images to each other. In such cases, the movement of the first end 04a along the first work platform 02a is enabled to be symmetrical in relation to the movement of the second end 04b along the second work platform 02b, when the work platforms 02a, 02b are moving up and down.

[0053] For the structure with the curved and inclined wall, it is advantageous that the angle θ02 is more than 0°. In the examples illustrated in Figs. 4 and 5, the angle θ02 is around 30°. For the above-mentioned special case, the angle θ02 is 0°.

[0054] The angles θ01, θ02 may be realized by many suitable ways. For example, one or more idler wheels included in the motion transmitting mechanism may be used, as shown in the examples in Figs. 4 and 7. Fig. 7 shows a bottom view of the example shown in Fig.3. The adjusting bridge 03 comprises central idler wheels 06c attached to a middle section of the adjusting bridge 03 in such a way that the first and second linear elements 07a, 07b may be led via the central idler wheels 06c to change direction of travel of the first and second linear elements 07a, 07b.

[0055] Preferably, in the case the first and second linear elements 07a, 07b are chains, the central idler wheels 06c include an idler wheel that is in contact with both of the linear elements 07a, 07b for transmitting motion from one linear element to another, thereby preventing the adjusting bridge 03 from moving when the first and second work platforms 02a, 02b are not moving. The central idler wheels 06c may be chain wheels, gearwheels, or any similar wheels.

[0056] Reference is made to Fig. 2, where another example of the motion transmitting mechanism, herein referenced as the motion transmitting mechanism 05a, is illustrated in more detail. The motion transmitting mechanism 05a in this example comprises one or more pinions or gearwheels 10 attached to a middle section of the adjusting bridge 03; a first rack or toothed bar 11a having two opposite ends, which first rack or toothed bar is connected by a joint to the first work platform 02a by one end, the other end extending to the middle section to be in contact with the one or more pinions or gearwheels 10; and a second rack or toothed bar 11b having two opposite ends, which second rack or toothed bar is connected by a joint to the second work platform 02b by one end, the other end extending to the middle section to be in contact with the one or more pinions or gearwheels 10.

[0057] The one or more pinions or gearwheels 10 are adapted to transmit motion from the first rack 11a to the second rack 11b, and vice versa, whereby the first and second racks or toothed bars 11a, 11b are forced to move simultaneously in relation to each other when the work platforms 02a, 02b are moving up and down. Preferably, the first and second racks or toothed bars 11a, 11b are adapted to move in equal distances.

[0058] The motion transmitting mechanism 05a may be a rack-and-pinion gearset.

[0059] For the structure with the curved and inclined wall, it is advantageous that the first and second racks or toothed bars 11a, 11b in a horizontal plane define an angle in relation to each other, which angle corresponds the angle θ01 in Fig. 5, the angle being preferably less than 180°, or less than 160°, 140°, or 120°. For the above-mentioned special case, the angle is 180°.

[0060] Additionally, according to an example, the first and second racks or toothed bars 11a, 11b in a horizontal plane define substantially equal angles in relation to the longitudinal direction of the adjusting bridge 03, which angles corresponds the angle θ02 in Fig. 5, the angle θ02 being preferably more than 0°, or more than 10°, 20°, or 30°. For the structure with the curved and inclined wall, it is advantageous that the angle is more than 0°, e.g. around 30°. For the above-mentioned special case, the angle is 0°.

[0061] Alternatively, the motion transmitting mechanism is replaced with one or more actuators generating forces necessary to move the adjusting bridge 03 on the first and second work platforms 02a, 02b in such a way that the first and second ends 04a, 04b move in a symmetric or asymmetric fashion as explained above. The actuator may be a linear or rotary actuator, e.g. an electric motor. The actuator may include a transmission, e.g. gearwheels and/or a toothed bar, to move the adjusting bridge 03. The actuator may be controlled by an electronic control unit. The control unit may include a sensor adapted to measure the movement of the work platforms 02a, 02b along the masts 01a, 01b. A signal indicative of the distance moved by the work platforms 02a, 02b is transmitted to the control unit that is adapted to determine, based on the signal, the distance to be moved by the adjusting bridge 03. Alternatively, the signal is received from a control system of one of the work platforms 02a, 02b. According to an example, the control system controls the functioning of the actuator.

[0062] Advantageously and optionally, according to an example, the adjusting bridge 03 further comprises a guiding mechanism adapted to guide the adjusting bridge 03 in the examples explained above. Thanks to the guiding mechanism, the adjusting bridge 03 may be guided to move along the first and second work platforms 02a, 02b in a predetermined track or path only, or to a predetermined direction only, and therefore the stability and reliability of the work platform system is further ensured.

[0063] Reference is made to the examples in Figs. 2 and 4, Fig. 8a and Fig. 8b. The adjusting bridge 03 is guided to move in such a way that the first end 04a moves to a fifth direction D05 along the first work platform 02a, the fifth direction D05 in a horizontal plane defining a third angle θ03 in relation to the longitudinal direction of the adjusting bridge 03; and the second end 04b moves to a sixth direction D06 along the second work platform 02b, the sixth direction D06 in a horizontal plane defining a fourth angle θ04 in relation to the longitudinal direction of the adjusting bridge 03.

[0064] Preferably, the third and fourth angles θ03, θ04 are more than 0°, or more than 10°, 20°, or 30°. For the structure with the curved and inclined wall, it is advantageous that the angle is more than 0°, e.g. around 30°. For the above-mentioned special case, the angle is 0°.

[0065] The third and fourth angles θ03, θ04 may be the same or different, according to the actual applications. According to the examples in Figs. 2 and 4, Fig. 8a and Fig. 8b, the third and fourth angles θ03, θ04 are substantially equal, and the movements of the first and second ends 04a, 04b along the first and second work platforms 02a, 02b are substantially symmetrical.

[0066] Preferably, the first and second directions D01, D02, see e.g. Fig. 5, are parallel to the fifth direction D05, see e.g. Fig. 8a, and additionally, the third and fourth directions D03, D04 are parallel to the sixth direction D06. Thus, the stability and reliability of the work platform system is further ensured when the first and second linear elements 07a, 07b are in use, in particular. Thereby, e. g. loosening or excessive tightening of the linear elements 07a, 07b is avoided.

[0067] The examples in Fig. 9a and Fig. 9b show the relative position of the work platforms 02a, 02b and the adjusting bridge 03 when the work platform system is at a height wherefrom the work platform system may move upwards (see Fig. 9a), and when the work platform system is at a height wherefrom the work platform system may move downwards (see Fig. 9b), respectively. The principles and features explained in the examples presented above apply to these examples also, in which the first and second ends 04a, 04b of the adjusting bridge 03 move symmetrically on the work platforms 02a, 02b.

[0068] In these examples in Figs. 9a and 9b, when the first and second work platforms 02a, 02b simultaneously move up and down, a fifth angle θ05 formed between the first work platform 02a and the adjusting bridge 03, e.g. the longitudinal direction of the adjusting bridge 03, in a horizontal plane stays the same, and a sixth angle θ06 formed between the second work platform 02b and the adjusting bridge 03, e.g. the longitudinal direction of the adjusting bridge 03, in a horizontal plane stays the same.

[0069] Preferably, the fifth and sixth angles θ05, θ06 are substantially equal and thereby the adjusting bridge 03 moves along the work platforms 02a, 02b without turning in relation to the work platforms 02a, 02b nor in relation to the adjacent structure. To this end, the third and fourth angles and θ04 should be equal.

[0070] As shown in Fig. 9a and Fig. 9b, the first and second work platforms 02a, 02b in a horizontal plane define an eighth angle θ08 in relation to each other. The eighth angle θ08 depends on the curvature of the building and how far away the work platforms are from each other. Preferably, the eighth angle θ08 is less than 180°, or less than 160°, 140°, or 120°.

[0071] Additionally, see Figs. 8a and 8b, selecting the fifth and sixth directions D05 and D06, i.e. the third and fourth angles and θ04, in accordance with the inclination angle of the adjacent structure, or that of the masts 01a and 01b, the distance between the adjusting bridge 03 and the adjacent structure may be kept the same regardless of the height position of the work platforms 02a, 02b.

[0072] The guiding mechanism of the work platform system may be realized in many suitable ways.

[0073] In an example, with reference to Fig. 8b, the guiding mechanism may comprise at least one guide or rail 12 attached to the first work platform 02a; at least one element or wheel 13 attached to the first end 04a of the adjusting bridge 03 and adapted to glide or roll along the guide or rail 12 of the first work platform 02a; at least one guide or rail 12 attached to the second work platform 02b; and at least one element or wheel 13 attached to the second end 04b of the adjusting bridge 03 and adapted to glide or roll along the guide or rail 12 of the second work platform 02b.

[0074] Alternatively, or additionally in relation to the example in Fig. 8b, the guiding mechanism may comprise, with reference to Fig. 3 for example, a first guiding beam or rail 14a attached to the adjusting bridge 03 and extending from a middle section of the adjusting bridge 03 to the first end 04a; a second guiding beam or rail 14b attached to the adjusting bridge 03 and extending from the middle section to the second end 04b; a first directional steering device 15a, which is fixed onto the first work platform 02a and adapted to move along the first guiding beam or rail 14a when the first end 04a is moving along the first work platform 02a; and a second directional steering device 15b which is fixed onto the second work platform 02b and adapted to move along the second guiding beam or rail 14b when the second end 04b is moving along the second work platform 02b.

[0075] In this example, for the structure with the curved and inclined wall, it is advantageous that the first and second guiding beams or rails 14a, 14b in a horizontal plane define a seventh angle θ07 in relation to each other, the seventh angle θ07 being preferably less than 180°, or less than 160°, 140°, or 120°. For the above-mentioned special case, the angle is 180°.

[0076] The guiding mechanism as shown in Fig. 3 and the guiding mechanism as shown in Fig. 8b may work independently, or in combination. In the latter case, on each work platform 02a and 02b, the guiding beam or rail 14a, 14b is parallel to the guides or rails 12 to ensure movement to the direction D05 or D06. In this example, the seventh angle θ07 equals the angle θ01, see Fig. 5.

[0077] The guiding mechanism is not limited to those examples shown in the Figures. For example, as an alternative to the example shown in Fig. 3, the guiding mechanism may comprise a first guiding beam or rail attached to and extending along the first work platform 02a; a second guiding beam or rail attached to and extending along the second work platform 02b; a first directional steering device, which is fixed to the first end 04a and adapted to move along the first guiding beam or rail when the first end 04a is moving along the first work platform 02a; and a second directional steering device, which is fixed to the second end 04b and adapted to move along the second guiding beam or rail when the second end 04b is moving along the second work platform 02b.

[0078] The first and second guiding beams or rails, and the first and second directional steering devices, may equal or correspond the first and second guiding beams or rails 14a, 14b in Fig. 4, and the first and second directional steering devices may equal or correspond the first and second directional steering devices 15a, 15b in Fig. 4.

[0079] In this example, for the structure with the curved and inclined wall, it is advantageous that the first and second guiding beams or rails in a horizontal plane define a seventh angle θ07 in relation to each other, the seventh angle θ07 being preferably less than 180°, or less than 160°, 140°, or 120°. For the above-mentioned special case, the angle is 180°.

[0080] According to an example, the directional steering device 15a, 15b is a pair of wheels, the guiding beam or rail 14a, 14b being located between the wheels. Preferably, each directional steering device is adapted to allow the adjusting bridge 03 to move to the direction D05 or D06 only and not to a direction transverse to the direction D05 or D06.

[0081] According to an example, the first directional steering device 15a is attached to the bracket of the first attachment point 08a and the second directional steering device 15b is attached to the bracket of the second attachment point 08b.

[0082] It is to be understood that the examples of the solution disclosed are not limited to the structures disclosed herein, but are extended to equivalents thereof as would be recognized by those skilled in the relevant art.

[0083] It should also be understood that terminology employed herein is used for the purpose of describing examples only and is not intended to be limiting. Reference throughout this specification to "one example " or "an example" means that a feature, structure, or characteristic described in connection with the example is included in at least one example of the present solution.

[0084] As used herein, a plurality of items or structural elements may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member.

[0085] In this description, the terms "substantially vertical" and "substantially horizontal" may be replaced with the terms "vertical" and "horizontal". The direction of the acceleration due to gravity is defined as the "vertical direction", the "horizontal direction" defining directions perpendicular to the vertical direction. In relation to the orientations defined in this description, see e.g. "substantially vertical", "substantially horizontal", "substantially perpendicular", and "substantially parallel", they also include orientations at angles in relation to absolute vertical, horizontal, perpendicular, and parallel directions, whereby the angles cover a range of angles considered reasonable when taking production tolerances and installation work into consideration, and without departing from the concept of the presented solution.

[0086] The verbs "to comprise" and "to include" are used in this document as open limitations that neither exclude nor require the existence of also un-recited features. Furthermore, it is to be understood that the use of "a" or "an", i.e. a singular form, throughout this document does not exclude a plurality, unless where specifically mentioned.

[0087] While the solution has been described by way of examples it is to be understood that the solution is not limited to the disclosed examples but is intended to cover various combinations or modifications within the scope of the appended claims.

Claims

1. A work platform system comprising

- a first mast (01a) and a second mast (01b), each of which is substantially upright, the first and second masts (01a, 01b) being at an angle in relation to each other;
- a first movable work platform (02a) and a second movable work platform (02b), each of which is connected to the first and second masts (01a, 01b), respectively, in such a way that the work platform (02a, 02b) is capable of climbing up and down along the mast (01a, 01b), and the first and second work platforms (02a, 02b) are configured to move simultaneously in such a way that the work platforms (02a, 02b) stay substantially at the same height in relation to each other;
- an adjusting bridge (03) having opposite first and second ends (04a, 04b) in a longitudinal direction of the adjusting bridge, said adjusting bridge (03) being adapted to connect the first and second work platforms (02a, 02b);

characterized by

- the first end (04a) being movably placed on the first work platform (02a) and the second end (04b) being movably placed on the second work platform (02b);
- wherein the adjusting bridge (03) further comprises a motion transmitting mechanism (05a, 05b, 05c) adapted to automatically synchronize movements of the first and second ends (04a, 04b) in such a way that
- when the first and second work platforms (02a, 02b) are approaching each other because of climbing along the first and second masts (01a, 01b), the first end (04a) is adapted to horizontally move along the first work platform (02a) towards the first work platform (02a) and simultaneously the second end (04b) is adapted to horizontally move along the second work platform (02b) towards the second work platform (02b); and
- when the first and second work platforms (02a, 02b) are departing from each other because of climbing along the first and second masts (01a, 01b), the first end (04a) is adapted to horizontally move along the first work platform (02a) away from the first work platform (02a) and simultaneously the second end (04b) is adapted to horizontally move along the second work platform (02b) away from the second work platform (02b).

2. The work platform system according to claim 1, wherein the motion transmitting mechanism (05a, 05b, 05c) is adapted to be driven mechanically by the movement of the first and second work platforms (02a, 02b) in relation to each other.

3. The work platform system according to claim 1 or 2, wherein the motion transmitting mechanism (05a, 05b, 05c) is adapted to synchronize movements of the first and second ends (04a, 04b) in such a way that a distance moved by the first end (04a) along the first work platform is substantially equal to a distance simultaneously moved by the second end (04b) along the second work platform (02b).

4. The work platform system according to claim 1, 2 or 3,

- wherein the motion transmitting mechanism (05b, 05c) comprises

  - a first idler wheel (06a) attached to the first end (04a) of the adjusting bridge (03);
  - a second idler wheel (06b) attached to the second end (04b) of the adjusting bridge (03);
  - a first flexible linear element (07a) having two opposite ends, which first flexible linear element is connected, at a first attachment point (08a), to the first work platform (02a) by one end, going around the first idler wheel (06a), and connected, at a second attachment point (08b), to the second platform (02b) by the other end;
  - a second flexible linear element (07b) having two opposite ends, which second flexible linear element is connected, at the second attachment point (08b), to the second work platform (02b) by one end, going around the second idler wheel (06b), and connected, at the first attachment point (08a), to the first work platform (02a) by the other end; and

- wherein the first and second linear elements (07a, 07b) form a loop which loops over the first and the second idler wheels (06a, 06b) and the first and second linear elements (07a, 07b) are forced to move along the loop when the work platforms (02a, 02b) are moving up and down.

5. The work platform system according to claim 4,

- wherein the first linear element (07a) is led from the first attachment point (08a) to the first idler wheel (06a) in a substantially horizontal first direction (D01) away from the second work platform (02b), and additionally the first linear element (07a) is led from the first idler wheel (06a) in a substantially horizontal second direction (D02) towards the second work platform (02b) in such a way that the first and second directions (D01, D02) are opposite directions; and
- wherein the second linear element (07b) is led from the second attachment point (08b) to the second idler wheel (06b) in a substantially horizontal third direction (D03) away from the first work platform (02a), and additionally the second linear element (07b) is led from the second idler wheel (06b) in a substantially horizontal fourth direction (D04) towards the first work platform (02a) in such a way that the third and fourth directions (D03, D04) are opposite directions.

6. The work platform system according to claim 4 or 5, wherein the motion transmitting mechanism (05b, 05c) further comprises

- central idler wheels (06c) attached to a middle section of the adjusting bridge (03);
- wherein the first and second linear elements (07a, 07b) are led via the central idler wheels to change direction of travel of the first and second linear elements (07a, 07b).

7. The work platform system according to claim 1, 2 or 3, wherein the motion transmitting mechanism (05a) comprises

- one or more pinions or gearwheels (10) attached to a middle section of the adjusting bridge (03);
- a first rack or toothed bar (11a) having two opposite ends, which first rack or toothed bar is connected by a joint to the first work platform (02a) with one end and extends to the middle section to be in contact with the one or more pinions or gearwheels (10);
- a second rack or toothed bar (11b) having two opposite ends, which second rack or toothed bar is connected by a joint to the second work platform (02b) with one end and extends to the middle section to be in contact with the one or more pinions or gearwheels (10);
- wherein the one or more pinions or gearwheels (10) are adapted to transmit motion of the first rack (11a) to the second rack (11b), and vice versa, and the first and second racks or toothed bars (11a, 11b) are forced to move in relation to each other when the work platforms (02a, 02b) are moving up and down.

8. The work platform system according to any one of claims 1 to 7, further comprising a guiding mechanism adapted to guide the adjusting bridge (03) to move along the first and second work platforms (02a, 02b) in such a way that

- the first end (04a) is adapted to move to a fifth direction (D05) along the first work platform (02a), the fifth direction (D05) defining in a horizontal plane a third angle (θ03) in relation to the longitudinal direction of the adjusting bridge (03); and
- the second end (04b) is adapted to move to a sixth direction (D06) along the second work platform (02b), the sixth direction (D06) defining in a horizontal plane a fourth angle (θ04) in relation to the longitudinal direction of the adjusting bridge (03).

9. The work platform system according to claim 8, wherein the third and fourth angles (θ03, θ04) are more than 10° and substantially equal.

10. The work platform system according to claim 8 or 9, wherein the guiding mechanism comprises

- at least one guide or rail (12) attached to the first work platform (02a);
- at least one element or wheel (13) attached to the first end (04a) of the adjusting bridge (03) and adapted to glide or roll along the guide or rail (12) of the first work platform;
- at least one guide or rail (12) attached to the second work platform (02b); and
- at least one element or wheel (13) attached to the second end (04b) of the adjusting bridge (03) and adapted to glide or roll along the guide or rail (12) of the second work platform.

11. The work platform system according to any one of claims 8 to 10, wherein the guiding mechanism comprises

- a first guiding beam or rail (14a) attached to the adjusting bridge (03) and extending from a middle section of the adjusting bridge to the first end (04a);
- a second guiding beam or rail (14b) attached to the adjusting bridge (03) and extending from the middle section to the second end (04b), wherein the first and second guiding beams or rails (14a, 14b) define in a horizontal plane a seventh angle (θ07) in relation to each other;
- a first directional steering device (15a), which is fixed onto the first work platform (02a) and adapted to move along the first guiding beam or rail (14a) when the first end (04a) is moving along the first work platform (02a); and
- a second directional steering device (15b) which is fixed onto the second work platform (02b) and adapted to move along the second guiding beam or rail (14b) when the second end (04b) is moving along the second work platform (02b).

12. The work platform system according to any one of claims 8 to 10, wherein the guiding mechanism comprises

- a first guiding beam or rail attached to and extending along the first work platform (02a);
- a second guiding beam or rail attached to and extending along the second work platform (02b), wherein the first and second guiding beams or rails define in a horizontal plane a seventh angle (θ07) in relation to each other;
- a first directional steering device, which is fixed to the first end (04a) and adapted to move along the first guiding beam or rail when the first end (04a) is moving along the first work platform (02a);
- a second directional steering device, which is fixed to the second end (04b) and adapted to move along the second guiding beam or rail when the second end (04b) is moving along the second work platform (02b).

13. The work platform system according to any one of claims 1 to 12, wherein, when the first and second work platforms (02a, 02b) simultaneously move up and down, a fifth angle (θ05) formed between the first work platform (02a) and the adjusting bridge (03) in a horizontal plane stays the same and a sixth angle (θ06) formed between the second work platform (02b) and the adjusting bridge (03) in a horizontal plane stays the same.

14. The work platform system according to any one of claims 1 to 13, wherein the first and second masts (01a, 01b) are both at an angle in relation to a vertical direction, and wherein the first and second masts (01a, 01b) are both supported to a building or construction that includes a wall being at an angle in relation to a vertical direction and defining a curved shape in a horizontal direction.

15. An adjusting bridge (03) suitable for connecting a first and second work platforms (02a, 02b) connected to a first and the second masts (01a, 01b), respectively (03), the first and second work platforms (02a, 02b) being capable of climbing up and down along the first and second masts (01a, 01b) and moving simultaneously in such a way that the first and second work platforms (02a, 02b) stay substantially at the same height in relation to each other;
characterized in that the adjusting bridge (03) comprises

- opposite first and second ends (04a, 04b) in a longitudinal direction of the adjusting bridge, the first end (04a) being adapted to be movably placed on the first work platform (02a) and the second end (04b) being adapted to be movably placed on the second work platform (02b);
- wherein the adjusting bridge (03) further comprises a motion transmitting mechanism (05a, 05b, 05c) adapted to automatically synchronize movements of the first and second ends (04a, 04b) in such a way that
- when the first and second work platforms (02a, 02b) are approaching each other because of climbing along the first and second masts (01a, 01b), the first end (04a) is adapted to horizontally move along the first work platform (02a) towards the first work platform (02a) and simultaneously the second end (04b) is adapted to horizontally move along the second work platform (02b) towards the second work platform (02b); and
- when the first and second work platforms (02a,

02b) are departing from each other because of climbing along the first and second masts (01a, 01b), the first end (04a) is adapted to horizontally move along the first work platform (02a) away from the first work platform (02a) and simultaneously the second end (04b) is adapted to horizontally move along the second work platform (02b) away from the second work platform (02b).

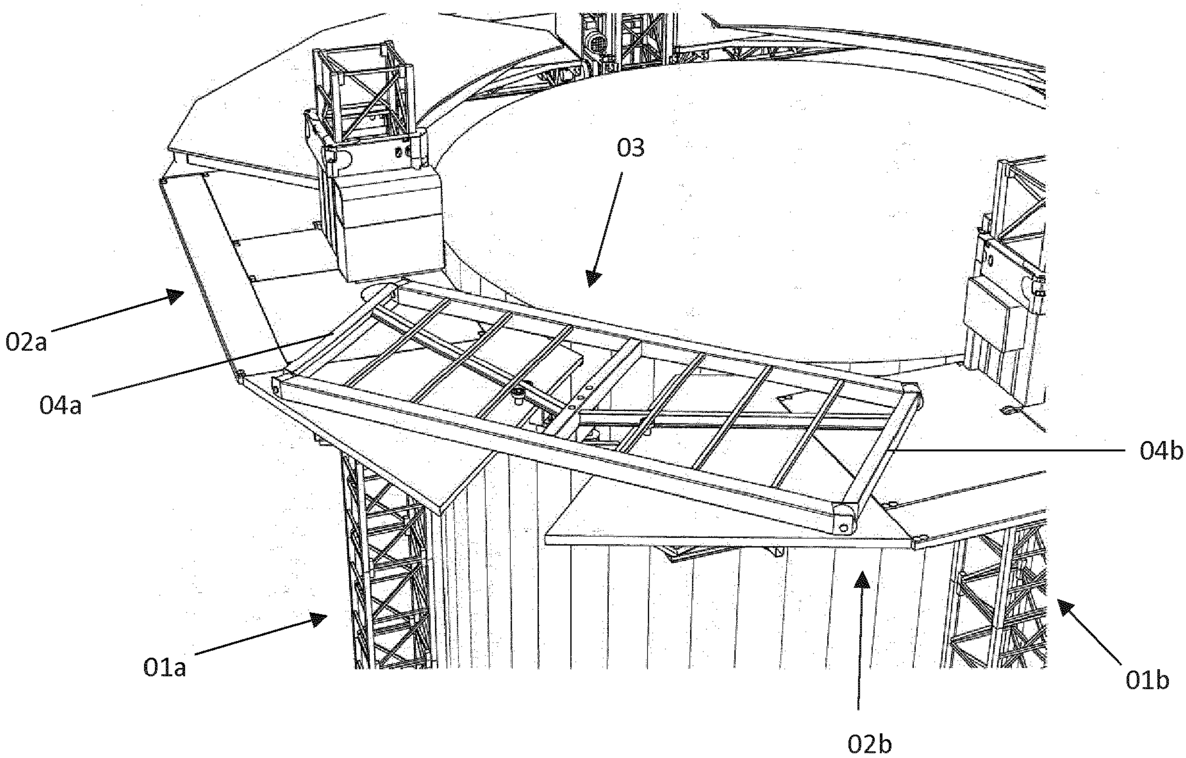
03
02a
04a
04b
01a
01b
02b

Fig. 1

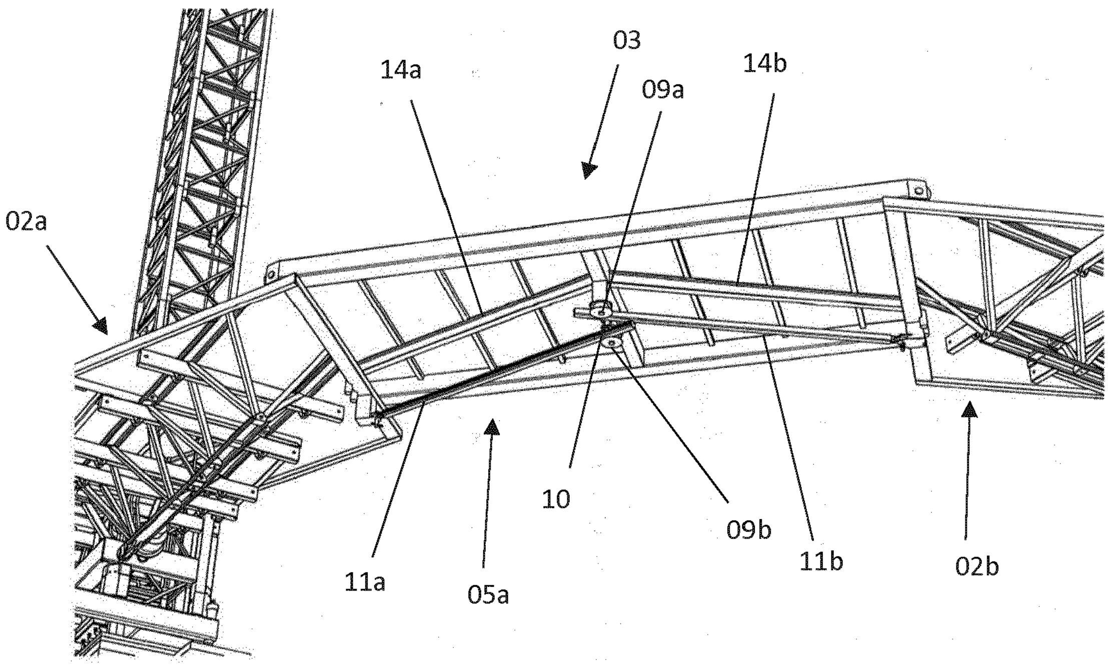
03
14a
09a
14b
02a
10
09b
11a
05a
11b
02b

Fig. 2

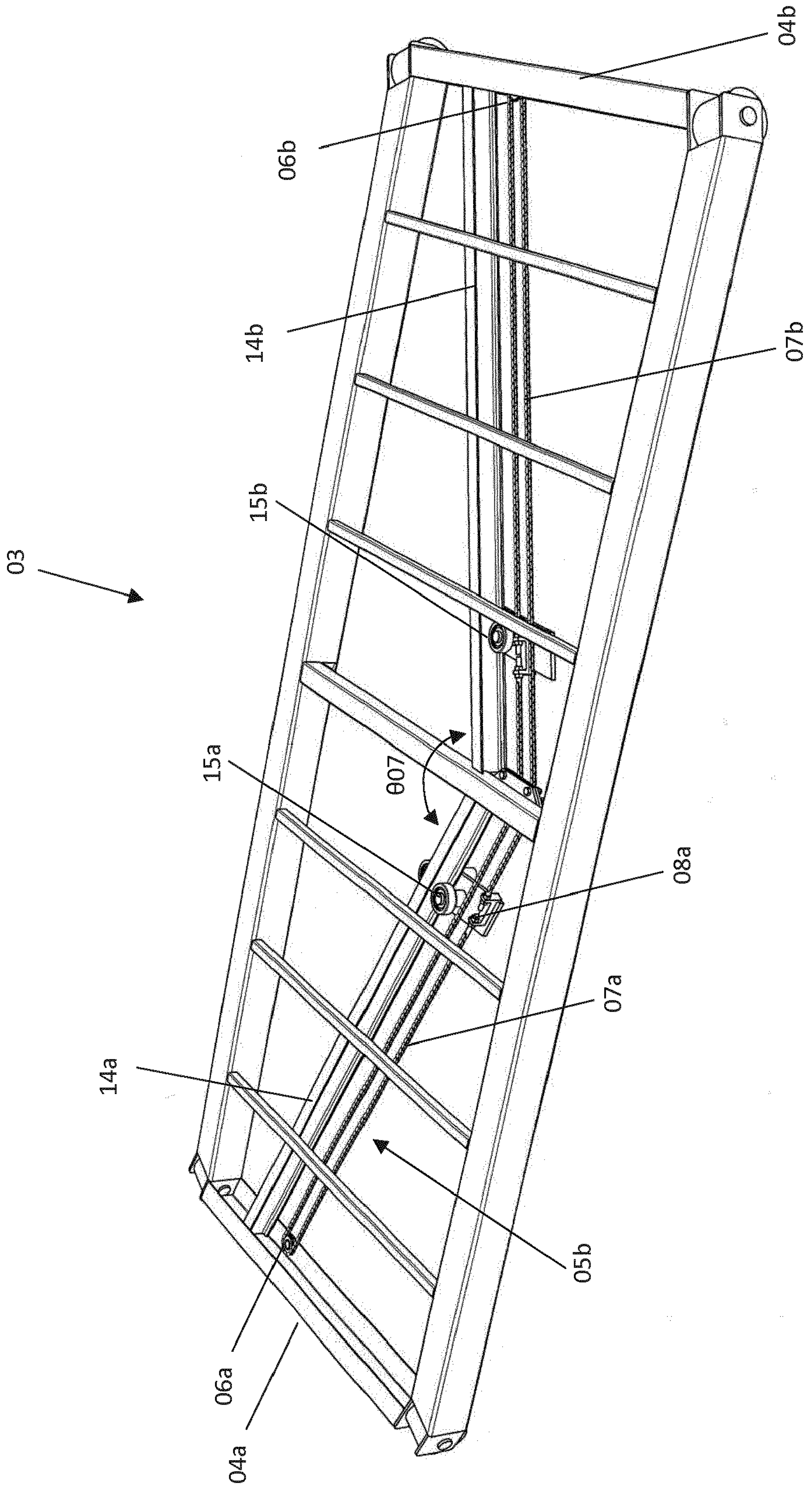

Fig. 3

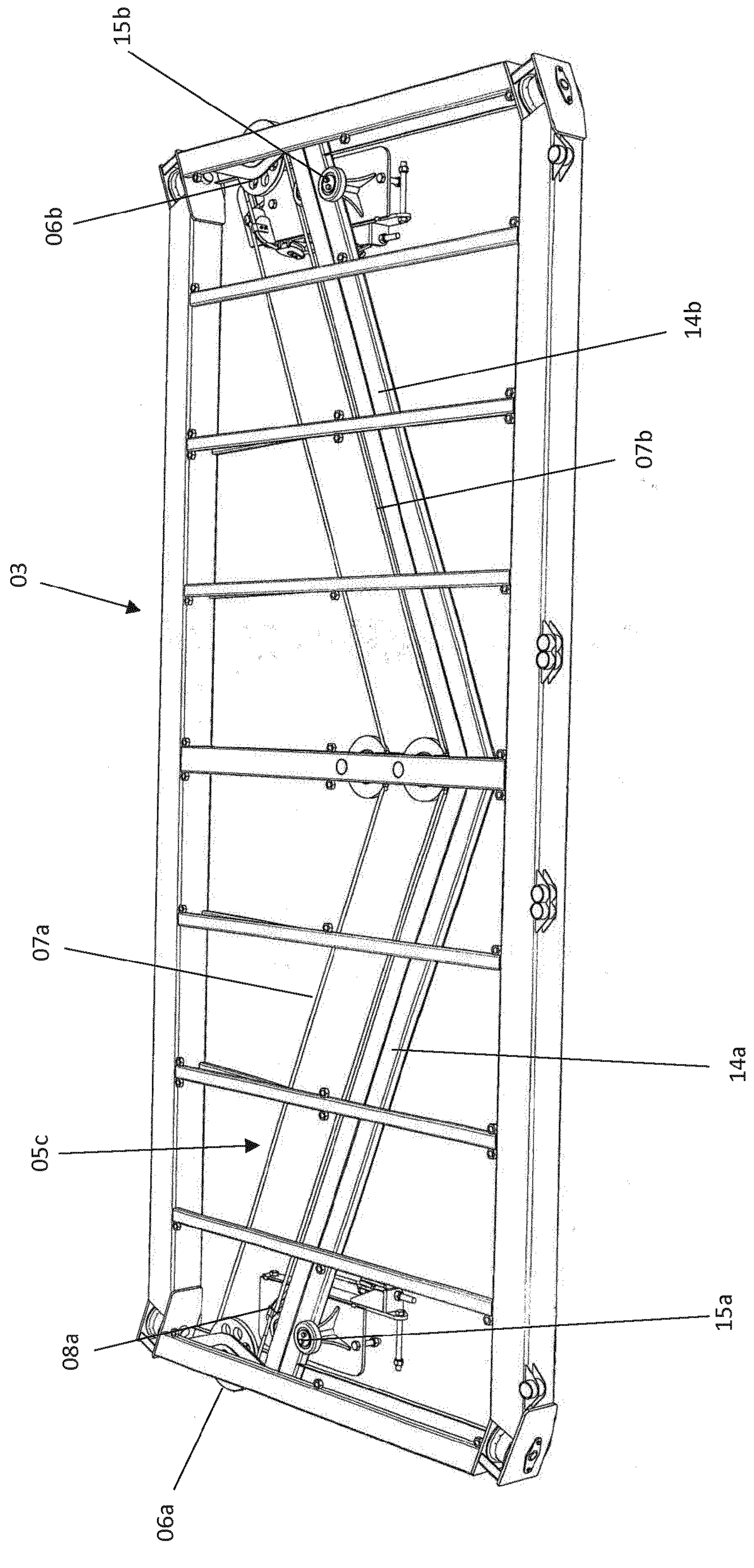

Fig. 4

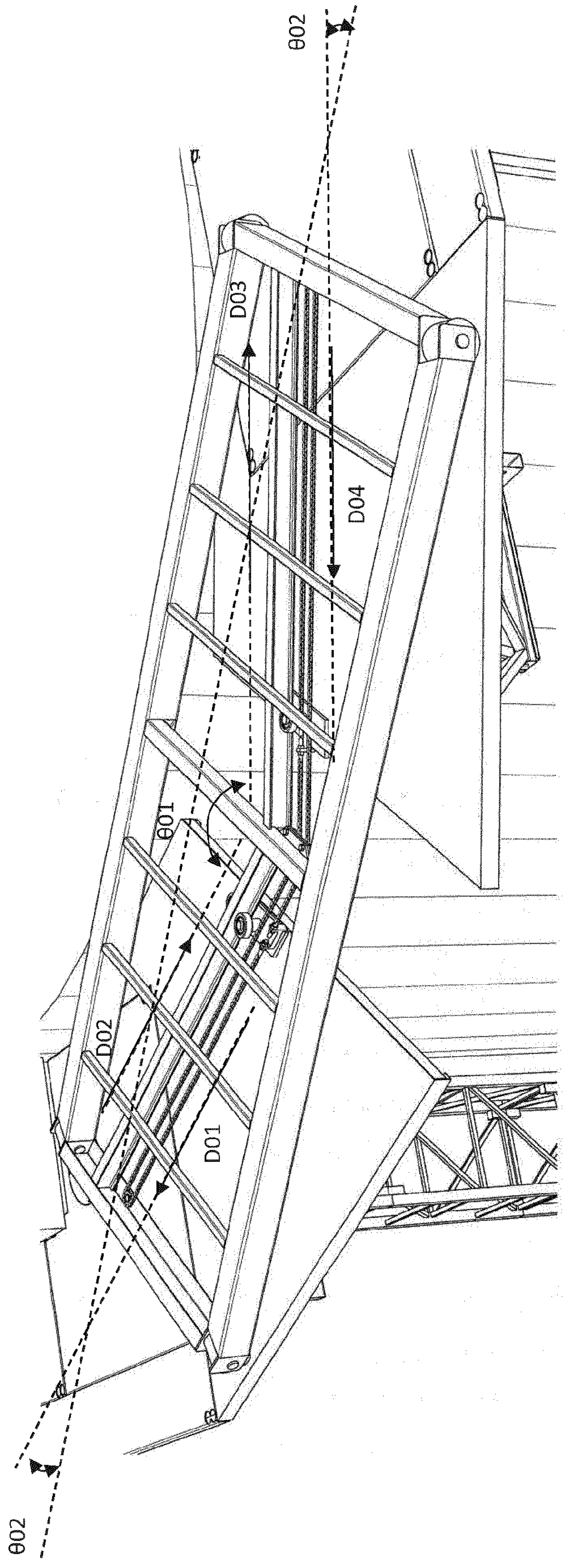

Fig. 5

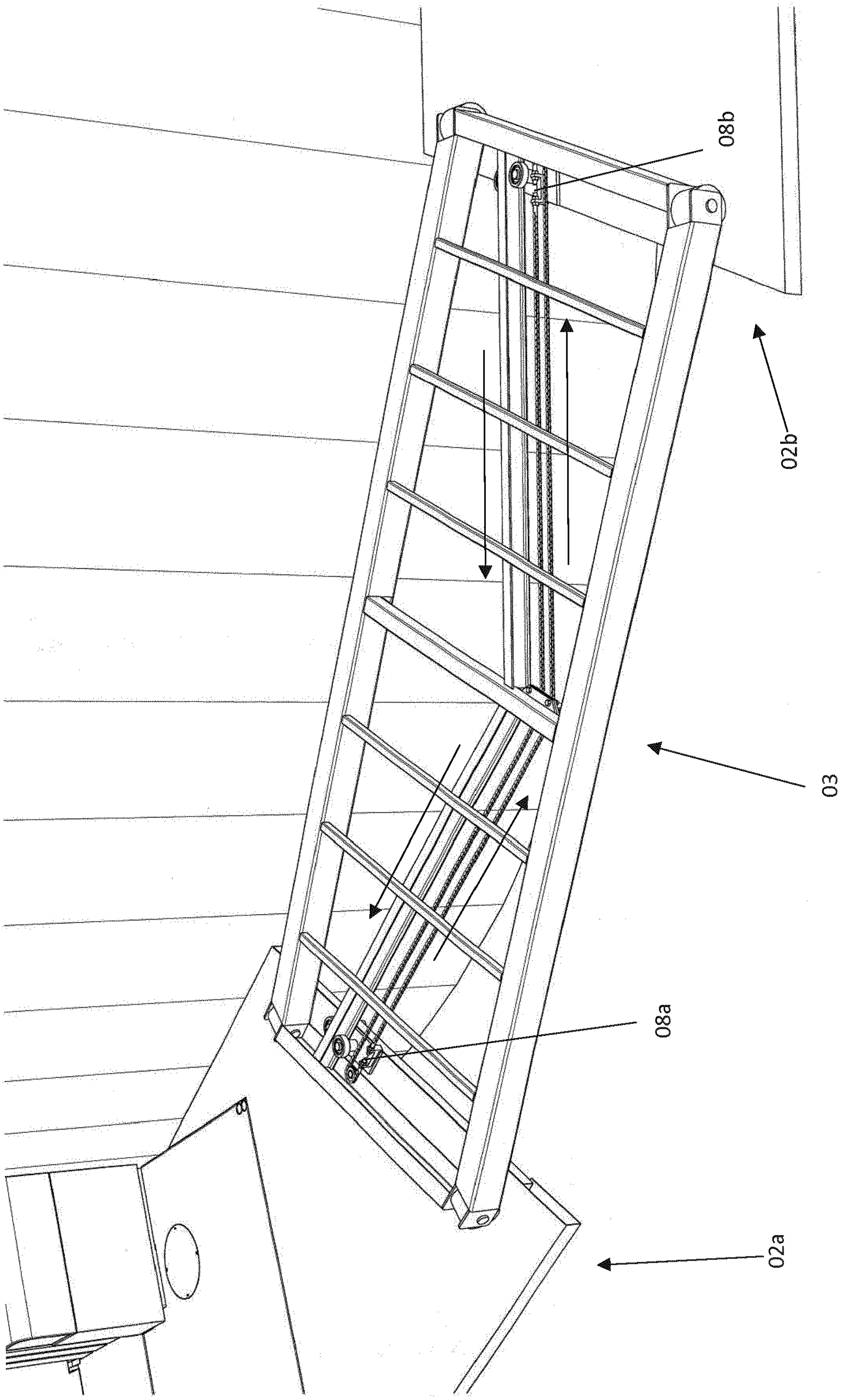

Fig. 6

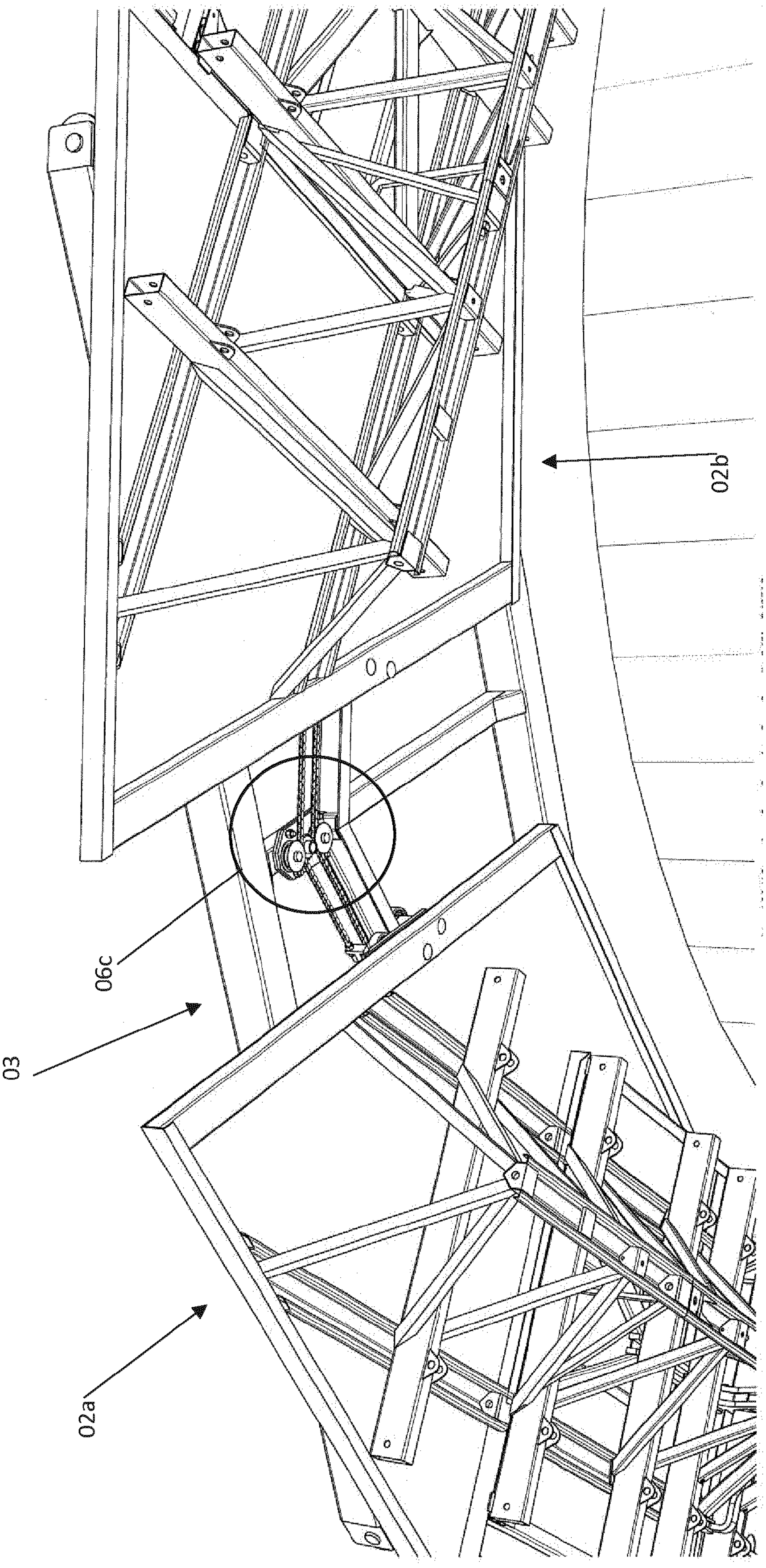

Fig. 7

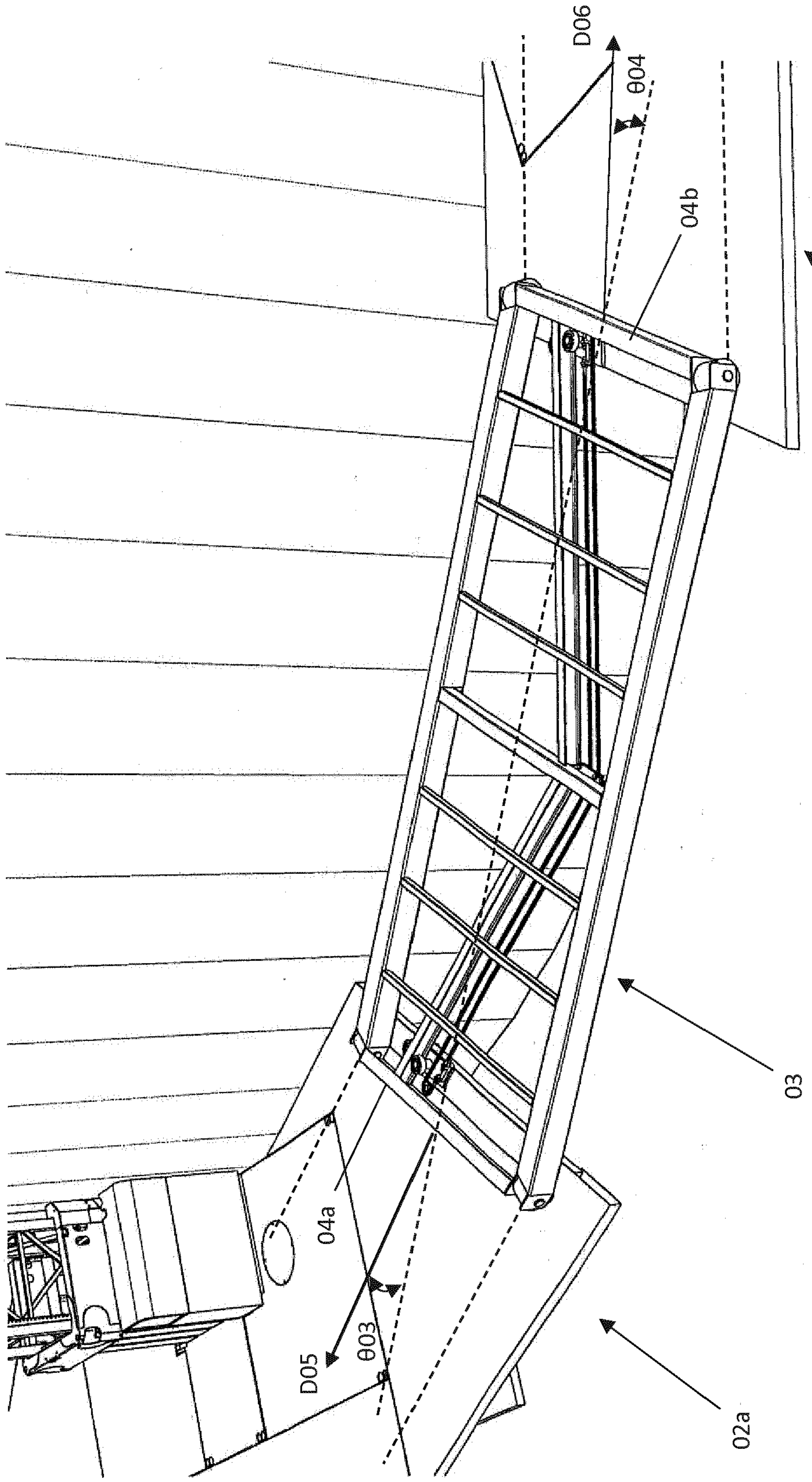

Fig. 8a

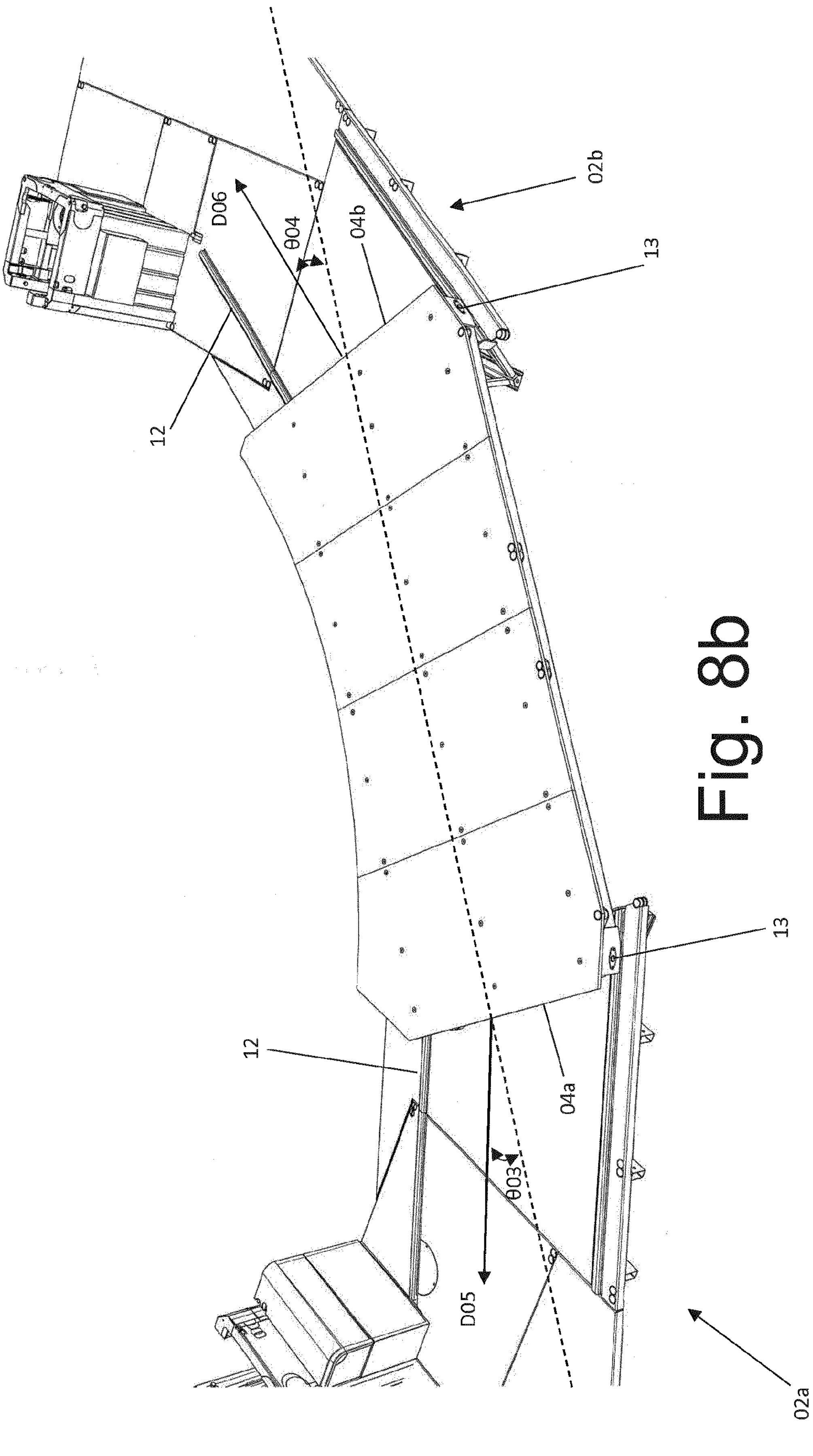

Fig. 8b

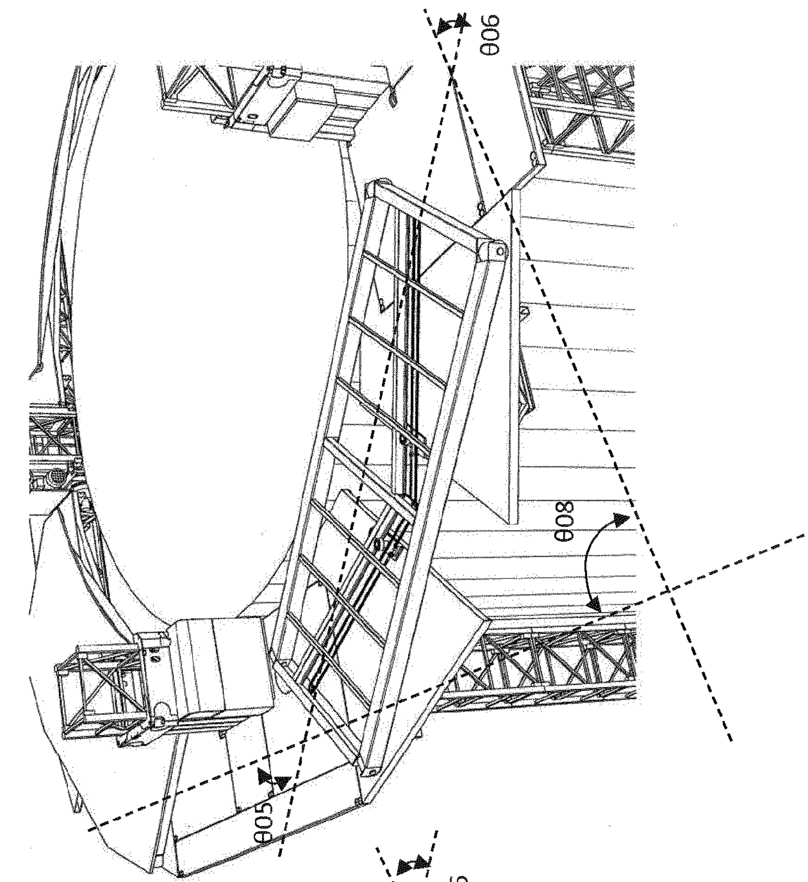

Fig. 9b

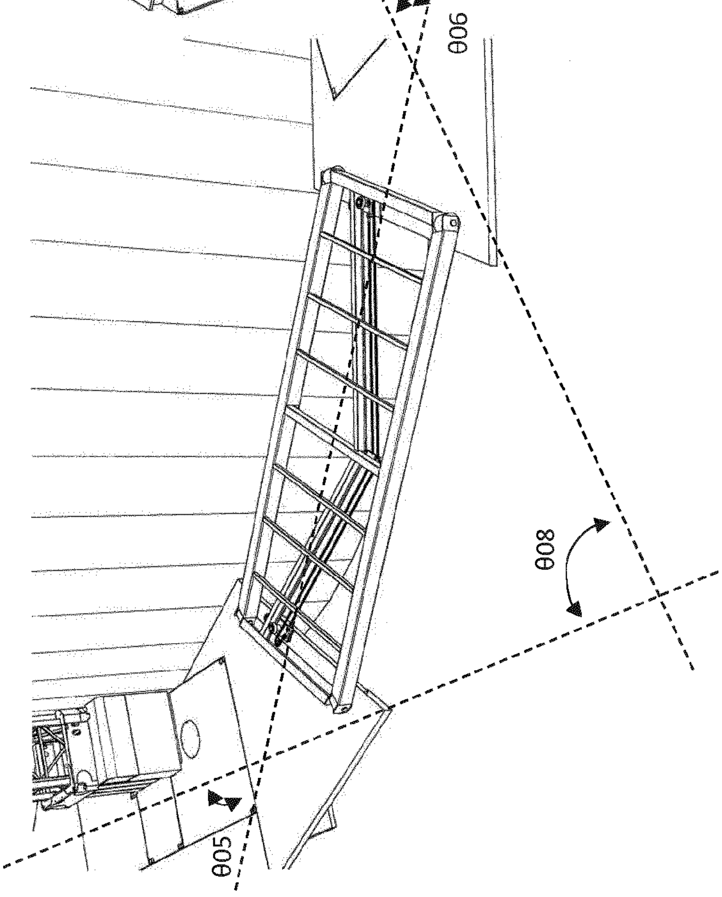

Fig. 9a

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EUROPEAN SEARCH REPORT

Application Number
EP 19 39 7519

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	26 November 2019	Tryfonas, N

CATEGORY OF CITED DOCUMENTS

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