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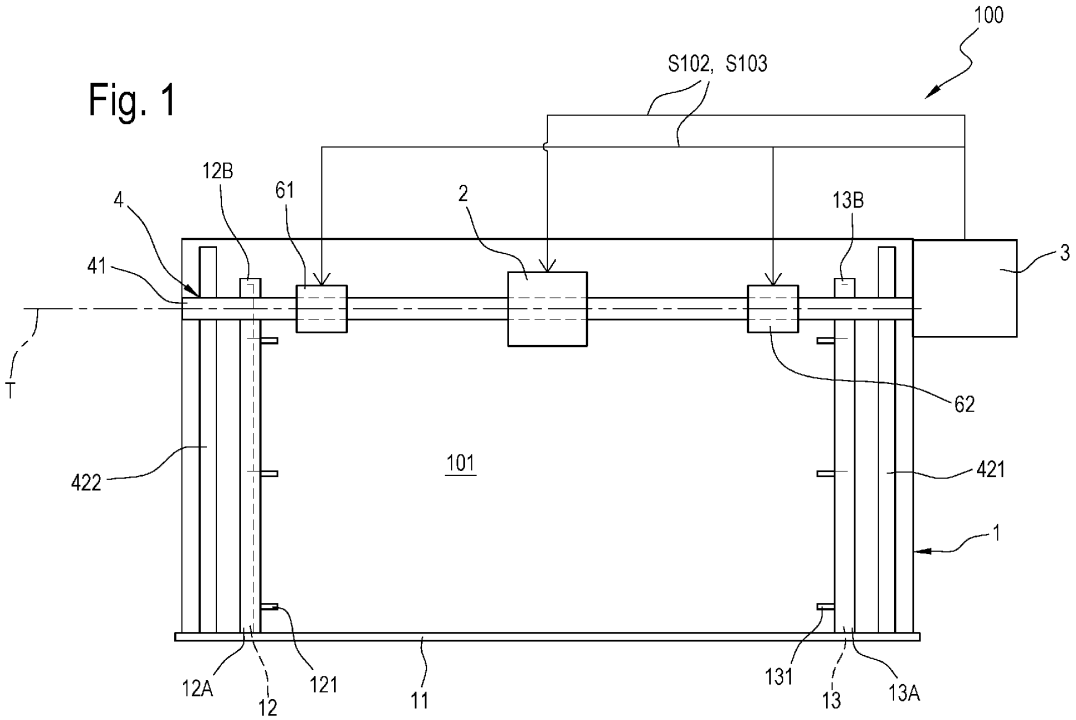
(54) A WORKBENCH FOR A NAILING APPARATUS FOR MAKING A WALL FOR WOODEN PACKAGING

(57) A workbench (1) for a nailing apparatus (100) comprises: a supporting wall (10) defining a supporting surface (101) on which to position the first and the second wooden board (T1, T2); an abutment wall (11), extending from the supporting surface (101) to define an abutment for the first wooden board (T1) along a longitudinal direction (L); a first supporting bar (12) extending along the longitudinal direction (L) and comprising a first supporting element (121) protruding from the first supporting bar (12) to define a first shoulder along the longitudinal direction (L); a second supporting bar (13) extending along the longitudinal direction (L) and comprising a second supporting element (131) protruding from the second supporting bar (13) to define a second shoulder along the longitudinal direction (L). The first supporting element and the second supporting element (121, 131) are aligned along a transverse direction (T), perpendicular to the longitudinal direction (L).

Fig. 1



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Description

[0001] This invention relates to a workbench for a nailing apparatus. This invention also addresses an apparatus and a method for nailing a first and a second wooden board used to make a wall for wooden packaging.

[0002] In the field of nailing machines used for making wooden packaging, solutions are known in the prior art which comprise handheld nailing devices used to shoot the connecting elements at the points which need to be nailed and which are identified by users themselves.

[0003] It is evident that the work involved, besides being laborious and strenuous for a user, is also unsafe and slow.

[0004] Also known are solutions comprising laser systems that comprise working heads with automatic nailing devices but these are all used in applications without the difficulties encountered in this field, where there are two wooden parts that are superposed on each other only in certain zones.

[0005] Thus, the automatic systems available in this field are not suitable for the purpose of this disclosure because they are not capable of automating the nailing process described herein.

[0006] The documents listed below disclose some examples of solutions which are similar to those provided by this invention and which have the above-mentioned disadvantages: US4204624A, US4492016A, CA914708A, FR2785842A1, CN111483030A, CN216127417U, US2003172615A1 and FR2554754A1.

[0007] The aim of this invention is to provide an apparatus and a method for nailing a first and a second wooden board used to make a wall for wooden packaging to overcome the above-mentioned disadvantages of the prior art. This aim is fully achieved by the apparatus and method of this disclosure as characterized in the appended claims.

[0008] According to an aspect of it, this disclosure provides a nailing apparatus for nailing a first and a second wooden board (that is to say, wood material) to make a wall for wooden packaging. It is specified that the wall for wooden packaging may be of different kinds, including, for example, only one first and one second wooden board, or a plurality of first wooden boards, parallel to each other, and a plurality of second wooden boards, parallel to each other and perpendicular to the first wooden boards. In other words, walls for open or closed crates, with reinforcing strips, can be made.

[0009] It should be noted that the boards may be plywood or blockboards.

[0010] The nailing apparatus comprises a supporting bench (hereinafter also called workbench or simply bench). The workbench defines a supporting surface on which the first and the second wooden board can be positioned, superposed on each other along a direction perpendicular to the supporting surface. The first and second boards are superposed on each other so that they can be joined to each other by a connecting element.

[0011] The nailing apparatus comprises a working head. The working head comprises a reservoir, configured to contain a plurality of connecting elements. The nailing apparatus comprises a nailing device, configured to withdraw a connecting element from the reservoir. The nailing device is configured to shoot the connecting element towards the supporting surface. The nailing apparatus comprises a movement actuator, configured to move the working head in a plane parallel to the supporting surface.

[0012] The nailing apparatus comprises a control unit, configured to send move signals to the movement actuator via a control unit to control the movement of the working head. The control unit is configured to send shoot signals to the nailing device to instruct the nailing device to shoot the connecting element.

[0013] Advantageously, the nailing apparatus comprises a sensor. The sensor is configured to capture shooting data. The shooting data identify a position of a shooting zone (shooting coordinates, shooting position) characterized by the superposing of the first wooden board and the second wooden board. The control unit is configured to receive the shooting data from the sensor. The control unit is configured to generate the move signals and/or the shoot signals as a function of the shooting data received from the sensor.

[0014] In other words, the control unit generates the move signals to bring the working head into the shooting zone (shooting position) and then, when the shooting position has been reached, it generates the shoot signals to start the nailing operation.

[0015] The sensor allows automatically identifying the superposition zones where the first board and the second board are superposed, thus deriving drive signals for the working head, allowing it to shoot at the shooting zones correctly and automatically.

[0016] In an embodiment, the sensor is mounted on the working head.

[0017] In an embodiment, the sensor is a distance sensor. The distance sensor is configured to detect an operating distance representing a distance of the working head from the first wooden board and/or from the second wooden board resting on the supporting surface.

[0018] In an embodiment, the sensor is an optical distance sensor.

[0019] This embodiment allows obtaining a system that is simple to set up, inexpensive and yet very reliable.

[0020] According to an aspect of it, this disclosure provides a nailing method for nailing a first and a second wooden board to make a wall for wooden packaging.

[0021] The method comprises a step of positioning the first wooden board on a workbench defining a supporting surface.

[0022] The method comprises a step of positioning the second wooden board so it is superposed on the first wooden board along a direction perpendicular to the supporting surface.

[0023] The method comprises a step of providing a

working head, including a reservoir containing a plurality of connecting elements, and a nailing device which shoots a connecting element towards the wooden boards.

[0024] The method comprises a step of sending move signals to the movement actuator via a control unit to control the movement of the working head. The method comprises a step of moving the working head in a plane parallel to the supporting surface via a movement actuator.

[0025] The method comprises a step of sending shoot signals to the nailing device. The method comprises a step of shooting the connecting element by means of the nailing device.

[0026] Advantageously, the method comprises a step, via a sensor, of capturing shooting data identifying a position of a shooting zone characterized by the superposing of the first wooden board and the second wooden board. The method comprises a step of receiving the shooting data in the control unit.

[0027] The method comprises a step of generating the move signals and/or the shoot signals as a function of the shooting data received from the sensor.

[0028] In an embodiment, in the step of capturing, the sensor detects an operating distance representing a distance of the working head from the first wooden board and/or from the second wooden board resting on the supporting surface.

[0029] In an embodiment, the sensor detects the operating distance in real time. The method also comprises a step of instructing the working head to make a movement along a longitudinal direction.

[0030] The method comprises a step of detecting a reduction in the operating distance.

[0031] The method comprises a step of instructing the working head to make a further movement along the longitudinal direction by a value greater than or equal to a preset movement value. The movement value may also be less than the preset movement value.

[0032] The method comprises a step of sending a shoot signal to perform a first nailing operation.

[0033] The method comprises a step of instructing the working head to make a movement along the transverse direction.

[0034] The method comprises a step of sending the shoot signal as the working head moves along the transverse direction for a preset number of shots.

[0035] According to an aspect of it, this disclosure provides a workbench for a nailing apparatus used to make a wall for wooden packaging from a first wooden board and a second wooden board.

[0036] The workbench comprises a supporting wall defining a supporting surface on which to position the first and the second wooden board.

[0037] The workbench (preferably) comprises an abutment wall. The abutment wall extends from the supporting surface to define an abutment for the first wooden board along a longitudinal direction.

[0038] Advantageously, the workbench comprises a first supporting bar. The first supporting bar extends along the longitudinal direction. The first supporting bar comprises a first supporting element. The first supporting element protrudes from the first supporting bar to define a first shoulder along the longitudinal direction.

[0039] Advantageously, the workbench comprises a second supporting bar. The second supporting bar extends along the longitudinal direction. The second supporting bar comprises a second supporting element. The second supporting element protrudes from the second supporting bar to define a second shoulder along the longitudinal direction.

[0040] The first supporting element and the second supporting element are aligned along a transverse direction, perpendicular to the longitudinal direction to support the second wooden board so it is superposed on the first wooden board along a nailing direction perpendicular to the supporting surface. The first and second supporting elements allow having a workbench on which the second wooden boards can be mounted without having to be held by a user. This is essential to enable the second wooden boards to be positioned more easily with the workbench in a vertical position but, even if the workbench were horizontal, it would enable the second wooden boards to be stabilized better by simply inclining it slightly.

[0041] According to a particularly advantageous aspect, the first supporting element and the second supporting element are movable along the longitudinal direction on the first supporting bar and on the second supporting bar respectively.

[0042] This allows the position of the second wooden board to be adapted along the longitudinal direction, thus increasing the flexibility of the workbench and of the apparatus for making the walls of wooden packaging.

[0043] According to an aspect of it, this disclosure also provides a method for holding a first wooden board and a second wooden board in place during nailing operations for making a wall for wooden packaging. The method comprises a step of positioning the first wooden board on a supporting surface defined by a supporting wall of a workbench.

[0044] The method comprises a step of abutting the first board on an abutment wall of the workbench, extending from the supporting surface to define an abutment for the first wooden board along a longitudinal direction.

[0045] The method comprises a step of providing a first supporting bar extending along the longitudinal direction and comprising a first supporting element protruding from the first supporting bar to define a first shoulder along the longitudinal direction.

[0046] The method comprises a step of providing a second supporting bar extending along the longitudinal direction and comprising a second supporting element protruding from the second supporting bar to define a second shoulder along the longitudinal direction. The first

supporting element and the second supporting element are aligned along a transverse direction perpendicular to the longitudinal direction.

[0047] The method advantageously comprises a step of positioning the second wooden board so it rests on the first and the second supporting element and is superposed on the first wooden board along a nailing direction which is perpendicular to the supporting surface.

[0048] These and other features will become more apparent from the following description of a preferred embodiment, illustrated purely by way of nonlimiting example in the accompanying drawings, in which:

- Figure 1 shows a schematic side view of a nailing apparatus according to this disclosure;
- Figure 2 shows a schematic side view of the apparatus of Figure 1 in a positioning configuration CF1;
- Figure 3 shows a schematic side view of the apparatus of Figure 1 in a nailing configuration CF2;
- Figure 4 shows a schematic perspective view of the apparatus of Figure 1;
- Figure 5 shows a schematic side view of a detail of the workbench of the apparatus of Figure 1;
- Figure 6 shows a schematic side view of a first supporting bar and of a second supporting bar respectively;
- Figure 7 shows a schematic side view of a nailing device of the apparatus of Figure 1;
- Figures 8 and 9 schematically illustrate a display of a user interface showing the shooting zones on the wooden wall.

[0049] With reference to the accompanying drawings, the numeral 100 denotes an apparatus for nailing at least one first wooden board T1 and one second wooden board T2 for making a wall PI of wooden packaging.

[0050] The apparatus 100 comprises a workbench 1 which is configured to hold the first and second boards T1, T2 in respective nailing positions. It should be noted that the drawings illustrate a solution in which the wall PI is made from a first board T1 and a plurality of second boards T2 (that is, a plurality of strips T2). It is evident that this method may be extended to any type of wall which can be made for packaging purpose, such as, for example, but with no limitation of scope implied:

- walls for closed crates, where the first board T1 is a flat board extending along both the transverse direction T and the longitudinal direction L and where the second boards T2 are strips oriented transversely or longitudinally and are spaced from each other along the transverse direction T or along the longitudinal direction L;
- walls for open crates, comprising a plurality of first boards T1, defined by strips oriented longitudinally and spaced from each other along the transverse direction T and where the second boards T2 are strips oriented transversely and spaced from each other along the longitudinal direction L.

[0051] The wall PI made is then integrated, assembled with other wooden walls to make the wooden packaging.

[0052] The apparatus 100 comprises a base frame 1001. The base frame 1001 may be made according to different embodiments.

[0053] In a first embodiment, the base frame comprises a load-bearing structure 1001A, configured to hold the workbench 1 at a first position CF1 (positioning configuration) where the workbench 1 is substantially inclined to the direction of the weight force at an angle less than 45 degrees or greater than 135 degrees. In a second embodiment, the load-bearing structure 1001A is configured to hold the workbench 1 at a second position CF2 (nailing configuration) where the workbench 1 is substantially inclined to the direction of the weight force at an angle greater than 45 degrees and less than 135 degrees.

[0054] In a third, more flexible embodiment, on the other hand, the load-bearing structure 1001A comprises a fixed column 1001A' and a hinge 1001A" which connects the workbench 1 to the fixed column 1001A'. In this embodiment, the workbench 1 is configured to rotate about the hinge 1001A" between the positioning configuration CF1 and the nailing configuration CF2 so as to position the first board T1 and the second boards T2 in the positioning configuration CF1 which is vertical and to nail them in the nailing configuration CF2 which is horizontal.

[0055] The workbench 1 comprises a supporting wall 10 which defines a supporting surface 101, on which the first board T1 and the second boards T2 are positioned. In particular, the second boards T2 are superposed on the first board T1 along a nailing direction DC perpendicular to the supporting surface 101.

[0056] In an embodiment (not illustrated in the drawings), the supporting wall 10 comprises a plurality of suction holes to exert a suction force on the first board so as to hold it securely during nailing.

[0057] The workbench 1 comprises an abutment wall 11. The abutment wall 11 extends from the supporting surface to define an abutment for the first wooden board T1 along a longitudinal direction L.

[0058] In particular, with the workbench 1 in the positioning configuration CF1, the abutment wall 11 is substantially perpendicular to the direction of the weight force, so that the first board T1 abuts against the abutment wall 11 by effect of its own weight.

[0059] In an embodiment, the workbench 1 comprises a first supporting bar 12. The first supporting bar 12 extends along the longitudinal direction L, between a first end 12A and a second end 12B. The first end 12A is associated with the abutment wall 11. The second end 12B, on the other hand, is opposite the first end 12A.

[0060] The first supporting bar 12 comprises at least a first supporting element 121 protruding from the first supporting bar 12 to define a first shoulder along a longitudinal direction L. By "shoulder along the longitudinal di-

rection L" is meant an obstacle which can be abutted while moving along the longitudinal direction L.

[0061] In a preferred embodiment, like the one shown in the drawings, the first supporting bar 12 comprises a plurality of first supporting elements 121 which are (or can be) spaced along the longitudinal direction L between the first end 12A and the second end 12B of the first supporting bar 12.

[0062] It is noted that references to the features of the first supporting element 121 mentioned hereinafter are intended to be extended also to the other supporting elements of the plurality of first supporting elements 121 of the first supporting bar 12.

[0063] The first supporting element 121 comprises a contact element 121A which juts out from the first supporting bar 12.

[0064] Thus, to constitute a shoulder along the longitudinal direction L, the first supporting element 121 extends along a direction perpendicular to the longitudinal direction L. In particular, in a first embodiment, the first supporting element 121 extends along the nailing direction DC (the contact element 121A juts out in the nailing direction DC). In a second embodiment, the first supporting element 121 extends along a transverse direction T, perpendicular to the nailing direction DC and to the longitudinal direction L (the contact element 121A juts out in the transverse direction T). Furthermore, in another embodiment, the plurality of first supporting elements 121 comprises a first group, of supporting elements which extend along the nailing direction and a second group of supporting elements which extend along the transverse direction.

[0065] This increases the flexibility of the workbench, which can operate with walls not only for open crates, using supporting elements 121 that jut out along the nailing direction DC, but also for closed crates, where the supporting elements 121, instead, need to jut out transversely.

[0066] In an embodiment, the abutment wall 11 comprises a guide on which the first supporting bar 12 is engaged. The first supporting bar 12 is slidable along the guide of the abutment wall 11 so as to vary its position along the transverse direction T.

[0067] In an embodiment, the supporting elements 121 are movable along the longitudinal direction L to vary their longitudinal position.

[0068] For example, the first supporting bar 12 comprises a track chain including respective drive rollers (rotating about an axis parallel to the transverse direction T) which cause it to slide. The supporting elements 121 are meshed with the track chain to move as one with the chain along the longitudinal direction L so as to vary their longitudinal position.

[0069] This embodiment itself gives the tool a first degree of flexibility, which allows varying the position of the second boards T2 in the longitudinal direction L. In another solution, however, the workbench is even more flexible. In effect, in such a solution, each of the plurality of first supporting elements 121 is selectively positionable along the longitudinal direction L. This allows varying not only the longitudinal position of the second boards T2 but also their mutual spacing.

[0070] For example, in a purely exemplary embodiment, the first supporting bar 12 comprises a fixed rack 122. Further, the first supporting elements 121 each comprise, besides the contact element 121A, a respective positioning actuator 121B and a pinion 121C which receives motion from the positioning actuator 121B and, by rotating, produces a longitudinal movement along the rack 122.

[0071] This allows the first supporting elements 121 to be positioned simultaneously, setting the workbench in the desired configuration more quickly and efficiently; it is, however, a more expensive solution.

[0072] Alternatively, there may be a single actuator with a single pinion, comprising a selective clutch mechanism, movable between an engaged position, where it engages the contact element 121A of a first supporting element 121 so that a movement of the single actuator entrains the first supporting element 121, and a selection position, where the selective clutch mechanism is spaced from the first supporting element and moves longitudinally to engage another supporting element 121. Thus, the single actuator selectively engages each first supporting element 121 and moves it to a corresponding longitudinal position. This mode of configuring the workbench 1 is certainly slower but less expensive.

[0073] In an embodiment, the workbench 1 comprises a second supporting bar 13. The second supporting bar 13 extends along the longitudinal direction L, between a first end 13A and a second end 13B. The first end 13A is associated with the abutment wall 11. The second end 13B, on the other hand, is opposite the first end 13A. The second supporting bar 13 is spaced from the first supporting bar 12 along the transverse direction T. Basically, in use, the first supporting bar 12 and the second supporting bar 13 are located on opposite sides of the first board T1 along the transverse direction T.

[0074] The second supporting bar 13 comprises a second supporting element 131 protruding from the second supporting bar 13 to define a second shoulder along the longitudinal direction L.

[0075] In a preferred embodiment, like the one shown in the drawings, the second supporting bar 13 comprises a plurality of second supporting elements 131 which are (or can be) spaced along the longitudinal direction L between the first end 13A and the second end 13B of the second supporting bar 13.

[0076] It is noted that references to the features of the second supporting element 131 mentioned hereinafter are intended to be extended also to the other supporting elements of the plurality of second supporting elements 131 of the second supporting bar 13.

[0077] The second supporting element 131 comprises a respective contact element 131A which juts out from the second supporting bar 13.

[0078] Thus, to constitute a shoulder along the longitudinal direction L, the second supporting element 131 extends along a direction perpendicular to the longitudinal direction L. In particular, in a first embodiment, the second supporting element 131 extends along the nailing direction DC (the contact element 131A juts out in the nailing direction DC). In a second embodiment, the second supporting element 131 extends along a transverse direction T, perpendicular to the nailing direction DC and to the longitudinal direction L (the contact element 131A juts out in the transverse direction T). Furthermore, in another embodiment, the plurality of second supporting elements 131 comprises a first group, of supporting elements which extend along the nailing direction and a second group of supporting elements which extend along the transverse direction.

[0079] This increases the flexibility of the workbench, which can operate with walls not only for open crates, using supporting elements 131 that jut out along the nailing direction DC, but also for closed crates, where the supporting elements 131, instead, need to jut out transversely.

[0080] In an embodiment, the second supporting bar 13 is engaged in the guide of the abutment wall 11. The second supporting bar 13 is slidable along the guide of the abutment wall 11 so as to vary its position along the transverse direction T.

[0081] In an embodiment, the supporting elements 131 are movable along the longitudinal direction L to vary their longitudinal position.

[0082] For example, the second supporting bar 13 comprises a respective track chain including respective drive rollers (rotating about an axis parallel to the transverse direction T) which cause it to slide. The supporting elements 131 are meshed with the track chain to move as one with the chain along the longitudinal direction L so as to vary their longitudinal position.

[0083] In the workbench, each of the plurality of second supporting elements 131 is selectively positionable along the longitudinal direction L.

[0084] For example, in a purely exemplary embodiment, the second supporting bar 13 comprises a respective fixed rack 132. Further, the second supporting elements 131 each comprise, besides the contact element 131A, a respective positioning actuator 131B and a pinion 131C which receives motion from the positioning actuator 131B and, by rotating, produces a longitudinal movement along the rack 132.

[0085] Alternatively, there may be a respective single actuator with a respective single pinion, comprising a selective clutch mechanism, movable between an engaged position, where it engages the contact element 131A of a second supporting element 131 so that a movement of the single actuator entrains the second supporting element 131 along the longitudinal direction L to position it, and a selection position, where the selective clutch mechanism is spaced from the second supporting element 131 and moves longitudinally to engage another second supporting element 131. Thus, the single actuator selectively engages each second supporting element 131 and moves it to a corresponding longitudinal position.

[0086] Basically, therefore, the first and second supporting bars 12, 13 comprise corresponding movement systems for positioning the first supporting elements 121 and the second supporting elements 131, respectively.

[0087] The first supporting elements 121 and the second supporting elements 131 constitute respective shoulders on opposite transverse sides of the first board T1 which allow the second board T2 or the second boards T2 to be placed on top of the first board T1 along the nailing direction.

[0088] Preferably, the first supporting elements 121 and the second supporting elements 131 are aligned along the transverse direction T so that the second board T2 or the second boards T2 remain parallel to the transverse direction T. In other words, each first supporting element 121 is aligned with a respective second supporting element 131 along the transverse direction T. This is not to exclude that, if the second boards T2 of the packaging walls to be made need to be inclined relative to the transverse direction T, the first supporting elements 121 and the second supporting elements 131 may be misaligned along the transverse direction T.

[0089] In an embodiment, the first and the second supporting element 121, 131 (the first and second supporting elements) are spaced from the supporting surface 101 along the nailing direction DC so as to support the second board T2 at a distance from the supporting surface 101, in particular at a distance which is at least equal to the thickness of the first board T1 along the nailing direction DC.

[0090] In a particularly advantageous embodiment, the first and the second supporting element 121, 131 (the first and second supporting elements) are movable along the nailing direction so as to vary their distance from the supporting surface. This allows the workbench 1 to be adapted to first boards T1 having different thicknesses.

[0091] To move the first and the second supporting element 121, 131 (the first and second supporting elements) along the nailing direction DC, the workbench 1 comprises a second actuator.

[0092] In a purely exemplary embodiment, the first supporting bar 12 and the second supporting bar 13 each comprise a respective pair of linear actuators 123, 133, connected to the corresponding rack 122, 132 to move it along the nailing direction DC. In other words, in the first supporting bar 12, the unit defined by the rack 122 and the first supporting elements 121 moves along the nailing direction DC via the respective pair of linear actuators 123. In the same way, in the second supporting bar 13, the unit defined by the rack 132 and the second supporting elements 131 moves along the nailing direction DC via the respective pair of linear actuators 133. In an embodiment, the first supporting elements 121 and the second supporting elements 131 each comprise a clamping groove. The clamping groove comprises a bot-

tom wall which the second wooden board rests on in use. The clamping groove comprises at least one clamping wall which extends from the bottom wall parallel to the supporting surface 101. The clamping wall allows reducing the probability of the second boards T2 tipping over the first supporting elements 121 and the second supporting elements 131 and falling off the workbench 1.

[0093] In an embodiment, the nailing apparatus 100 comprises a control unit 3, configured to control one or more components, actuators and devices of the apparatus 100.

[0094] Specifically, in an embodiment, the control unit 3 is configured to receive design data, representing a position of the second wooden board on the supporting surface. For example, the design data are CAD data which illustrate the original design of the packaging wall.

[0095] The control unit 3 is programmed to derive a longitudinal coordinate of the first and the second supporting element 121, 131 along the longitudinal direction L, based on the design data. In the embodiment illustrated in the drawings, the control unit 3 is programmed to derive a respective longitudinal coordinate for each first supporting element 121, based on the design data. The control unit 3 is also programmed to derive a respective longitudinal coordinate for each second supporting element 131, based on the design data. In the preferred embodiment, the longitudinal coordinate of the first supporting element 121 is the same as that of the corresponding second supporting element 131.

[0096] The control unit 3 is programmed to generate move signals S102 for moving the first and second supporting elements 121, 131 based on the longitudinal coordinate (of each first and second supporting element 121, 131).

[0097] The control unit 3 is programmed to send the move signals S102 to each positioning actuator 121B, 131B or to the single actuator, to instruct them to position each first and second supporting element 121, 131 at the respective longitudinal coordinates.

[0098] In an embodiment, the control unit 3 is programmed to receive thickness data, representing a thickness of the first wooden board. The thickness data may also be included in the design data.

[0099] The control unit 3 is programmed to derive a normal coordinate of each the first and the second supporting element 121, 131 along the nailing direction DC, based on the thickness data.

[0100] The control unit 3 is programmed to generate move signals S102 based on the normal coordinate of each first and second supporting element 121, 131. The control unit 3 is programmed to send the move signals S102 to each pair of linear actuators 123, 133, to instruct each of said pairs to position the first supporting elements 121 and the second supporting elements 131 at the respective normal coordinates, respectively.

[0101] Thus, with the workbench 1 described above, the nailing apparatus 100 can be used to hold the first wooden board T1 and the second wooden board/second wooden boards T2 during nailing operations to make a wall for wooden packaging.

[0102] In particular, the first wooden board T1 is positioned on the supporting surface 101. The first board T1 is made to abut against the abutment wall 11 of the workbench 1.

[0103] Next, the control unit 3, based on the design data received, captures the longitudinal coordinates of the first and second supporting elements 121, 131 and instructs the positioning actuators 121B, 131B to position them at the coordinates derived.

[0104] At this point, the control unit 3, based on the thickness data, also instructs the linear actuators 123, 133 to position the first and second supporting elements 121, 131 at the respective normal coordinate.

[0105] Thus, after these adjustments to adapt to the type of wall to be made, the second wooden board T2 is positioned so it rests on the first and the second supporting element 121, 131 and is superposed on the first wooden board T1 along the nailing direction DC. If there are two or more second boards T2, as illustrated in the accompanying drawings, each of the second boards T2 may be rested on a respective pair of supporting elements defined by a first supporting element 121 and a corresponding second supporting element 131.

[0106] Once the second board T2 (the second boards T2) has been placed on top of the first board T1, the apparatus can proceed to joining the second boards T2 to the first board T1.

[0107] To do this, the apparatus comprises a working head 2. The working head 2 comprises a reservoir, configured to contain a plurality of connecting elements, preferably nails.

[0108] The working head 2 comprises a nailing device 21, configured to withdraw a connecting element from the reservoir and to shoot the connecting element towards the supporting surface 101.

[0109] The apparatus 100 comprises a movement actuator, configured to move the working head 2 in a plane parallel to the supporting surface 101.

[0110] The control unit 3 is configured to send move signals S102 to the movement actuator to instruct it to move the working head 2.

[0111] The control unit 3 is also configured to send shoot signals S103 to the nailing device 21 to instruct the nailing device 21 to shoot the connecting element. The apparatus 100 comprises a movement structure 4. The movement structure 4 is coupled to the working head 2 to move the latter in a plane parallel to the supporting surface 101.

[0112] The movement structure 4 comprises a transverse member 41 on which the working head 2 is slidable along a transverse direction T to vary the transverse coordinate of the working head 2.

[0113] The movement structure 4 comprises a longitudinal member 42. The longitudinal member 42 is perpendicular to the transverse member 41. The transverse member 41 is slidable on the longitudinal member 42

along a longitudinal direction L, perpendicular to the transverse direction T, to vary the longitudinal position of the working head 2.

[0114] Preferably, the longitudinal member 42 comprises a first longitudinal member 421 and a second longitudinal member 422, located on opposite sides of the transverse member 41 to guide the two ends of it.

[0115] It should be noted that the movement structure 4 just described is only an example and different, more complex embodiments of it are imaginable such as a four-point linkage control, where each link rod is controlled by a respective actuator to modify the position of the working head 2 in a plane parallel to the supporting surface 101.

[0116] It is also noted that in an embodiment, the movement structure is configured to allow relative movement between the working head 2 and the first and second boards T1, T2. Thus, in an embodiment, the boards T1, T2 or the supporting wall 10 may slide relative to the working head 2.

[0117] In an embodiment, the apparatus 100 comprises a sensor 5. The sensor 5 is configured to capture shooting data S101 identifying a position of a shooting zone ZS characterized by the superposing of the first wooden board T1 and the second wooden board T2. The control unit 3 is configured to receive the shooting data S101 from the sensor 5. The control unit 3 is configured to generate the move signals S102 and/or the shoot signals S103 as a function of the shooting data S101 received from the sensor 5. In a preferred embodiment, the sensor 5 is mounted on the working head 2. This allows capturing the shooting data S101 at the working head.

[0118] In this embodiment, the sensor 5 is a distance sensor. The distance sensor 5 is configured to detect an operating distance DO, representing a distance of the working head 2 from the first wooden board T1 and/or from the second wooden board T2 resting on the supporting surface 101.

[0119] For example, the distance sensor 5 is an optical sensor which detects the distance of the working head 2 from the boards T1 and T2. Preferably, the distance sensor 5 is configured to capture the shooting data S101 (that is, the operating distance) in real time.

[0120] Based on the shooting data S101 received over time, the control unit 3 is programmed to control nailing operations according to different control logic sequences. For example, in a particularly advantageous embodiment, the control unit 3 is programmed to instruct the working head 2 to make a movement along a longitudinal direction L.

[0121] The control unit 3 is programmed to detect a reduction in the operating distance. Specifically, by detecting the operating distance DO in real time, the control unit 3 is capable of detecting when this distance is reduced, that is to say, when the presence of the second board T2 is detected.

[0122] The control unit 3 is programmed to instruct the working head 2 to make a further movement along the longitudinal direction L by a value greater than or equal to a preset movement value.

[0123] Basically, when the control unit 3 detects a reduction in the operating distance DO, it translates this as the start of the second board T2. At this point, therefore, the control unit 3 moves further and positions itself half way along the second board T2 along the longitudinal direction L. To move to the half way position, the control unit 3 instructs the working head 2 to make a further movement by a value greater than or equal to (that is, around) a preset movement value, that is to say, a value equal to half the longitudinal thickness of the second board T2.

[0124] After moving the working head 2 to the centre of the second board T2, the control unit 3 is programmed to send the shoot signal to perform a first nailing operation.

[0125] The control unit 3 is programmed to instruct the working head 2 to make a movement along a transverse direction T. This allows the working head 2 to move along the second board T2 to nail it at transverse points (at least two transverse points) spaced from each other to make nailing more effective and stable.

[0126] The control unit 3 is programmed to send the shoot signal as the working head 2 moves along the transverse direction T for a preset number of shots, at least two.

[0127] Once the control unit 3 has sent the last shoot signal, the control unit 3 instructs the working head 2 to move along the longitudinal direction L. The control unit 3 is programmed to detect an increase in the operating distance DO, from which it derives the information that it is longitudinally misaligned with the second board T2.

[0128] Now, as it slides along the longitudinal direction L, the working head 2 meets the next second board T2 which will be identified, again, by detecting a reduction in the operating distance DO.

[0129] The cycle is now repeated until the working head 2 reaches its longitudinal limit position.

[0130] In an embodiment, the apparatus 100 comprises a user interface. The user interface is configured to receive configuration data representing one or more of the following quantities:

- a first length L1, representing a dimension of the second wooden board T2 along the longitudinal direction L;
- a second length L2, representing a dimension of the second wooden board T2 along the transverse direction T.

[0131] The control unit 3 is programmed for deriving the preset movement value based on the first length L1 and for deriving the preset number of shots based on the second length L2. In other words, the longer the second board T2 along the transverse direction T, the more the nails that will be needed to make nailing stable and reliable.

[0132] According to an aspect of this disclosure, the

nailing device 21 is configured to shoot the nail along a direction that is inclined to the nailing direction DC and thus along a direction that is not perpendicular to the supporting surface 101.

[0133] In an embodiment, the apparatus 100 comprises a hold-down device 61. The hold-down device 61 is configured to apply a force perpendicular to, and directed towards, the supporting surface 101.

[0134] That way, the hold-down device 61 holds the first board T1 and the second board T2 in place during the nailing operation.

[0135] Preferably, the apparatus 100 comprises a first hold-down device 61 (which is the hold-down device 61 just mentioned above) and a second hold-down device 62. The first and second hold-down devices 61, 62 are movable along the transverse member 41 T. The first and second hold-down devices 61, 62 are mounted on the transverse member 41 T on opposite sides of the nailing device 21 (on opposite sides of the working head 2).

[0136] In an embodiment, the first and/or the second hold-down devices 61, 62 are cylinder and piston mechanisms. The piston is movable relative to the cylinder to push the second board T2 towards the first board T1. Preferably, the piston, at the end of it which is in contact with the second board T2, comprises a plate which is connected to the piston rod by a ball joint, allowing the plate to adapt to the surface of the second board T2.

[0137] In another embodiment, according to an aspect of this disclosure, the sensor 5 is a picture camera 52. The picture camera 52 faces the supporting surface 101. The picture camera 52 is configured to capture image data.

[0138] The control unit 3 is programmed for identifying the shooting zones ZS through image recognition artificial intelligence algorithms configured to detect superposition zones between the first board T1 and the second board T2, which define the shooting zones ZS.

[0139] Specifically, therefore, the control unit 3, based on the image data, determines a vector of the shooting zones ZS, each having a respective transverse coordinate and a longitudinal coordinate.

[0140] The control unit 3, after determining the vector of the shooting zones, instructs the working head 2 to move progressively into each of the shooting zones identified and, in each of said shooting zones ZS, instructs the nailing device 21 to perform a nailing operation (by sending the shoot signal to it).

Claims

1. A workbench (1) for a nailing apparatus (100) for making a wall for wooden packaging (PI) from a first wooden board and a second wooden board (T1, T2), the workbench (1) comprising:

- a supporting wall (10) defining a supporting surface (101) on which to position the first and the second wooden board (T1, T2);
- an abutment wall (11), extending from the supporting surface (101) to define an abutment for the first wooden board (T1) along a longitudinal direction (L),

characterized in that it comprises:

- a first supporting bar (12) extending along the longitudinal direction (L) and comprising a first supporting element (121) protruding from the first supporting bar (12) to define a first shoulder along the longitudinal direction (L);
- a second supporting bar (13) extending along the longitudinal direction (L) and comprising a second supporting element (131) protruding from the second supporting bar (13) to define a second shoulder along the longitudinal direction (L),
- wherein the first supporting element and the second supporting element (121, 131) are aligned along a transverse direction (T), perpendicular to the longitudinal direction (L) to support the second wooden board (T2) so it is superposed on the first wooden board (T1) along a nailing direction (DC) perpendicular to the supporting surface (101).

2. The workbench (1) according to claim 1, wherein the first supporting element and the second supporting element (121, 131) are movable along the longitudinal direction (L) on the first supporting bar and on the second supporting bar (12, 13) respectively.

3. The workbench (1) according to claim, 2 comprising a first actuator (121B, 131B), configured to move the first supporting element and/or the second supporting element (121, 131) on the first and the second supporting bar (12, 13) respectively.

4. The workbench (1) according to claim, 3 comprising a control unit (3), configured to receive design data, representing a position of the second wooden board (T2) on the supporting surface (101), and wherein the control unit (3) is programmed for:

- deriving a longitudinal coordinate of the first and the second supporting element (121, 131) along the longitudinal direction (L), based on the design data;
- generating move signals based on the longitudinal coordinate of the first and the second supporting element (121, 131);
- sending the move signals to the first actuator (121B, 131B), to instruct it to position the first and the second supporting element (121, 131) at the respective longitudinal coordinates.

5. The workbench (1) according to any one of the preceding claims, wherein the first and the second supporting element (121, 131) protrude from the respective first and second supporting bar (12, 13) along a transverse direction (T), perpendicular to the longitudinal direction (L) and to the nailing direction (DC), and wherein the first and the second supporting element (121, 131) are spaced from the supporting surface (101) along the nailing direction (DC) so as to support the second board at a distance from the supporting surface (101).

6. The workbench (1) according to claim 5, wherein the first and the second supporting element (121, 131) are movable along the nailing direction (DC) so as to vary their distance from the supporting surface (101), and wherein the workbench (1) comprises a second actuator (123, 133), configured to move the first and the second supporting element (121, 131) along the nailing direction (DC).

7. The workbench (1) according to claim 6, comprising a control unit (3), configured to receive thickness data, representing a thickness of the first wooden board (T1), and wherein the control unit (3) is programmed for:

- deriving a normal coordinate of the first and the second supporting element (121, 131) along the nailing direction (DC), based on the thickness data;
- generating move signals based on the derived normal coordinate of the first and the second supporting element (121, 131);
- sending the move signals to the second actuator (123, 133), to instruct it to position the first and the second supporting element (121, 131) at the respective normal coordinates.

8. The workbench (1) according to claim 5, wherein the first and the second supporting element (121, 131) are provided with an engagement groove, comprising a bottom wall on which the second wooden board (T2) rests, in use, and at least one engagement wall, which extends from the bottom wall, parallel to the supporting surface (101).

9. The workbench (1) according to any one of the preceding claims, wherein the first supporting bar (12) and the second supporting bar (13) are movable along the transverse direction (T).

10. The workbench (1) according to any one of the preceding claims, for making a wall for wooden packaging (PI) from a first wooden board (T1) and a plurality of second boards (T2), wherein:

- the first supporting bar (12) comprises a first plurality of supporting elements (121), spaced longitudinally along the first supporting bar (12), and
- the second supporting bar (13) comprises a second plurality of supporting elements (131), spaced longitudinally along the second supporting bar (13), the first and the second supporting element (121, 131) being part of the first plurality of supporting elements and of the second plurality of supporting elements (121, 131), respectively,

wherein each supporting element (121) of the first plurality is aligned transversely with a corresponding supporting element (131) of the second plurality, in order to support a respective second board (T2).

11. The workbench (1) according to any one of the preceding claims, wherein the supporting wall (10), the abutment wall (11), the first supporting bar (12) and the second supporting bar (13) define a clamping assembly for holding the first wooden board and the second wooden board (T1, T2) in place, and wherein the clamping assembly is movable between a positioning configuration (CF1), in which the supporting wall (10) is inclined with respect to the vertical direction parallel to the weight force at an angle less than 45 degrees or more than 135 degrees, and a nailing configuration (CF2), in which the supporting wall (10) is inclined with respect to the vertical direction parallel to the weight force at an angle between 45 degrees and 135 degrees.

12. The workbench (1) according to any one of the preceding claims, wherein the
workbench (1) is inclined to the direction of the weight force at an angle less than 45 degrees or greater than 135 degrees.

13. A nailing apparatus (100) for nailing a first and a second wooden board (T1, T2) to make a wall for wooden packaging, comprising:

- a working head (2), including a nailing device (21), configured to shoot a connecting element;
- a workbench (1) according to any one of the preceding claims.

14. A method for holding a first wooden board and a second wooden board (T1, T2) in place during nailing operations for making a wall for wooden packaging (PI), the method comprising the following steps:

- positioning the first wooden board (T1) on a supporting surface (101) defined by a supporting wall (10) of a workbench (1);
- abutting the first board (T1) on an abutment wall (11) of the workbench (1), extending from

the supporting surface (101) to define an abutment for the first wooden board along a longitudinal direction (L),

- providing a first supporting bar (12) extending along the longitudinal direction (L) and comprising a first supporting element (121) protruding from the first supporting bar (12) to define a first shoulder along the longitudinal direction (L);
- providing a second supporting bar (13) extending along the longitudinal direction (L) and comprising a second supporting element (131) protruding from the second supporting bar (13) to define a second shoulder along the longitudinal direction (L); - wherein the first supporting element and the second supporting element (121, 131) are aligned along a transverse direction (T), perpendicular to the longitudinal direction (L);
- positioning the second wooden board (T2) so it rests on the first and the second supporting element (121, 131) and is superposed on the first wooden board along a nailing direction (DC) perpendicular to the supporting surface (101).

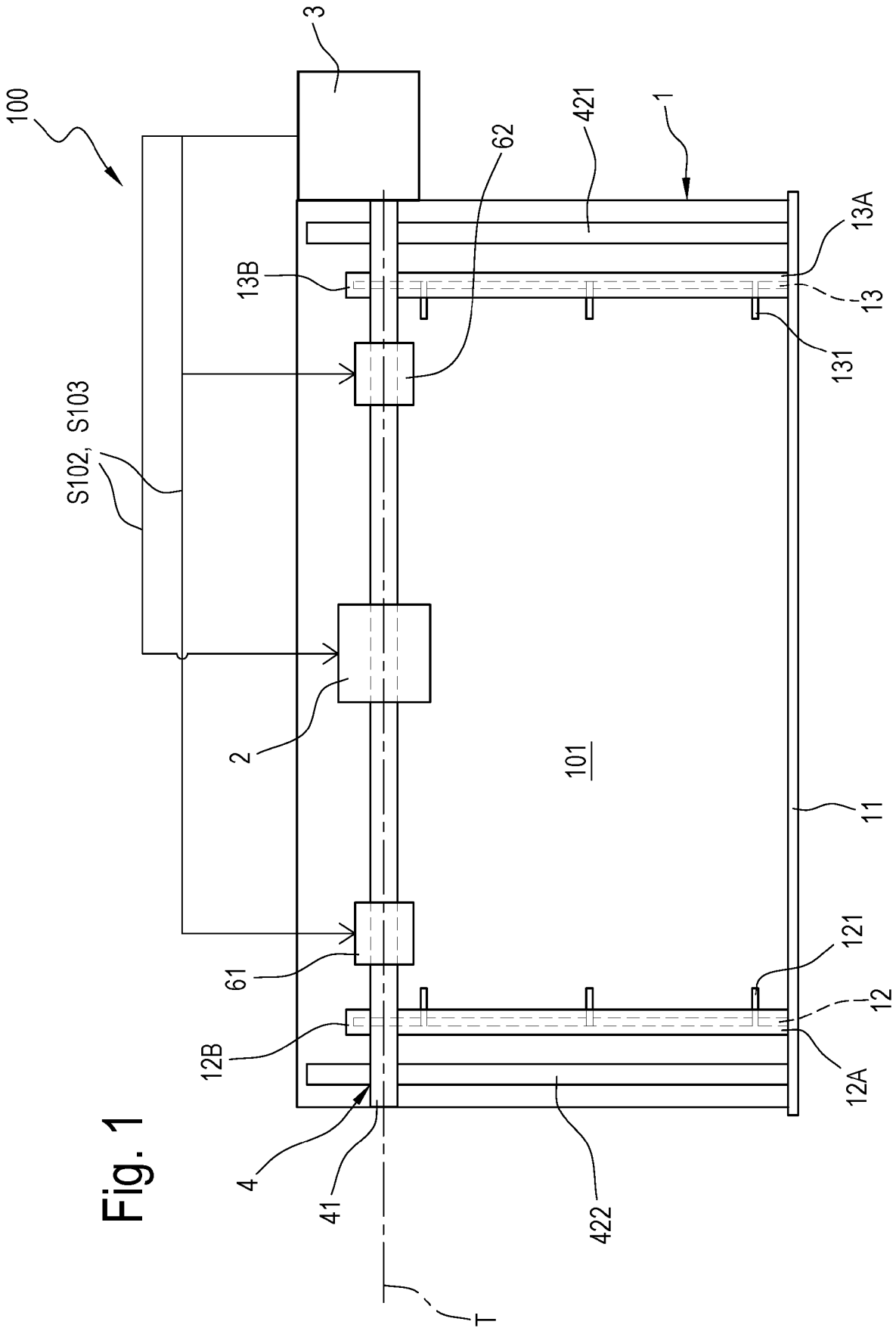

100
3
62
421
1
13A
13B
13
131
S102, S103
2
101
11
121
61
12
12B
12A
4
41
422
T

Fig. 1

Fig. 2

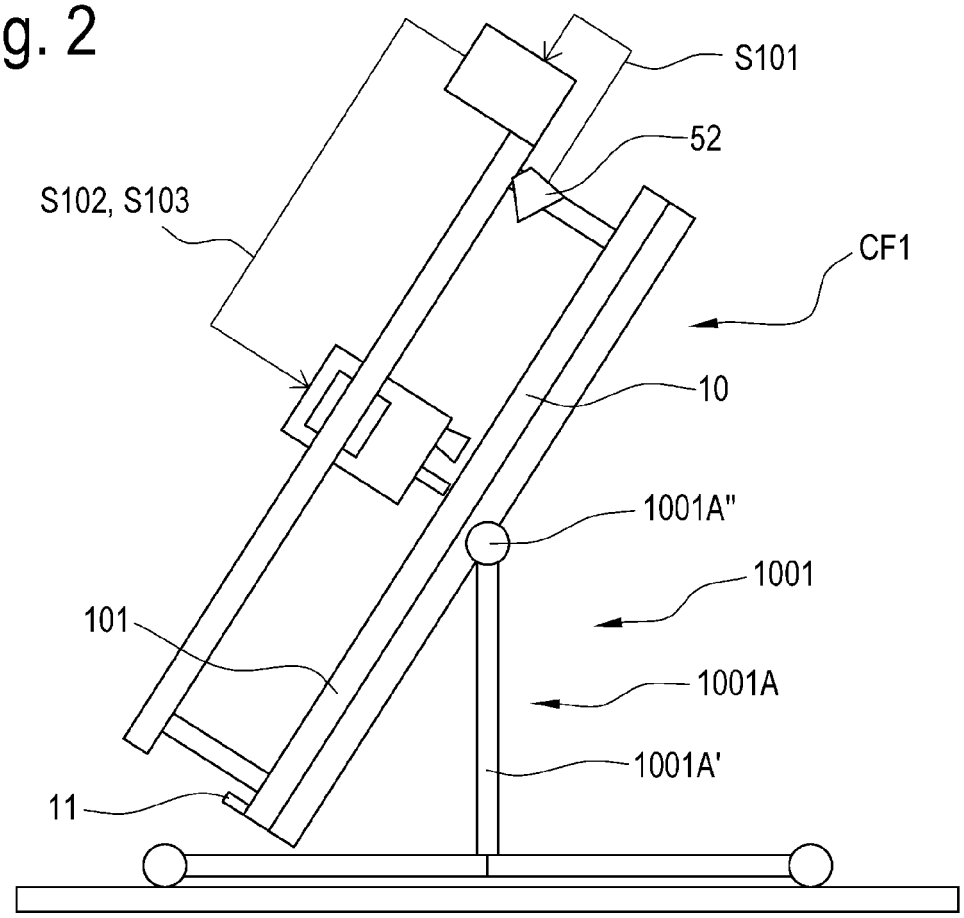

S101
52
S102, S103
CF1
10
1001A"
1001
101
1001A
1001A'
11

Fig. 3

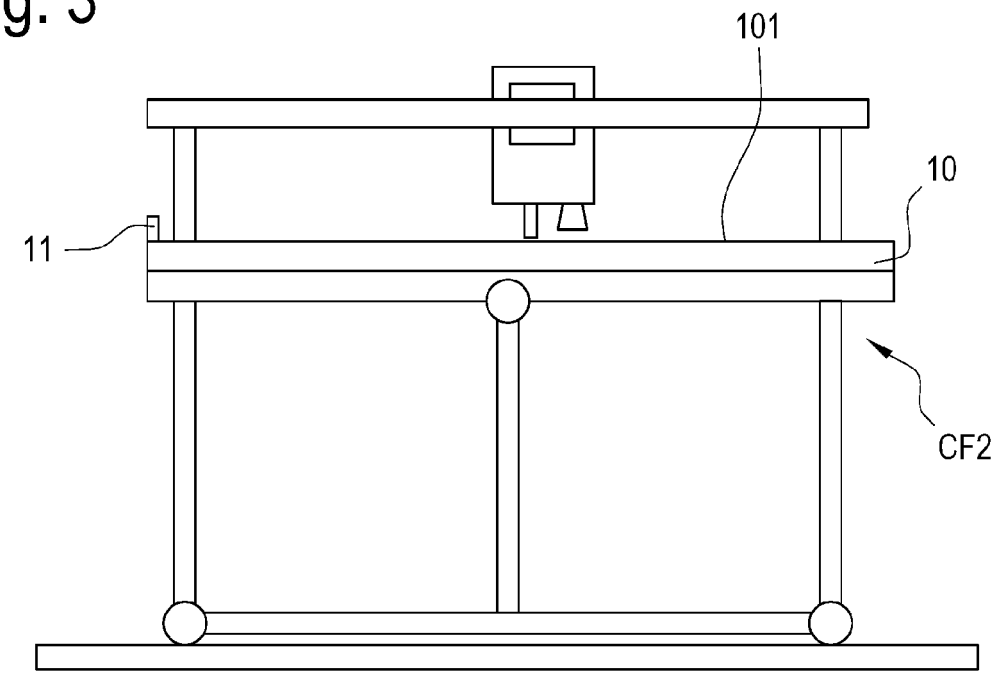

101
10
11
CF2

Fig. 4

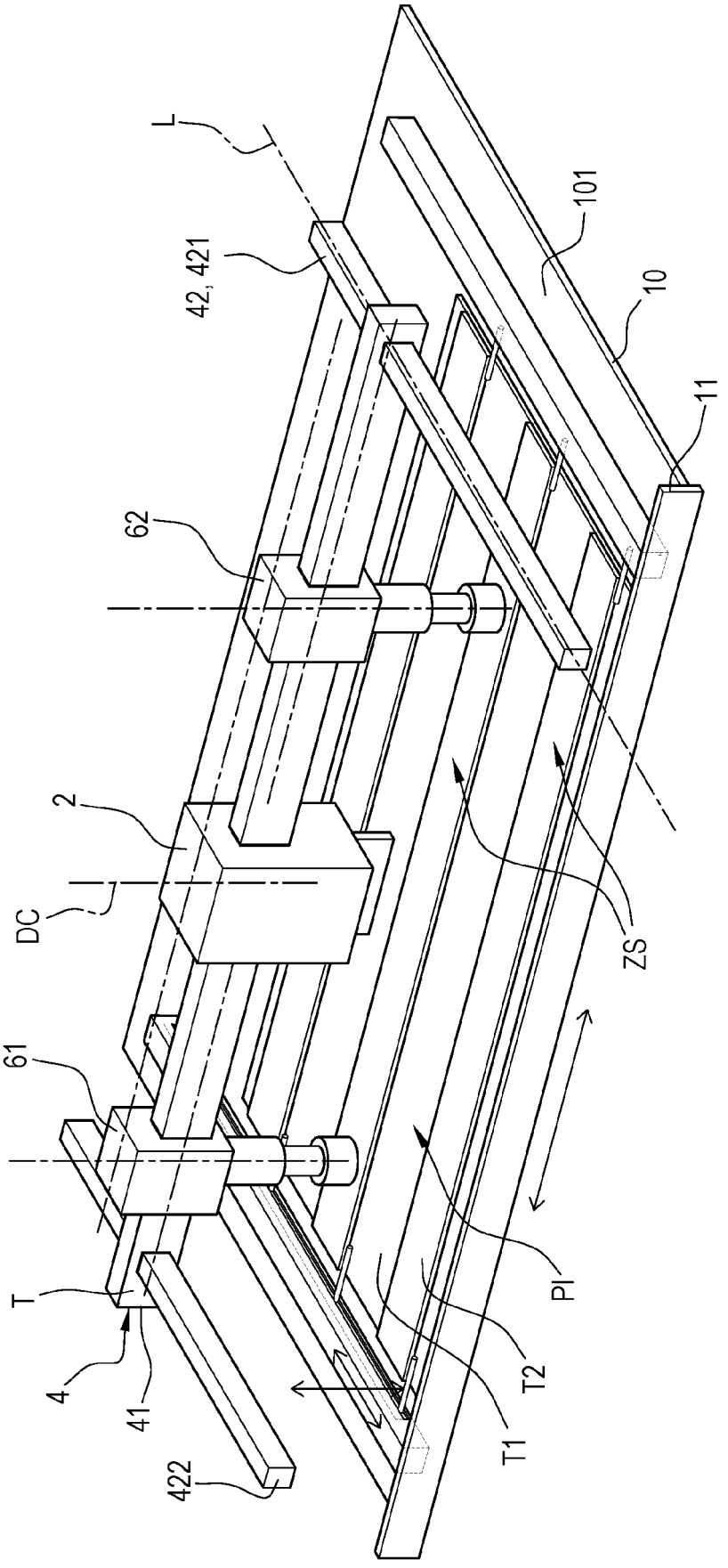


Fig. 5

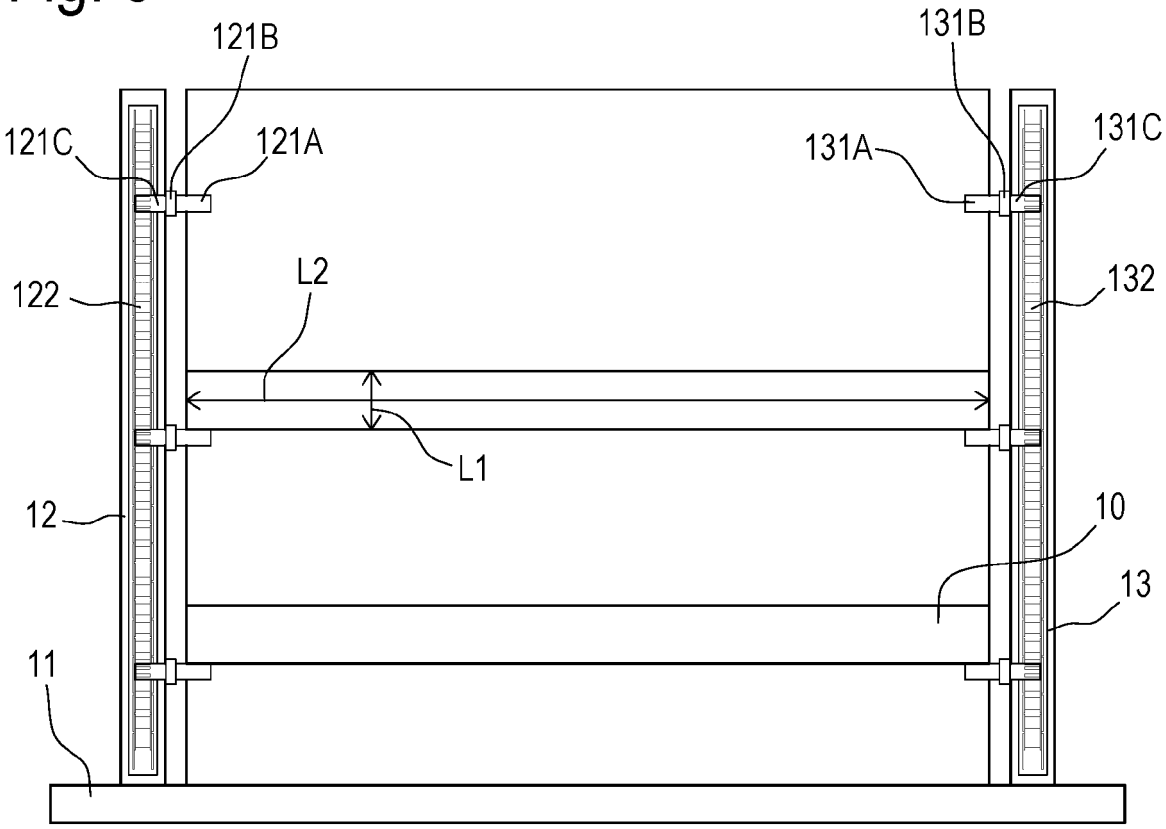

121B
131B
121C
121A
131A
131C
122
L2
132
L1
12
10
13
11

Fig. 6

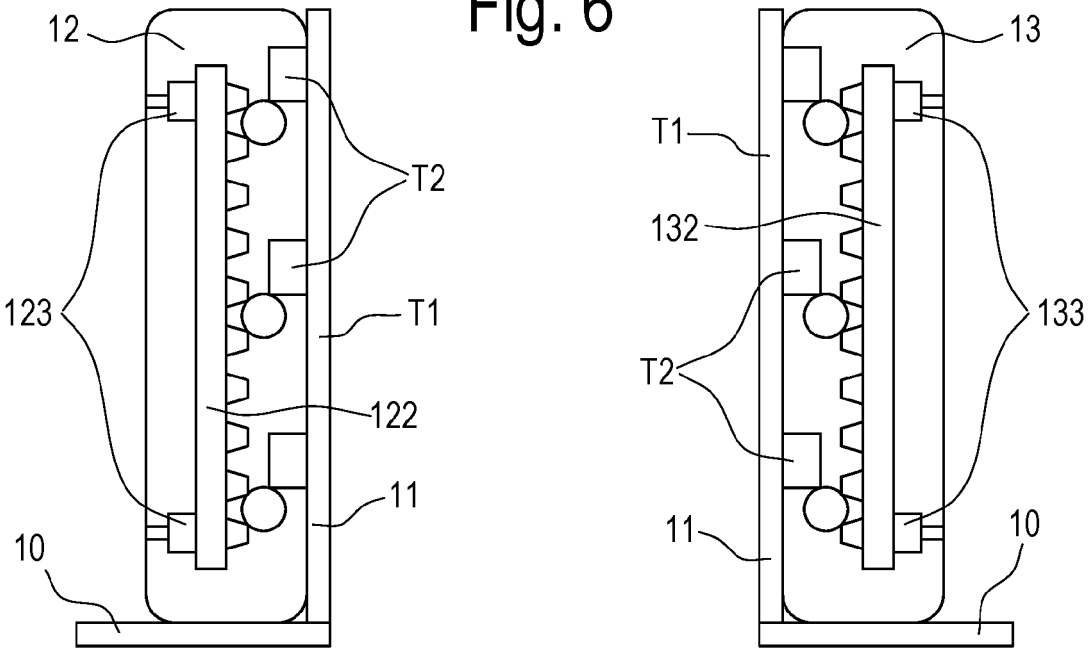

12
13
T1
T2
132
123
T1
133
T2
122
11
11
10
10

Fig. 7

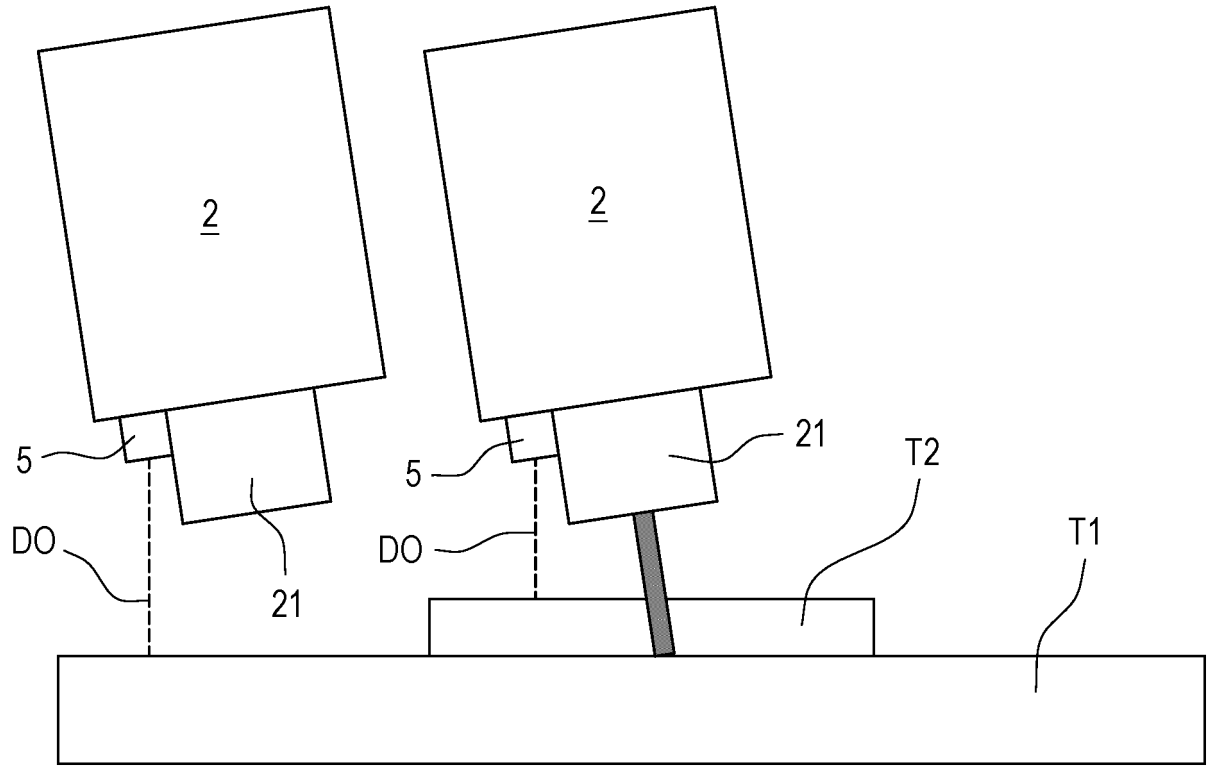


Fig. 8

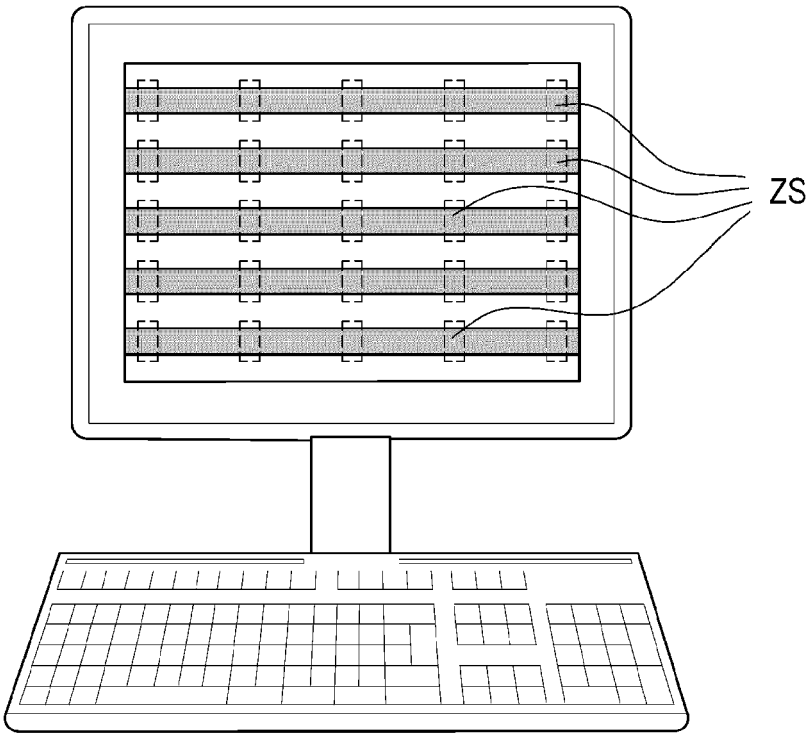
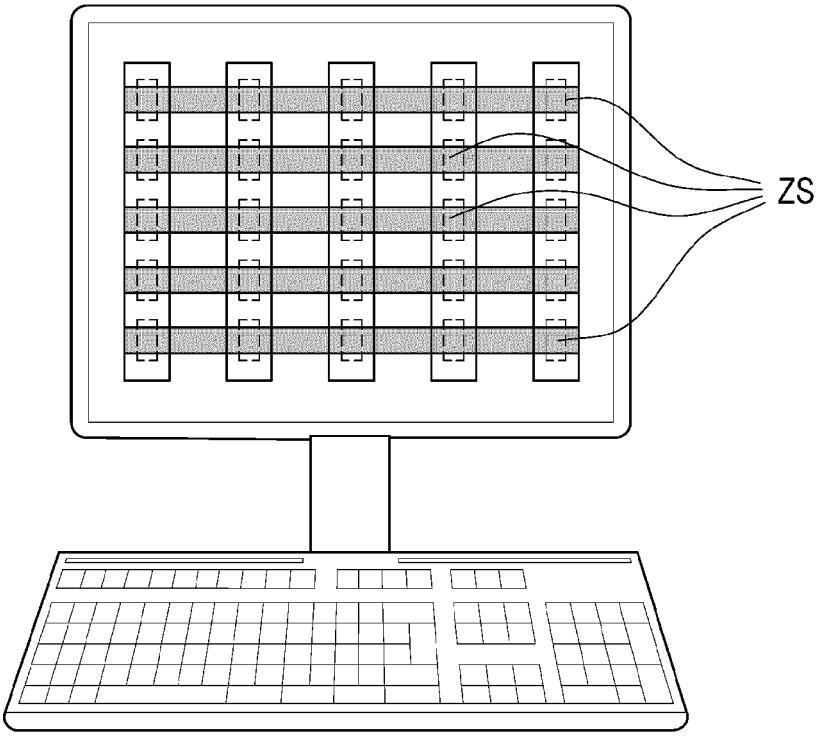


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 2234

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