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(54) **A CNC DRILLING/MILLING MACHINE FOR WOODEN PANELS WITH AN AUXILIARY PANEL HOLDING SYSTEM**

(57) The present invention relates to the sector of processing wood and in particular relates to a numerical control drilling/milling machine for processing wood pan-

els provided with a perfected device, and the related method, for holding the panel during the processing thereof.

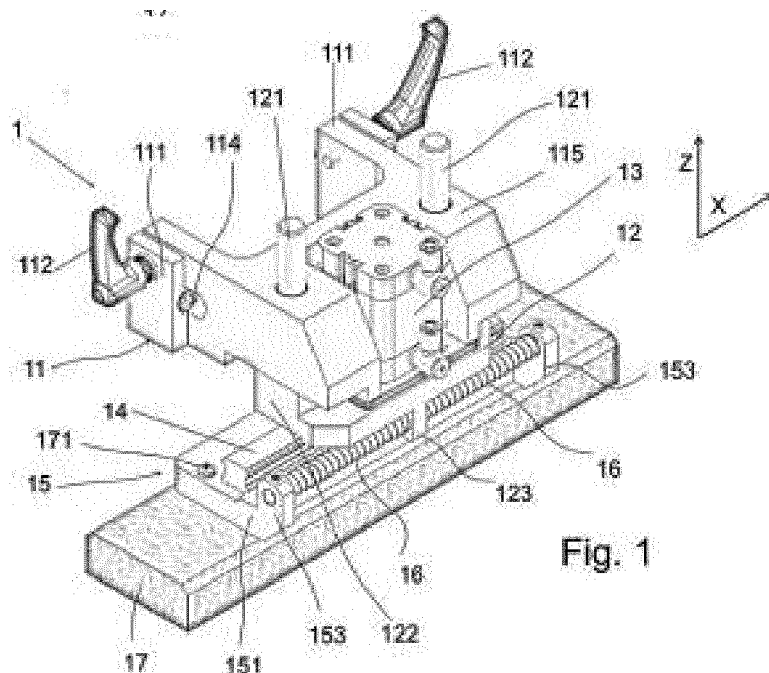


Fig. 1

Description

[0001] The present invention relates to the field of woodworking and in particular it concerns a CNC drilling/milling machine for processing wooden panels improved with an auxiliary equipment, and the related method, for holding the panel during the processing thereof.

[0002] As known, in recent years it has become increasingly common to use furniture made up of panels of variable dimensions produced in small repeatable batches and later assembled to make the desired furniture. Such types of furniture have quickly become popular and are currently among the most sold. The panels, of standard dimensions, must be pre-worked with the drill holes, grooves and openings necessary for connection with other panels, the finishings, the locks and other accessories in general, horizontal and lateral holes to allow the insertion of pins, the fastening of the door hinges or furthermore for the positioning of the locks and/or handles.

[0003] Such workings are performed on Computer Numeric Control (CNC) work centres generally called "borders". The machine is programmed with the mapping of the holes and openings to be made on the panel, that is moved so as to translate and be positioned in correspondence to the bit or milling tool adapted for the hole to be made.

[0004] Even more generally, in many panels for making furniture or parts thereof (including the panels for making cooking hobs or top surfaces of vanity units), made of wood, chipboard or materials with similar characteristics and workability such as MDF, there is a need to form openings or windows of relatively broad dimensions. To such a purpose, a milling through the thickness of the panel is performed along the profile desired for the opening, according to a curved or polygonal closed path, isolating an inner portion of material that is clearly waste material.

[0005] When the opening is a large one, the aforesaid inner waste portion is consequently large, and therefore has a substantial mass (and inertia).

[0006] The applicant has in fact noted that in a path closing step, i.e. when the internal waste portion becomes detached completely from the rest of the panel (which continues to be held by its dedicated conveying system), it tends to suffer an impulsive shaking that very often causes it to hit the same panel, with a certain amount of energy, against the edge of the opening that has just been completed. This leads to more or less significant incisions or dents, which in the best-case scenario can subsequently be repaired, but at the cost of manual (or however supplementary) interventions that are expensive and slow down productivity; in any case there is a decline in the quality of the working, that can even lead to the waste of the entire panel.

[0007] Similar problems arise when the aforesaid internal part is not actually the waste, but really represents the desired part (e.g. a round, oval, polygonal portion

etc.), to be isolated with respect to an outer frame which in that case is the waste part. Also in this case scratches or imperfections must be prevented so that there is no decline in the finish of the piece.

[0008] By stopping the milling step before the closure of the path, and therefore leaving the inner portion inside the opening attached to the panel through a residual small bridge of material, damage would be prevented but at the cost of production complications, in particular the fact of resorting to a subsequent operation for breaking the connecting bridge and finishing the opening (or the inner portion, if this is the desired piece), with additional times and costs, and quality in the finished subsequently zone that may however be lacking. It is in fact an impractical solution.

[0009] Moving on from the sharp observation made above, the present applicant has devised a solution that accomplishes a significant quality improvement in a panel worked with closed path millings, in particular evolving around large surface portions, without penalizing the production speed, and at the same time with simple tooling systems (also from the perspective of revamping or updating pre-existing machines) and at a contained cost.

[0010] According to the present invention, a CNC drilling/milling machine for wooden panels has an auxiliary panel holding system as disclosed in the appended claim 1.

[0011] The characteristics and advantages of the CNC drilling/milling machine for wooden panels with an auxiliary panel holding system according to the present invention will be apparent from the following description of an embodiment thereof, provided by way of non-limiting example with reference to the appended drawings wherein:

- figure 1 represents a perspective view of a floating pad of the panel holding system according to the invention, shown in isolation;
- figure 2 is a front view of the pad of figure 1;
- figure 3 is sectional view of the pad taken along lines III-III of figure 2;
- figure 4 is a plan view from above, with a broken region, of the pad of the previous figures;
- figure 5 is again a perspective view of the pad mounted on the relative drilling apparatus, and notably on a standard pressing device, shown only in part in the region which is relevant to the present invention, with the pad lowered and engaging with a panel being worked;
- figures 6a and 6b are side views of a detail of the pad, respectively, inactive (i.e. raised) and active in engagement on the panel (i.e. lowered); and
- figure 7 is again a perspective view of a detail of the apparatus, in the region where the panel is engaged by the pad, lowered in a step of imminent closure of the opening path of the panel.

[0012] With reference to the above figures, according

to the invention an auxiliary panel holding pad device 1 is adapted to be mounted on a CNC drilling/milling machine or work centre for processing and in particular drilling and milling wooden panels (or the like) intended for manufacturing items of furniture. The overall characteristics of the drilling machine can be the same as in the prior art, being for example (but not limitatively) similar to those of the machine described in EP3106276, incorporated herein for reference; therefore, the machine is not illustrated in full or described in detail.

[0013] In relation to the present invention, with more specific reference to figures 5 and 7, it is sufficient to note that the drilling machine comprises a feeding lane with a generally horizontal working plane XY on which the panel P that is to be processed lies and is transported, according to a feeding axis or direction X, by a primary holding and transporting system of the apparatus. A third axis Z orthogonal to the working plane completes an absolute reference system, and represents the advancement direction for the entry into the working step of a tool-holder head of a drilling unit (also clearly well known in terms of its structure and functionality) that in fact performs the working on the panel P and is arranged below the plane XY; only the end of a milling tool F of such unit is represented in figure 7. All the operations of the machine are controlled by an electronic control unit that can be programmed through a microprocessor, configured according to the known control techniques of automatic or semi-automatic machines.

[0014] It is also to be noted that the machine, again according to a known construction, can advantageously comprise, adjacent to the operating region of the drilling unit, but on the opposite semi-space with respect to the plane XY (in practice it will generally be the upper semi-space above the plane and the panel), one or more pressing devices 2 of the standard type. They are provided in number and position - intended as the distribution along a transverse axis Y, orthogonal to the feeding axis X on the plane XY - as a function of the dimensional characteristics of the panel to be processed and the type of working, and are adapted to press on the top face of the panel P to oppose the drilling thrust.

[0015] Returning to the auxiliary pad device 1, and with more specific reference to figures 1 to 4, the device in the preferred embodiment here illustrated comprises the following essential elements (their spatial arrangement being referred to the position when mounted on the machine, in the aforesaid upper semi-space):

- a support 11 adapted to be made integral with an infrastructure of the machine; preferably such infrastructure is actually provided for by one of the pressing devices 2 mentioned above;
- a slide 12 supported by the support 11, below it and slidably according to a direction parallel to the axis Z;
- a linear actuator 13, normally a pneumatic one, arranged between the support 11 and the slide 12 for controlling the movement of the latter with respect

to the former;

- a shoe 15 supported by the slide 12 below it, slidably according to a direction parallel to the feeding direction X, by means of a linear guide 14, preferably of the ball bearing type;
- elastic opposition means such as coil springs 16, in turn operatively arranged between the shoe 15 and the slide 12 to oppose the movement of the former with respect to the latter in both senses and to promote the return to a centred position in the absence of external forces;
- and finally an actual pad 17 fixed in a replaceable way to a lower side of the shoe 15, adapted to enter into holding contact through pressure on the panel P on the opposite side with respect to the drilling unit, and for that purpose made of a material adapted to determine sufficient static friction with the material of the panel but without causing any damage or scratches (for example wood can be used having hardness lower than the hardness of the panel).

[0016] Entering into greater detail on the construction characteristics of the device illustrated in the example, the support 11 advantageously has two tails configured according to respective clamps 111, that can be tightened manually via handles 112 around bushes 113 externally coaxial to respective screws 114 which are inserted, remaining protruded to some extent, in holes formed in a frame of a pressing device 2. In order to be coupled with the bushes, the clamps have appropriately shaped seats. By loosening the clamps, the position of the support can be adjusted (and with it the position of the entire pad device) according to the transverse axis Y, and it is also possible to take out and completely remove the device itself.

[0017] The support 11, sustained at the rear through the clamps 111, has therefore a projecting front part 115, on which the guide system for the slide 12 is configured, which in this embodiment envisages two uprights 121 rising in a mutually spaced fashion from the actual slide body 122 and slidably engaging in seats 116 formed on the support 11. In an intermediate position between the uprights, and therefore centrally, the linear actuator 13 is fixed with its actuator body to the support 11 and with its stem to the slide body 122. Obviously, the actuator body will be provided with the appropriate powering connections, as well known to the skilled person. The actuator is adapted to move the slide vertically between a lowered (active) position in which it abuts with a certain degree of force on the panel P, and an inactive, raised position in which it does not interfere with the panel itself.

[0018] One of the two members of the linear guide 14 is connected to the underside of the slide, the other member sustaining the shoe 15. Adjacent to the guide 14, parallel thereto, two coil springs 16 extend, arranged coaxially about a bar 152 sustained by a shoe body 151 of the shoe 15 along the guide 14, at a certain distance therefrom, and slidable within a guide bracket 123 pro-

jecting centrally towards the bottom from the slide body 122. The springs 16 are compressed between the bracket 123 and flanges 153 that rise at the ends of the body 151 and that in fact sustain the bar 152.

[0019] The pad 17 is then fixed in a replaceable way to the lower face of the body 151 of the shoe 15, by means of screws 171.

[0020] From an operating point of view, the positioning and consequent mounting of the device 1 on the machine is performed so as to overlook the working area of the drilling unit, and in particular to be able to engage with the panel P being processed, in a region surrounded by a predefined path T of the milling/drilling action, and therefore to be engaged with a panel portion P' defined within the aforesaid path, the portion P' being thus intended to be isolated from the rest of the panel and to become waste after processing (but also or alternatively it may be the desired finished product itself). In synchrony with the start of drilling (or however in advance of the milling tool completing the closure of the path) the slide 12, raised until then (figure 6a), is lowered into the active position bringing the pad into engagement onto the panel (Figure 6b). The slide is maintained in this position during milling, with the possibility of the shoe 15 moving horizontally, modulated by the springs 16, which however allows the movements of the panel to be followed along the feeding direction X.

[0021] The lowered position is maintained at least until the completion of the path, and it is precisely at the time of closing the path (moment that is about to occur in the step represented in figure 7) that the action of the pad is fundamental for securing the inner portion P' against the work surface, opposing the impulsive force that tends to shake such portion P' and therefore prevent it from strongly impacting with the perimeter of the path on the main portion of the panel.

[0022] The isolation and detachment of the inner portion is concluded and it is therefore possible to proceed with traditional methods to return to the rest configuration of the milling tool and the removal of the panel from the machine, bringing the pad back into the raised position at the right time, all obviously managed appropriately by the control system.

[0023] The advantages of the drilling machine according to the invention are clear from what has been described above. With a rational and relatively simple construction solution which can also be immediately implemented on pre-existing machines, a perceived problem can be effectively solved, hence preventing the occurrence of pieces to be rejected due to the effect of impact by the portion of the panel when large opening paths are performed (both if the inner portion is waste, and if it represents the desired final product), ensuring at the same time unaltered production speed.

[0024] Various changes can be brought to the construction of the pad device 1 and to its mounting methods, it being in principle sufficient for the device to have support means 11 that can be anchored (reversibly or irre-

versibly) to an infrastructure of the machine (infrastructure in general and comprising for example accessory means such as pressing devices 2), of one or more pad elements 17 intended for contact with the panel, along a partial run segment with respect to the feeding run of the panel and along it, with a coordinated control of the actuator means of the pad element(s) with respect to the drive of the drilling unit.

[0025] Such result can in principle be obtained with different kinematic mechanisms, e.g. articulated systems, it being understood that a solution to be considered particularly effective in terms of compactness, reliability and simplicity is the one that envisages a slide 12 activated with a reciprocating movement with respect to the support means in the advancement direction Z, actuator means 13 for controlling the movement of the slide, and shoe means 15 with one or more pad elements 17 for contact with the panel, the device or a part thereof that comprises the shoe means also being provided with a linear degree of freedom along a direction that is concordant/parallel to the feeding/movement direction of the panel on the working surface of the machine, for a partial run segment with respect to the feeding run of the panel, preferably but not necessarily so as to be passively moved by the dragging motion of the panel. Such degree of freedom is preferably, as in the example, materialized by a slidable connection of the shoe with respect to the slide, but more generally it can be attained otherwise, for example by a disconnection inside the support means.

[0026] More generally speaking the invention encompasses a method for holding a panel during a milling process of a panel that follows a curved or polygonal closed path that isolates an inner portion of the same panel, wherein at a predetermined advance time, before the path becomes closed by a milling tool, an auxiliary holding thrust/pressure is exerted on said inner portion against the working plane, and said thrust is kept at least up to a determined delay time after said path becomes closed (in practice the time sufficient for the lowering of the milling tool into the rest position along the axis Z).

[0027] Again, considering that the pad device 1 represents a distinct unit, with its own structural and functional independence, and is adapted to be interfaced with pre-existing machines, such device is within the scope of the invention also when physically detached from the machine (i.e. as an accessory before being mounted onto the machine or when dismounted therefrom).

[0028] The present invention has been described herein with reference to a preferred embodiment thereof. It is to be understood that there may be other embodiments that relate to the same inventive core, all falling within the scope of protection of the claims provided below.

Claims

1. A drilling/milling machine for panels made of wood or similar materials, comprising: an infrastructure de-

- fining a feeding lane defining a working plane (XY) and a feeding direction (X) for a panel (P) to be processed on said plane; a drilling unit (F) mounted on said infrastructure in a semi-space identified by said plane (XY) so as to be adapted to move at least towards and/or away from said panel (P) along an advancement direction (Z) orthogonal to said working plane; primary holding and transporting means adapted to feed said panel in said feeding direction (X) provided on said infrastructure or associated therewith; and control means adapted to operatively control at least said drilling unit and said primary holding and transporting means, the machine being **characterized in that** it comprises an auxiliary panel (P) holding device, the device comprising support means (11) reversibly or irreversibly anchored to said infrastructure, in the opposite semi-space with respect to that of the drilling unit (F), one or more pad elements (17) movably supported by said support means, adapted to enter into pressing contact with the panel for a partial run segment with respect to the feeding run of the panel in said feeding direction (X), and actuator means (13) adapted to control the movement of said one or more pad means, said control means being configured to control said actuator means of said one or more pad elements (17) in a coordinated fashion with the operation of said drilling unit (F).
2. The machine according to claim 1, comprising slide means (12) alternatively slidable with respect to said support means at least in said advancement direction (Z) between an active position and an inactive position in which they respectively engage and disengage the panel, said actuator means (13) being adapted to control the movement of said slide means, and shoe means (15) provided with said one or more pad elements (17) adapted to make contact with the panel in the active position, at least one further linear degree of freedom also being provided, for letting at least part of said device including at least said shoe means (15) slide alternatively over said partial run segment along a direction parallel to said feeding direction (X), said control means being configured to control the movement of said slide means (12).
 3. The machine according to claim 2, wherein as a result of said further degree of freedom at least said shoe means (15) are passively movable by the dragging motion of the panel when said slide means (12) are in the active position.
 4. The machine according to claim 2 or 3, wherein said further degree of freedom is provided by a sliding support of said shoe means (15) with respect to said slide means (12).
 5. The machine according to claim 4, comprising elastic opposition means such as coil springs (16) operatively arranged between said shoe means (15) and said slide means (12) to oppose the movement of the former with respect to the latter in both senses and to promote the return to a centred position in the absence of external forces.
 6. The machine according to claim 5, wherein said shoe means (15) are connected to said slide means (12) through a linear guide (14) of the ball bearing type, said coil springs (16) extending adjacent to said guide (14), parallel thereto, being arranged coaxially about a bar (152) sustained by a body (151) of said shoe means (15), along said guide (14) and at a certain distance therefrom, and slidable within a guide bracket (123) projecting centrally from a body (122) of said slide means (12), said springs (16) being compressed between said bracket (123) and respective flanges (153) that rise at the ends of said body (151) of the shoe means and that sustain said bar (152).
 7. The machine according to claim 6, wherein said slide means (12) comprise two uprights (121) rising in a mutually spaced fashion from said slide body (122) and slidably engaging in seats (116) formed on said support means (11), said actuator means (13) being arranged at an intermediate position between said uprights and operatively connected to said support means (11) and to said body (122).
 8. The machine according to claim 6 or 7, wherein said one or more pads comprise a pad (17) connected in a replaceable fashion to said body (151) of said shoe means (15),
 9. The machine according to any one of claims 2 to 8, wherein said support means (11) comprise two tails configured according to respective clamps (111), adapted to be tightened manually via handles (112) around bushes (113) externally coaxial to respective screws (114) inserted in holes formed on the frame of a pressing device (2) provided on said infrastructure.
 10. The machine according to any one of the previous claims, wherein said one or more pads (17) are made of a material adapted to determine sufficient static friction with the panel material without causing damage or scratches, such as wood having hardness lower than that of the panel.
 11. The machine according to any one of the previous claims, wherein said control means are configured for the execution, by said drilling unit, of a milling process according to a curved or polygonal closed path isolating an inner portion of the panel, and to control said auxiliary holding device whereby said

device is thrust/pressed on said inner portion against the working plane, and the thrust is kept at least up to a determined delay time after said path becomes closed.

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12. The auxiliary panel holding device adapted to be mounted on a drilling machine for panels made of wood or similar materials according to any one of the previous claims.

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13. A method for holding a panel during a milling process of a panel that follows a curved or polygonal closed path that isolates an inner portion of the same panel, wherein at a predetermined advance time, before the path becomes closed by the milling tool, an auxiliary holding thrust is exerted on said inner portion against the working plane, and said thrust is kept is kept at least up to a determined delay time after said path becomes closed.

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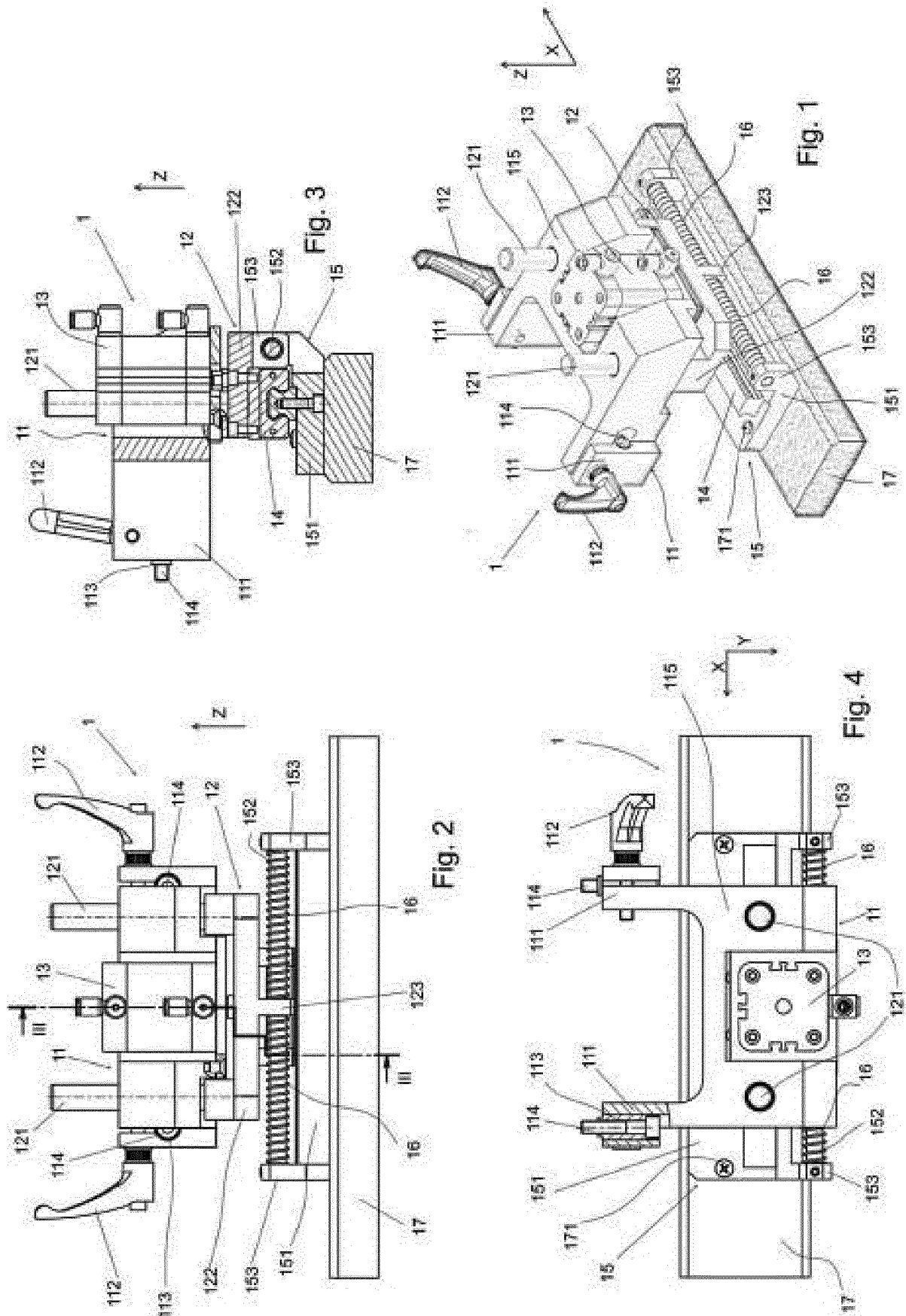
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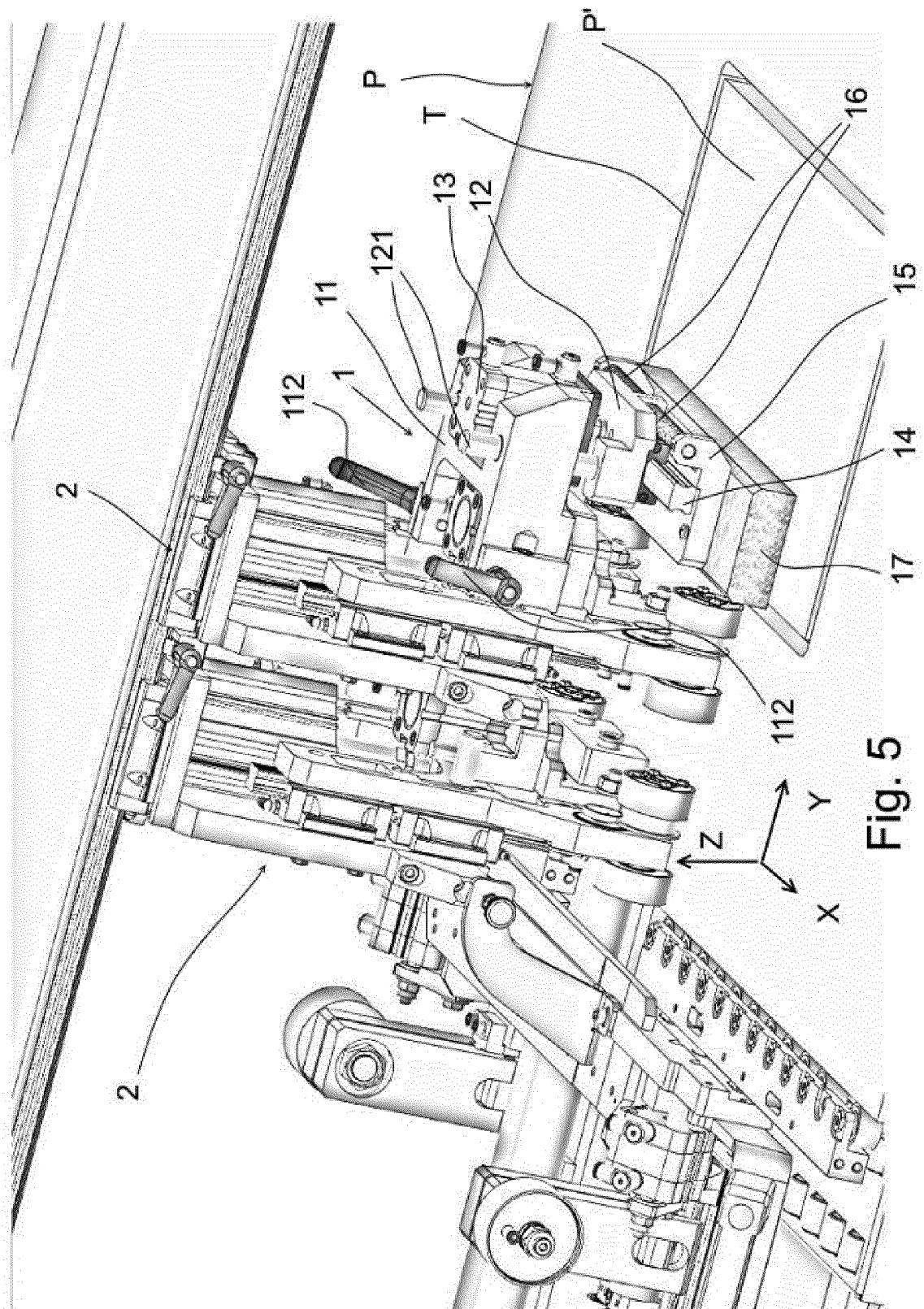
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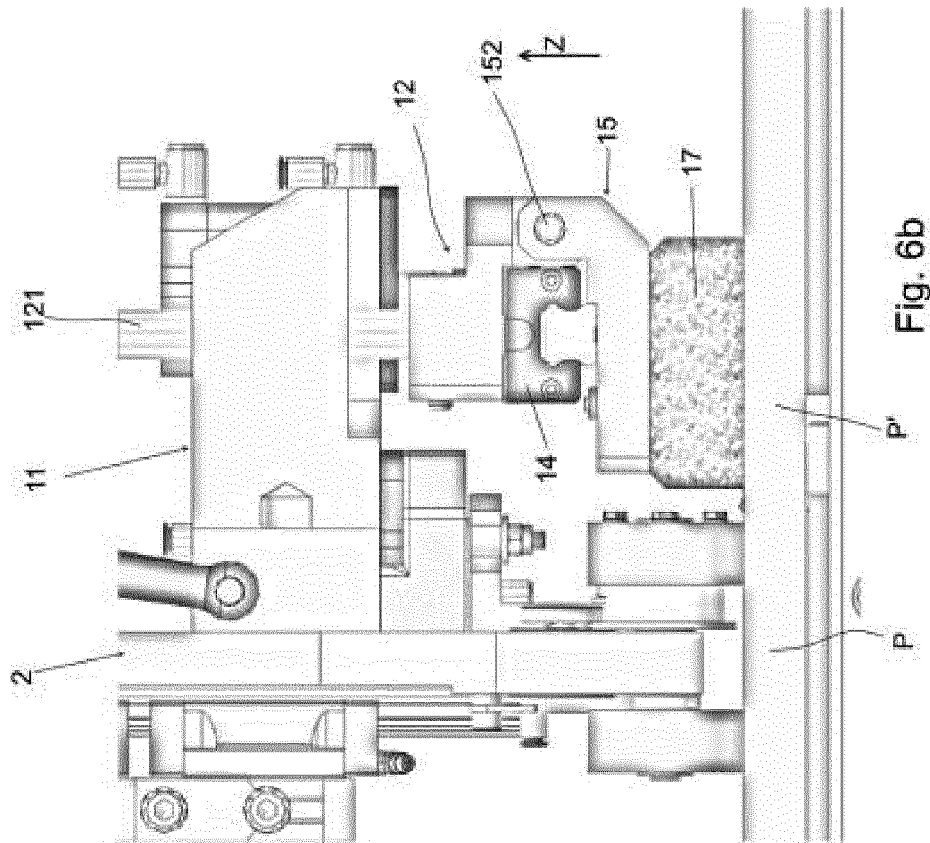


Fig. 6b

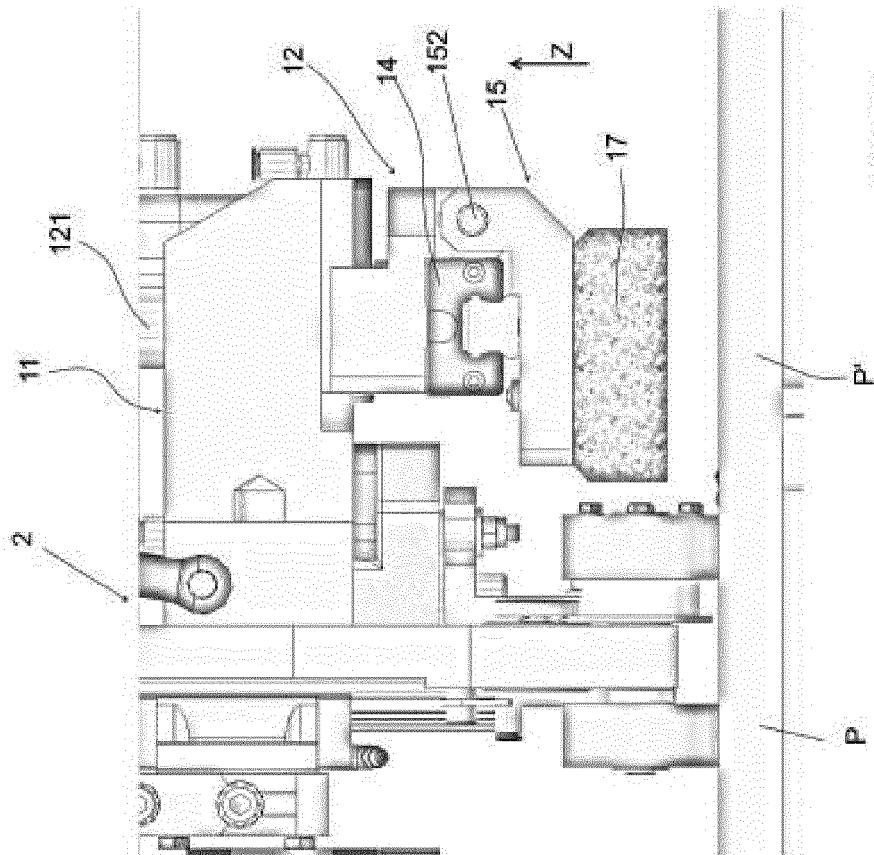


Fig. 6a

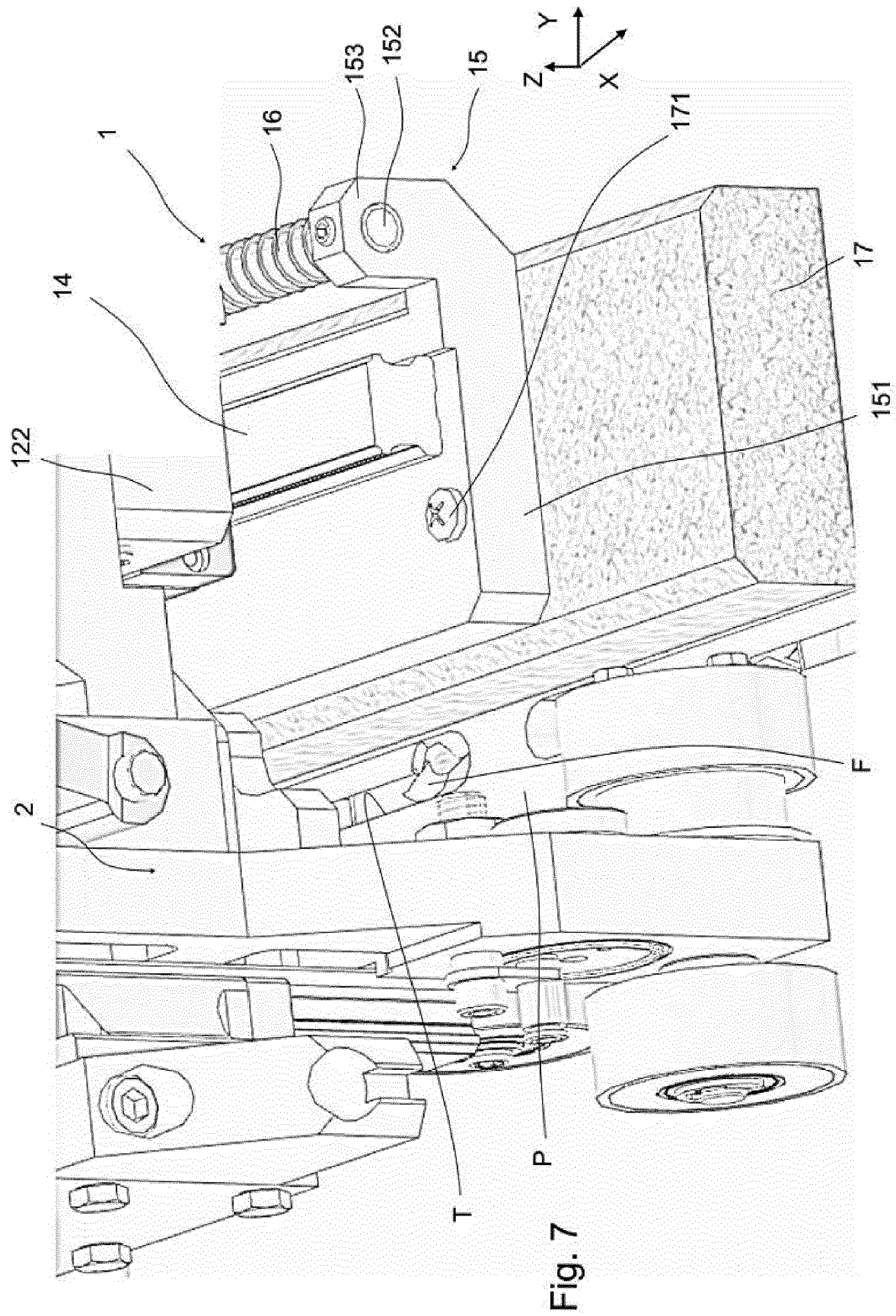


Fig. 7



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