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(54) **MACHINING CENTER**

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Description

Technical Field

[0001] The present invention relates to a machining center according to the preamble of claim 1. Such a machining center is known from the document EP1719574A1.

State of the Art

[0002] To machine through chip removal workpieces of different type, for instance and especially elongated workpieces made of wood or plastic, such as components of pieces of furniture, windows and doors and the like, numerically controlled machine tools or machining centers are generally used, that comprise a structure bearing an operating head with one or more numerically controlled axes and one or more electro-spindles with respective tools. The operating head cooperates with one or more workpiece-holding slides or tables, typically moving between a position where workpieces to be machined, so-called blanks, are loaded and a position where the machined workpieces are unloaded, which is at a safety distance with respect to the working area where the operating head moves.

[0003] Several different manual and automatic systems have been developed for loading and unloading the workpieces and for blocking them on the workpiece-holding slide to machine them.

[0004] Figures 1A, 1B and 1C show a plan view, a front view according to B-B, and a side view according to C-C, respectively, respectively of a prior art machining center. In this case, the machining center, labeled as a whole with number 100, comprises a gantry structure 101, onto which an operating head 103 is arranged. The operating head 103 is carried by a slide 105 movable along a crossbeam 101T of the gantry structure 101, which also comprises two columns 101M supporting the crossbeam 101T.

[0005] The operating head 103 comprises a plurality of electro-spindles and is provided with a movement according to a numerically controlled axis Y of horizontal translation and a numerically controlled axis Z of vertical translation. The operating head is also provided with a numerically controlled movement according to rotary axes A and C (figure 1C). Associated with the gantry structure 101 is a base 105, along which a workpiece-holding slide 107 moves. The workpiece-holding slide is provided with one or more blocking members 109, each of which is advantageously provided with jaws to clamp a workpiece to be machined.

[0006] The base extends horizontally through the gantry structure 101 and is sufficiently long to allow the workpiece-holding slide 107 to translate from a loading position to an unloading position, these two positions being arranged on opposite parts or sides of the gantry structure 101. In figures 1A and 1B both the positions are indicated with a continuous line and indicated with 107C (loading position) and 107S (unloading position). The workpiece-holding slide or table 107 and the base 105 are associated with a conveyor or conveyor belt 111. The conveyor belt or conveyor 111 extends horizontally from the loading position 107C towards an area where the workpieces P1 to be machined are positioned. The area where the workpieces to be machined P1 are positioned is indicated as a whole with number 113. The machined workpieces, indicated with P2, are unloaded in a gathering area 115 arranged, with respect to the structure 101, at the opposite side with respect to the rest area 113 of the workpieces to be machined (blank) P1.

[0007] The machining center schematically illustrated in figures 1A-1C and briefly described above works as explained below. The workpieces to be machined P1 are loaded, generally by means of an automatic system, translating them according to arrow fP1 on the conveyor belt or conveyor 111. This latter transfers the workpieces to be machined P1 towards the loading position 107C where the workpiece-holding slide 107 is temporarily positioned. An insertion system, not shown, transfers the workpieces to be machined P1 according to the arrow f1 to insert them one by one into the blocking members 109 of the workpiece-holding slide 107 when this latter is in position 107C. The single workpieces to be machined P1, blocked by means of the blocking members 109, are transferred, with a motion according to arrow X along the base 105 of the workpiece-holding slide 107, to the working area of the operating head 103. The workpieces are machined by means of a coordinated movement of the tools according to the numerically controlled axes X, Y, Z, A, and C, until machining is completed. Once the working cycle has been completed, the workpiece-holding slide 107 is moved with a motion according to the axis X along the base 105 up to the unloading area 115, where the machined workpieces P2 are unloaded manually or automatically by means of unloading members, not shown, of the workpiece-holding slide 107.

[0008] Reference 117 indicates a preferably adjustable stop for defining the position that the workpieces to be machined P1 shall achieve to arrive in front of the workpiece-holding slide 107 and be inserted in the blocking members 109.

[0009] The machine or machining center of figures 1A, 1B, 1C has great limits as regards the times necessary for loading and unloading the workpieces. Indeed, once the machined workpiece P2 has been completed, the workpiece-holding table or slide 107 shall translate from the working area of the operating head 103 up to the unloading area 115, the blocking members 109 shall be opened and the machined workpiece P2 shall be unloaded. Once the workpiece-holding slide 107 is free, it shall translated along the base 105 in opposite direction up to the position 107C and the new workpiece to be machined P1 shall be translated according to arrow f1 from the conveyor 111 up to the workpiece-holding slide 107, blocked by means of the blocking members 109 of the workpiece-

holding slide 107 and transferred form the loading area 107C to the working area of the operating head 103. These operations require relatively long times and affect the productivity of the machining center 100.

[0010] It is therefore necessary to improve the machining centers or machines to decrease the time required to load and/or unload the workpieces and thus increase the productivity of the machining center.

Summary of the Invention

[0011] According to one aspect, the invention provides a machining center for machining elongated pieces, comprising at least one operating head movable according to a plurality of numerically controlled axes and at least one workpiece-holding slide movable between a working area and an area where workpieces to be machined are loaded on the workpiece-holding slide and machined workpieces are unloaded from the workpiece-holding slide, and vice versa. At least one blocking member is provided on the workpiece-holding slide and carried thereby, to block at least one workpiece on the workpiece-holding slide. An insertion system for inserting the workpieces on the blocking member is provided to load the workpieces to be machined on the workpiece-holding slide. The insertion system for inserting the workpieces to be machined is associated according to the invention with a loading conveyor of the workpieces to be machined extending from a workpiece receiving area towards the area of loading the workpieces to be machined on the workpiece-holding slide and unloading the machined workpieces from the workpiece-holding slide. In the area of loading the workpieces to be machined on the workpiece-holding slide and unloading the machined workpieces from the workpiece-holding slide, the workpieces to be machined are transferred from the loading conveyor to the workpiece-holding slide. A removal system is also provided for removing the machined pieces from the workpiece-holding slide, especially from the blocking member arranged on said workpiece-holding slide. The removal system is associated according to the invention with an unloading conveyor that, extends from the area where the workpieces to be machined are loaded on the workpiece-holding slide and the machined workpieces are unloaded from the workpiece-holding slide towards a gathering area of the machined workpieces. The machined workpieces are transferred from the workpiece-holding slide to the unloading conveyor in the area where the workpieces to be machined are loaded on the workpiece-holding slide and the machined workpieces are unloaded from the workpiece-holding slide. The insertion system of the workpieces to be machined and the removal system of the machined workpieces are arranged at two different distinct heights. Moreover, advantageously the loading conveyor and the unloading conveyor overlap at least partially, at least in the area where workpieces to be machined are loaded on the workpiece-holding slide and machined workpieces are unloaded from the workpiece-holding slide. In this way it is possible to load a workpiece to be machined by transferring it from the loading conveyor to the workpiece-holding slide while a machined workpiece, just removed from the workpiece-holding slide, is transferred from the unloading conveyor towards the gathering area of the machined workpieces. In this way the unloading and loading operations occur at least partially contemporaneously, thus increasing the productivity of the machining center. According to some embodiments, the blocking member advantageously comprises at least one lower clamping element and at least one upper clamping element, movable with respect to each other to block a workpiece there between. The workpiece-holding slide preferably comprises at least two pairs of upper clamping element and lower clamping elements to block elongated workpieces. Advantageously, the distance between the two pair of clamping elements can be adjusted, for instance by providing adjustment guides on the workpiece-holding slide.

[0012] Both the lower clamping element and the upper clamping element may be advantageously movable in a vertical direction with respect to the workpiece-holding slide. As it will be better explained below, this allows according to the invention to handle workpieces at different (loading and unloading) heights and, at the same time, to define the position of the workpiece to be machined with respect to the operating head in a precise and easily repeatable way. In fact, the lower clamping element can be used as a reference stop or reference surface for the workpieces. The upper clamping element forms a closing jaw, whose stroke varies according to the vertical dimension of the workpiece to be machined. The upper element may be coated with an elastically yielding material to protect the workpiece, avoiding damages thereof during machining.

[0013] According to the invention, the lower clamping element is vertically movable to be placed alternatively at the height of the insertion system of the workpieces to be machined and at the height of the removal system of the machined workpieces. The insertion system of the workpieces to be machined is preferably at a greater height than the height of the removal system of the machined workpieces.

[0014] The positions of the lower clamping elements with respect to the workpiece-holding slide can be advantageously adjusted for each lower clamping element independently of the others. Similarly, also the positions of the upper clamping elements with respect to the workpiece-holding slide can be advantageously adjusted for each upper clamping element independently of the others. In some embodiments, pairs of respectively upper and lower clamping elements, are carried by a single support that can be adjusted horizontally along the workpiece-holding slide. The reciprocal distance between at least two pairs of clamping elements can be adjusted, preferably in a direction orthogonal to the movement direction of the workpiece-holding slide, so as to adapt to the longitudinal dimension of the workpieces to be ma-

chined, that may be elongated workpieces directed orthogonally to the movement direction of the workpiece-holding slides.

[0015] Further advantageous features and embodiments are described below and in the attached claims, forming an integral part of the present description.

Brief description of the drawings

[0016] The invention shall be better understood by following the description and accompanying drawing, which shows non-limiting practical embodiments of the invention. More in particular in the drawing, wherein equal or equivalent parts are indicated with the same reference numbers:

figures 1A, 1B, and 1C, already described above, show a prior art machining center;
figure 2 is a plan view of a machining center or machine tool in one embodiment of the invention;
figure 3 is a view according to III-III of figure 2;
figure 4 shows a view analogous to that of figure 3 with the workpiece-holding slide in a different position;
figure 5 is a view according to V-V of figure 3;
figure 6 is a plan view of a machining center or machine tool according to the invention in a further embodiment;
figure 7 is a view according to VII-VII of figure 6;
figure 8 shows a view similar to that of figure 7 with the workpiece-holding slide in a different position;
figure 9 is a view according to IX-IX of figure 7;
figure 10 is a view similar to the plan view of figure 6, in a different operating mode of the machining center.

Detailed description of embodiments of the invention

[0017] Figures 2 to 5 show a first embodiment of a machining center or machine tool, indicated as a whole with number 1, for machining workpieces made of wood, aluminum, plastic or the like. The machining center is preferably designed to machine elongated workpieces, such as components of pieces of furniture, chairs or the like in a particularly efficient way.

[0018] The machining center or machine tool 1 may comprise a support structure 3 bearing an operating head 5. The support structure 3 can have any design; it can be for instance a gantry structure as shown in figures 1A, 1B, and 1C. As illustrated in the drawing, in other embodiments the bearing structure 3 can be a column structure, advantageously with movable column. The structure 3 may have for instance a column 4 carried by a base 6 onto which guides 7 are provided, along which the column 4 moves according to a numerically controlled axis of translation X. The movement according to X (as well as the other numerically controlled translation movements) may be imparted by means of an electronically controlled electric motor and a threaded bar, or by means of any other suitable system or mechanism.

[0019] In some embodiments the column 4 carries the operating head 5 so that this latter can move according to a vertically oriented numerically controlled axis of translation Z. The column 4 may carry for instance guides 9 along which a slide 11 carrying the operating head 5 translates.

[0020] Moreover, the operating head 5 may be provided with a numerically controlled movement according to a first rotary axis C, for instance vertical, and according to a further rotary axis A, for instance horizontal. The operating head 5 may carry a plurality of electro-spindles 5A. Each electro-spindle 5A may be provided with a respective tool U. In the illustrated example, the operating head 5 is a crosswise head with four electro-spindles carrying four tools. In other embodiments the operating head 5 may be provided with a different numbers of electro-spindles, and thus of tools. A different number of numerically controlled axes and/or a different spatial arrangement of said axes may also be provided..

[0021] In some embodiments the machining center 1 comprises a further base 13, onto which guides 15 for a workpiece-holding slide or table 17 are arranged. In some embodiments the base 13 is separated from the base 6, and the two bases are individually applied to the floor, as illustrated in the exemplary embodiment of figures 2 to 5. In other embodiments the base 13 and the base 6 may be directly connected to each other to form a single monolithic structure.

[0022] The workpiece-holding slide 17 is movable along the base 13, for instance through guides 15, according to a numerically controlled axis of translation Y.

[0023] In some embodiments the workpiece-holding slide 17 has a blocking member or a plurality of blocking members indicated as a whole with number 19. Herein, reference will be made to a single blocking member, being understood that this term can indicate a set of blocking members and being also understood that in some embodiments more blocking members can be provided on the workpiece-holding slide 17.

[0024] The blocking member indicated as a whole with number 19 may be for instance formed by more blocking systems 19, each of which may have an upper clamping element 21 and a lower clamping element 23. Advantageously, each pair of upper clamping element and lower clamping element 21, 23 may be carried by a support 25, which can be advantageously adjusted in position along the workpiece-holding slide 17. To this end the workpiece-holding slide 17 may be for instance provided with adjustment guides 27. Advantageously, the adjusting movement may be orthogonal to the numerically controlled axis Y.

[0025] The movement of the single supports 25 may allow adjusting the position and the mutual distance of the pairs of clamping elements 21, 23 so as to adapt the configuration of the blocking member indicated as a whole with number 19 to the longitudinal dimension of

the workpieces to be machined.

[0026] In some embodiments both the upper clamping element 21 and the lower clamping element 24 are movable vertically to block the workpieces to be machined and to perform the loading and unloading operations, as better described below.

[0027] The workpiece-holding slide 17 can move according to the direction defined by the numerically controlled axis of translation Y, both to perform relative motions between the workpiece and the tools U carried by the operating head 5, and to move the workpieces between a loading and unloading area and the working area of the operating head 5.

[0028] In greater detail, in figure 3 a broken line indicates a possible position taken by the workpiece-holding slide 17 during the machining of a workpiece, generically indicated with P, blocked by means of the blocking member 19 on the workpiece-holding slide 17. A solid line indicates the position of the workpiece-holding slide 17 in an area where the workpieces to be machined are loaded on the workpiece-holding slide 17 and the machined workpiece are unloaded from the workpiece-holding slide. In figures 2 to 5 this loading and unloading area is indicated as a whole with number 29.

[0029] In the loading and unloading area 29 two conveyors converge, for instance in the form of conveyor belts, roller conveyors or the like. The conveyors are schematically indicated with 31 and 33 respectively. The conveyor 31 is a loading conveyor of the workpieces to be machined (blanks) that are indicated with P1. The conveyor 33 is an unloading conveyor of the machined workpieces that are indicated with P2.

[0030] As shown in particular in figures 3, 4, and 5 the conveyors 31 and 33 are arranged at different heights. More in particular, in the illustrated embodiment the loading conveyor 31 is at a height HI with respect to a floor Pv, while the unloading conveyor 33 is at a height H2 with respect to the floor Pv, H2 being lower than HI. The opposite arrangement is also possible, wherein the loading conveyor is at a lower height with respect to the unloading conveyor. In the illustrated example the conveyors 31 and 33 are arranged substantially horizontally. In other embodiments the conveyors 31 and 33 may be designed so as to have ascents and descents. The entrance of the conveyor 31 may be for instance at the same height as the exit of the conveyor 33. In this case the conveyor 31 may have an ascending segment or portion and the conveyor 33 may have a descending segment or portion. However, in any case there will be an area where the two conveyors 31 and 33 are arranged at different heights, substantially overlapping each other. In this area the conveyors have preferably a rectilinear extension, due to reasons that will be clear from the description below of the operation of the machining center.

[0031] Basically, the loading conveyor and the unloading conveyor 31, 33 overlap at least partially, at least in the area 29 where workpieces to be machined are loaded on the workpiece-holding slide and machined workpieces are unloaded from the workpiece-holding slide so as to transfer single workpieces to be machined P1 in front of the workpiece-holding slide 17 and to pick up machined workpieces from the workpiece-holding slide 17 to transfer them towards a removal area.

[0032] An insertion system is associated with the loading conveyor 31 for inserting the workpieces P1 to be machined in or on the blocking member 19 carried by the workpiece-holding slide 17. In the figures, the insertion system for inserting the workpieces P1 to be machined is schematically represented as cylinder-piston actuators 35 carried by a fixed structure 37, indicated only schematically. The cylinder-piston actuators 35 may be fixed to a movable crossbeam 36 pushing the workpieces P1 to be machined removing them from the loading conveyor 31.The actuators 35 transfer the workpieces P1 to be machined, carried by the conveyor 31, from this latter onto the workpiece-holding slide 17, and especially inside the blocking member 19 between pairs of clamping elements 21, 23 transferring them with a movement according to the arrow f35 (see in particular figure 2).

[0033] A removal system, schematically labeled 37 in figures 3 and 4, is associated with the unloading conveyor 33. In this exemplary embodiment the removal system 37 is below the insertion system 35, accordingly to the overlapped arrangement of the conveyors 31 and 33.

[0034] Advantageously, associated with the loading conveyor there may be a stop 39 (figures 2 and 5), which may be movable and/or adjustable, to define the stop point of each workpiece to be machined P1 fed by the loading conveyor 31 towards the loading and unloading area 29.

[0035] In some embodiments, the loading conveyor 31 extends from a receiving area 41 of the workpieces P1 to be machined towards the area 29 where workpieces to be machined are loaded and machined workpieces are unloaded. The unloading conveyor 33 extends from the area 29 where workpieces to be machined are loaded and machined workpieces are unloaded towards a gathering area, schematically indicated with 43, of the machined workpieces P2.

[0036] In some embodiments, in the receiving area 41 of the workpieces P1 to be machined and in the gathering area 43 of the machined workpieces P2, systems may be provided for mechanically moving the workpieces. In the receiving area 41 of the workpieces to be machined systems may be provided for translating single workpieces P1 to be machined, these systems feeding single workpieces P1 to be machined onto the loading conveyor 31. To this end flexible elements 45 may be for instance provided, such as chains or the like, with pushers 47 acting on the single workpieces P1 to be machined, moving them forwards according to the arrow f47 (figure 2) towards the loading conveyor 31.

[0037] In some embodiments, in the gathering area 43 of the machined workpieces removal systems may be provided for removing the machined workpieces P2 and transferring them for instance onto a rest surface 43A.

In the embodiment schematically illustrated in figure 2, thrust actuators 49 are for instance provided, pushing single machined workpieces P2 outside the conveyor 33 on the surface 43A. Moving systems different than those schematically indicated may be also provided to move the workpieces P1 to be machined onto the loading conveyor 31 and the machined workpieces P2 from the unloading conveyor 33.

[0038] In some embodiments the workpieces P1 to be machined, or blanks, may be loaded on the conveyor 31 manually. In some embodiments the machined workpieces P2 may be unloaded manually.

[0039] Thanks to the machining center briefly described above with reference to figures 2 to 5 it is possible to perform loading, machining, and unloading cycles as described below. In figures 3 a broken line illustrates a position where the workpiece-holding slide 17 is arranged during a machining cycle. The workpiece P blocked by means of the lower clamping elements 21 and the lower clamping elements 23 may be approached by the tools U of the operating head 5. The numerically controlled axes X, Y, Z, A, C allow the relative movements between tools and workpiece to machine it. As the axis Y is numerically controlled, the position of the workpiece-holding slide 17 indicated with a broken line in figure 3 is neither fixed nor unique, as the workpiece-holding slide 17 moves along the axis Y in a coordinated way with the movements of the tools U along the numerically controlled axes X, Z, A, C to machine a workpiece according to a generic working cycle.

[0040] Once the workpiece P (P2) has been completely machined, the workpiece-holding slide can translate according to the numerically controlled axis Y along the base 13 to move towards the loading and unloading area 29. A solid line shows in figure 3 the position of the workpiece-holding slide 17 in the loading and unloading area 29 taken during the initial step of the unloading cycle of the machined workpiece P2.

[0041] To unload the machined workpiece P2, the lower clamping element 23 moves downwards. In advantageous embodiments the lower clamping element 23 may move to the minimum achievable height, for instance defined by a stop of a cylinder-piston actuator carried by the respective support 25, whose piston rods are labeled 26. When the lower clamping element 23 is in the lower position, it is substantially at the same height as the upper branch of the conveyor 33. The removal system 37 for removing the machined workpieces P2 may transfer the machined workpiece P2 from the blocking member 19 towards the conveyor 33. To this end it is possible to provide that, with respect to the position indicated in figure 3 with a solid line, the workpiece-holding slide 17 moves further forwards towards the unloading conveyor, until achieving the position illustrated in figure 4.

[0042] It should be understood that the removal system of the machined workpieces may be also carried by the workpiece-holding slide 17, instead of being arranged in a fixed position in the loading and unloading area 29. A movable stop may be for instance provided, carried by the workpiece-holding slide 17 that makes the machined workpiece P2 move shortly away from the blocking member 19. On the workpiece-holding slide 17 a stop, not shown, may be for instance provided, movable in horizontal direction and designed analogously to what described in DE102011084540.2.

[0043] Once the machined workpiece P2 has been transferred onto the unloading conveyor 33 as shown in figure 4, the lower clamping element 23 may be raised up to nearly the height of the upper branch of the loading conveyor 31. In the meanwhile, on the conveyor 31 a new workpiece P1 to be machined has been placed, that has been moved up to the stop 39 (figures 2 and 5). The insertion system comprising the actuators 35 and the crossbeam 36 pushes the new workpiece P1 to be machined transversally to the longitudinal direction of the loading conveyor 31, to transfer it on the lower clamping elements 23.

[0044] In this step, the upper clamping elements 21 may be raised with respect to a final clamping position. The upper position of the lower clamping element 23 during this step may be the maximum rise position, defined by the stop of the cylinder-piston actuator (or other adequate actuator) whose piston rods 26 are shown. The position of the lower clamping elements 23 can be therefore repeated precisely at every machining cycle. Therefore, the lower clamping elements 23 may advantageously constitute reference stops of the workpiece to be machined P1. In other words, the reference height at which each workpiece P1 to be machined is positioned to perform the subsequent workings, and at which these workings refer, is the position defined by the lower clamping elements 23.

[0045] The workpiece P1 to be machined may be completely clamped by lowering the upper clamping element 21 of each pair 19A, so that the workpiece P1 to be machined is firmly blocked on the workpiece-holding slide 17. Now, this latter can translate according to the axis Y to bring the workpiece P1 to be machined in the working area of the operating head 5.

[0046] Whilst the new workpiece P1 to be machined is loaded on the workpiece-holding slide 17 as described above, the machined workpiece P2 transferred from the workpiece-holding slide 17 to the lower unloading conveyor 33 may be conveyed by means of the lower unloading conveyor 33 towards the gathering area 43 of the machined workpieces P2 where, automatically or manually, the single workpieces P2 may be collected for instance on the collection table 43A or in any other adequate manner.

[0047] It is clearly apparent from the description above that thanks to the new arrangement of the loading and unloading systems and of the corresponding conveyors, the unload of the machined workpieces from the workpiece-holding slide 17 and the load of the new workpieces to be machined on the workpiece-holding slide 17 are accelerated and performed at least partially in a timely

overlapping manner. The machined workpiece P2 shall be simply translated for a short stroke to free the lower clamping elements 23 without the need of transferring it by means of the workpiece-holding slide 17 towards the gathering area 43 of the machined workpieces. Once this short operation of transferring the machined workpiece P2 on the unloading conveyor 33 has been performed, the new workpiece to be machined P1 can be loaded on the workpiece-holding slide 17 substantially timely overlapping the operation of moving the machined workpiece P2 away and the operation of loading the new workpiece to be machined P1.

[0048] The use of movable lower clamping elements 23 and movable upper clamping elements 21 on the one hand allows unloading and loading the workpieces by means of the lower clamping elements 23 at the two different heights at which the loading conveyor 31 and the unloading conveyor 33 are arranged. On the other hand, it is also possible to define a reference position of the workpiece P1 to be machined that is fixed and repeatable, independently of the vertical dimension of the workpiece P1 to be machined. The mobility of the upper clamping element 21 allows the blocking member 19 immediately to adapt to workpieces P1 to be machined of any height within the operating range of the machine practically given by the stroke of the upper clamping element 21 in vertical direction.

[0049] As the reference stop in vertical direction of the workpieces P1 to be machined is defined by the lower clamping elements 23, the upper clamping elements 21 may have a yielding coating, to avoid damages to the workpieces clamped by means of these elements. Deformation of the coating of the upper clamping elements 21 does not alter the position of the workpiece P1, which is anyway always referred to a stop formed by the lower clamping elements 23, which at every working cycle are always in the same, easily repeatable position. The lower clamping elements 23 are substantially rigid, and therefore the compression force acting on the clamped workpieces does not alter the lower reference surface.

[0050] As the position of the lower clamping elements 23 may be fixed and unchangeable with respect to the vertical thickness of the workpiece P1 to be machined thanks to the mobility of the upper clamping elements 21, it is possible to move the lower clamping elements or jaws 23 between a position of maximum fall and a position of maximum rise, these positions being fixed and independent of the shape and vertical dimension of the workpiece to be machined P1. These positions are determined according to the height HI, H2 of the loading conveyor 31 and unloading conveyor 33, respectively.

[0051] The machining center 1 of figures 2 to 5 comprises only one single workpiece-holding slide 17 and one operating head 5. In other embodiments more than one operating head 5 may be provided to perform more complex working cycles in shorter times on single workpieces P1 to be machined, making the two or more operating heads 5 cooperate with the single workpiece-holding slide 17.

[0052] In other embodiments more than one workpiece-holding slide 17 may be provided, cooperating with one or more operating heads 5. Figures 6 to 9 show for instance a machining center with two workpiece-holding slides 17 to machine two workpieces at the same time. In the illustrated embodiment two operating heads 5 are also provided, each of which working with one of the two workpiece-holding slides 17 so as to machine in parallel. The working cycles may be equal to or different from one another.

[0053] In figures 6 to 9, the same reference numbers indicate the same or corresponding parts to those illustrated in figures 2 to 5. Equal or corresponding parts of the two workpiece-holding slides, of the two operating heads and the corresponding bearing structures, as well as of the insertion system and of the removal system of the workpieces with respect to the workpiece-holding slides are indicated with the same reference numbers for the two workpiece-holding slides.

[0054] The embodiment of the machining center illustrated in figures 6 to 9 therefore provides for an area 29 for loading the workpieces P1 to be machined and unloading the machined workpieces P2, extending for an extension comprising a double arrangement of bases 13 and corresponding workpiece-holding slides 17.

[0055] The loading conveyor 31 and unloading conveyor 33 are still at different height, indicated again with HI and H2, and overlap each other in the loading and unloading area 29. As in this area there are two bases 13 and two workpiece-holding slides 17, the length of the segment where the loading conveyor 31 and the unloading conveyor 33 overlap each other is greater than in the embodiment of figures 2 to 6, as it is particularly visible by comparing figures 5 and 9.

[0056] Along the loading conveyor 31 two stops are advantageously provided, indicated with 39A and 39B, instead of a single stop 39 as shown in the embodiment of figures 2 to 6.

[0057] The stops 39A and 39B define the position where the workpieces to be machined P1 shall stop to be transferred from the loading conveyor 31 to the respective workpiece-holding slides 17. To allow workpieces P1 to be machined to move from the receiving area 41 to the loading and unloading area 29 in correspondence of the base 13 farther from the receiving area 41 of the workpieces P1 to be machined, the stop 39A is movable according to the double arrow f39 (figure 6). The stop 39B downstream with respect to the forward direction of the workpieces to be machined P1 may be fixed.

[0058] In general, also more than two bases 13 and respective workpiece-holding slides 17 may be provided, with an equivalent number of stops 39 distributed along the extension of the loading conveyor 33; all these stops, excluding, if necessary, the last one, shall be movable to allow the workpieces P1 to be machined to move towards the position farthest from the receiving area 41.

[0059] Each section of the machining center 1 illustrat-

ed in figures 6 to 9 where there is one of the workpiece-holding slides 17 operates as described above with reference to the embodiments of figures 2 to 5. Therefore, the operation of the machining center 1 will not be described again. Figures 7 and 8 show the sequence of movements of the blocking member 19 and especially of the upper clamping elements 21 and the lower clamping elements 23, as well as of the insertion systems for inserting the workpieces to be machined and the removal systems for removing the machined workpieces to unload the machined workpiece P2 from one of the two workpiece-holding slide 17 and load the workpiece P1 to be machined on one of the two workpiece-holding slides 17.

[0060] The machining center illustrated in figures 6 to 9 may operate in swinging cycle and/or using the two operating heads 5 to simultaneously machine a workpiece P1 carried by one of the two workpiece-holding slides. This operating mode is schematically represented in the plan view of figure 10.

Claims

1. A machining center (1) for working elongated pieces (P1, P2), comprising:

at least one operating head (5) movable according to a plurality of numerically controlled axes (X, Z, A, C);
at least one workpiece-holding slide (17) movable between a working area and an area (29) where the workpieces (P1) to be machined are loaded on the workpiece-holding slide (17) and machined workpieces (P2) are unloaded from the workpiece-holding slide (17), and vice versa, the workpiece-holding slide (17) comprising at least one blocking member (19) to block the workpieces (PI; P2) with at least one lower clamping element (23) and at least one upper clamping element (21), movable with respect to each other to block a workpiece (P1, P2) there between;
an insertion system for inserting the workpieces (P1) to be machined on the workpiece-holding slide (17);
a removal system (37) for removing the machined workpieces (P2) from the workpiece-holding slide (17);

wherein: the insertion system (35) of the workpieces (P1) to be machined and the removal system (37) of the machined workpieces (P2) are arranged at two different and distinct heights and wherein the lower clamping element (23) is vertically movable and adapted to be placed alternatively at the height of the insertion system (35) of the workpieces (P1) to be machined and at the height of the removal system (37) of the machined workpieces (P2), **characterized in that**:
the insertion system (35) is associated with a loading conveyor (31) extending from a workpiece receiving area (41) towards the area (29) of loading the workpieces (P1) to be machined on the workpiece-holding slide (17) and unloading the machined workpieces (P2) from the workpiece-holding slide (17), where the workpieces are transferred from the loading conveyor (31) to the workpiece-holding slide (17); and **in that**:
the removal system (37) is associated with an unloading conveyor (33) extending from the area (29) where workpieces (P1) to be machined are loaded on the workpiece-holding slide (17) and machined workpieces (P2) are unloaded from the workpiece-holding slide (17) towards a gathering area (43) of the machined workpieces (P2), the removal system being configured such that the machined workpieces (P2) are transferred by the removal system from the workpiece-holding slide (17) to the unloading conveyor (33) in said area (29) where workpieces (P1) to be machined are loaded on the workpiece-holding slide (17) and machined workpieces are unloaded from the workpiece-holding slide (17).

2. Machining center (1) according to claim 1, wherein the loading conveyor (31) and the unloading conveyor (33) overlap at least partially, at least in the area (29) where workpieces (P1) to be machined are loaded on the workpiece-holding slide (17) and machined workpieces (P2) are unloaded from the workpiece-holding slide (17).

3. Machining center (1) according to claim 1 or 2, wherein both the lower clamping element (23) and the upper clamping element (21) are movable with respect to the workpiece-holding slide (17) with a motion having at least one vertical component.

4. Machining center (1) according to one or more of the previous claims, wherein the lower clamping element (23) has an upper stop position for the reference of the workpieces (PI; P2).

5. Machining center (1) according to claim 4, wherein said at least one lower clamping element (23) is controlled to reach, with respect to the workpiece-holding slide (17), at least two positions for each working cycle, respectively: a first position adapted to remove the machined workpiece (P2), in correspondence of the removal system (37) of the machined workpieces (P2); a second position adapted to insert the workpiece (P1), in correspondence of the insertion system (35) of the workpieces (P1) to be machined; one of said first position and second position being a working and reference position, the lower clamping element being adapted to maintain said working and

reference position during interaction between the operating head (5) and the workpiece (PI; P2).

6. Machining center (1) according to one or more of the previous claims, wherein in the receiving area (41) of the workpieces (P2) to be machined a feeder (45, 47) is arranged, designed to load single workpieces (P1) to be machined on the loading conveyor (31).

7. Machining center (1) according to one or more of the previous claims, wherein in the gathering area (43) an accumulator is arranged, designed to receive the machined workpieces (P1) from the unloading conveyor (33).

8. Machining center (1) according to one or more of the previous claims, wherein the insertion system (35) is at a greater height than the removal system (37), and wherein the loading conveyor (31) at least partially overlaps the unloading conveyor (33).

9. Machining center (1) according to one or more of the previous claims, wherein the removal system (37) comprises movable extractors for moving towards a machined workpiece (P2) carried by the workpiece-holding slide (17), remove it from the workpiece-holding slide (17), and transfer it on the unloading conveyor (33).

10. Machining center (1) according to one or more of the previous claims, wherein the insertion system (35) comprises inserters (36) translating a workpiece (P1) from the loading conveyor (31) towards the workpiece-holding slide (17).

11. Machining center (1) according to one or more of the previous claims, wherein: the workpiece-holding slide (17) is movable, with respect to a bearing structure (6) carrying the operating head (5), along a trajectory according to a first axis of translation (Y); the loading conveyor (31) is configured and arranged to move the workpieces (P1) in a direction substantially orthogonal to the direction of the first axis of translation (Y), the receiving area (29) of the workpieces (P1) to be machined being located on a first side of the trajectory of the workpiece-holding slide (17); and the unloading conveyor (33) is configured and arranged to move the machined workpieces (P2) in a direction substantially orthogonal to the direction of the first axis of translation (Y), the gathering area (43) of the machined workpieces (P2) being located on a second side of the trajectory of the workpiece-holding slide (17) opposite to the first side.

12. Machining center (1) according to claim 11, comprising a base (13), on which guides (15) are provided for the movement of the workpiece-holding slide (17) according to said first axis of translation (Y); and wherein the loading conveyor (31) and the unloading conveyor (33) overlap in an area above said base (13) and extend from said base (13) orthogonally to the guides (15) of the workpiece-holding slide (17), on the opposite sides of the base (13).

13. Machining center (1) according to one or more of the previous claims, wherein the loading conveyor (31) and the unloading conveyor (33) are substantially parallel.

14. Machining center (1) according to one or more of the previous claims, comprising: at least two workpiece-holding slides (17), each movable from an area (29) of loading the workpieces (P1) to be machined and unloading the machined workpieces towards a working area; and wherein the loading conveyor (31) and the unloading conveyor (33) overlap at least for a length sufficient to transfer the workpieces (P1) to both the workpiece-holding slides (17) by means of the loading conveyor (31) and to pick-up machined workpieces (P2) unloaded from both the workpiece-holding slides (17) by means of the unloading conveyor (33); preferably further comprising a respective operating head (5) movable according to a plurality of numerically controlled axes (X, Z, A, C) for each workpiece-holding slide (17); and wherein preferably a plurality of stops (39A, 39B) are arranged along the loading conveyor (31), aligned along a feeding direction of the loading conveyor (31) in the same number as the workpiece-holding slides (17).

15. Machining center (1) according to one or more of the previous claims, wherein a plurality of lower clamping elements (23) and a plurality of upper clamping elements (21) are arranged on said at least one workpiece-holding slide (17).

Patentansprüche

1. Bearbeitungszentrum (1) zum Bearbeiten länglicher Stücke (P1, P2), das umfasst:

mindestens einen Bearbeitungskopf (5), der entsprechend einer Anzahl numerisch gesteuerter Achsen (X, Z, A, C) bewegbar ist;
mindestens einen Werkstückhalteschlitten (17), der zwischen einem Bearbeitungsbereich und einem Bereich (29), in dem die zu bearbeitenden Werkstücke (P1) auf den Werkstückhalteschlitten (17) geladen und bearbeitete Werkstücke (P2) von dem Werkstückhalteschlitten (17) entladen werden, und umgekehrt, bewegbar ist, wobei der Werkstückhalteschlitten (17) mindestens ein Blockierelement (19) zum Blockieren der Werkstücke (P1; P2) mit mindestens einem unteren Klemmelement (23) und mindestens ei-

nem oberen Klemmelement (21), in Bezug auf einander zum Blockieren eines Werkstücks (P1, P2) dazwischen bewegbar, umfasst;
ein Einfügesystem zum Einfügen der Werkstücke (P1), die zu bearbeiten sind, auf dem Werkstückhalteschlitten (17);
ein Entnahmesystem (37) zum Entnehmen der bearbeiteten Werkstücke (P2) von dem Werkstückhalteschlitten (17);
wobei das Einfügesystem (35) der Werkstücke (P1), die zu bearbeiten sind, und das Entnahmesystem (37) der bearbeiteten Werkstücke (P2) an zwei unterschiedlichen und getrennten Höhen angeordnet sind und wobei das untere Klemmelement (23) vertikal bewegbar ist und angepasst ist, alternativ an der Höhe des Einfügesystems (35) der Werkstücke (P1), die zu bearbeiten sind, und an der Höhe des Entnahmesystems (37) der bearbeiteten Werkstücke (P2) angeordnet zu werden, **dadurch gekennzeichnet, dass**:
das Einfügesystem (35) einem Ladeförderer (31) zugehörig ist, der sich von einem Werkstückaufnahmebereich (41) in Richtung des Bereichs (29) der Beladung der Werkstücke (P1), die zu bearbeiten sind, auf dem Werkstückhalteschlitten (17) und der Entladung der bearbeiteten Werkstücke (P2) von dem Werkstückhalteschlitten (17) erstreckt, wo die Werkstücke von dem Ladeförderer (31) zu dem Werkstückhalteschlitten (17) befördert werden; und dass:
das Entnahmesystem (37) einem Entladeförderer (33) zugehörig ist, der sich von dem Bereich (29), wo Werkstücke (P1), die zu bearbeiten sind, auf den Werkstückhalteschlitten (17) geladen werden und bearbeitete Werkstücke (P2) von dem Werkstückhalteschlitten (17) entladen werden, in Richtung eines Sammelbereichs (43) der bearbeiteten Werkstücke (P2) erstreckt, wobei das Entnahmesystem so konfiguriert ist, dass die bearbeiteten Werkstücke (P2) durch das Entnahmesystem von dem Werkstückhalteschlitten (17) zu dem Entladeförderer (33) in dem Bereich (29), wo Werkstücke (P1), die zu bearbeiten sind, auf den Werkstückhalteschlitten (17) geladen werden und bearbeitete Werkstücke von dem Werkstückhalteschlitten (17) entladen werden, befördert werden.

2. Bearbeitungszentrum (1) gemäß Anspruch 1, wobei der Ladeförderer (31) und der Entladeförderer (33) sich mindestens teilweise überlappen, mindestens in dem Bereich (29), wo Werkstücke (P1), die zu bearbeiten sind, auf den Werkstückhalteschlitten (17) geladen werden, und bearbeitete Werkstücke (P2) von dem Werkstückhalteschlitten (17) entladen werden.

3. Bearbeitungszentrum (1) gemäß Anspruch 1 oder 2, wobei sowohl das untere Klemmelement (23) als auch das obere Klemmelement (21) in Bezug auf den Werkstückhalteschlitten (17) mit einer Bewegung, die mindestens eine vertikale Komponente aufweist, bewegbar sind.

4. Bearbeitungszentrum (1), gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei das untere Klemmelement (23) eine obere Stoppposition für die Referenz der Werkstücke (P1; P2) aufweist.

5. Bearbeitungszentrum (1) gemäß Anspruch 4, wobei das mindestens eine untere Klemmelement (23) zum Erreichen, mit Bezug auf den Werkstückhalteschlitten (17), jeweils mindestens zweier Positionen für jeden Arbeitszyklus gesteuert wird:
einer ersten Position, die zum Entnehmen des bearbeiteten Werkstücks (P2) angepasst ist, in Übereinstimmung mit dem Entnahmesystem (37) der bearbeiteten Werkstücke (P2); einer zweiten Position, die zum Einfügen des Werkstücks (P1) angepasst ist, in Übereinstimmung mit dem Einfügesystem (35) der Werkstücke (P1), die zu bearbeiten sind; wobei eine von der ersten Position und der zweiten Position eine Bearbeitungs- und Referenzposition ist, das untere Klemmelement zum Beibehalten der Bearbeitungs- und Referenzposition während Wechselwirkung zwischen dem Bearbeitungskopf (5) und dem Werkstück (P1; P2) angepasst ist.

6. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei in dem Aufnahmebereich (41) der Werkstücke (P2), die zu bearbeiten sind, eine Zuführung (45, 47) angeordnet ist, die zum Laden einzelner Werkstücke (P1), die zu bearbeiten sind, auf den Ladeförderer (31) gestaltet ist.

7. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei in dem Sammelbereich (43) ein Sammler angeordnet ist, der zum Aufnehmen der bearbeiteten Werkstücke (P1) von dem Entladeförderer (33) gestaltet ist.

8. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei das Einfügesystem (35) sich in einer größeren Höhe als das Entnahmesystem (37) befindet und wobei der Ladeförderer (31) sich mindestens teilweise mit dem Entladeförderer (33) überlappt.

9. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei das Entnahmesystem (37) bewegbare Auszieher zum Bewegen in Richtung eines bearbeiteten Werkstücks (P2), das durch den Werkstückhalteschlitten (17) getragen wird, seiner Entfernung von dem

Werkstückhalteschlitten (17) und seiner Beförderung auf dem Entladeförderer (33) umfasst.

10. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei das Einfügesystem (35) Einfüger (36) umfasst, die ein Werkstück (P1) von dem Ladeförderer (31) in Richtung des Werkstückhalteschlittens (17) versetzen.

11. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei: der Werkstückhalteschlitten (17), unter Bezug auf eine Tragstruktur (6), die den Bearbeitungskopf (5) trägt, entlang einer Bahn gemäß einer ersten Translationsachse (Y) beweglich ist; der Ladeförderer (31) zum Bewegen der Werkstücke (P1) in einer Richtung, die zu der Richtung der ersten Translationsachse (Y) im Wesentlichen orthogonal ist, konfiguriert und angeordnet ist, der Aufnahmebereich (29) der Werkstücke (P1), die zu bearbeiten sind, auf einer ersten Seite der Bahn des Werkstückhalteschlittens (17) angeordnet ist; und der Entladeförderer (33) zum Bewegen der bearbeiteten Werkstücke (P2) in einer Richtung, die zu der Richtung der ersten Translationsachse (Y) im Wesentlichen orthogonal ist, konfiguriert und angeordnet ist, der Sammelbereich (43) der bearbeiteten Werkstücke (P2) auf einer zweiten Seite der Bahn des Werkstückhalteschlittens (17), der ersten Seite entgegengesetzt, angeordnet ist.

12. Bearbeitungszentrum (1) gemäß Anspruch 11, das eine Basis (13) umfasst, auf der Führungen (15) für die Bewegung des Werkstückhalteschlitten (17) gemäß einer ersten Translationsachse (Y) bereitgestellt sind; und wobei der Ladeförderer (31) und der Entladeförderer (33) sich in einem Bereich über der Basis (13) überlappen und sich von der Basis (13) orthogonal zu den Führungen (15) des Werkstückhalteschlittens (17), auf den entgegengesetzten Seiten der Basis (13), erstrecken.

13. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei der Ladeförderer (31) und der Entladeförderer (33) im Wesentlichen parallel sind.

14. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, das umfasst: mindestens zwei Werkstückhalteschlitten (17), jeweils von einem Bereich (29) des Beladens der Werkstücke (P1), die zu bearbeiten sind, und Entladens der bearbeiteten Werkstücke in Richtung eines Bearbeitungsbereichs bewegbar; und wobei der Ladeförderer (31) und der Entladeförderer (33) sich mindestens für eine Länge überlappen, die ausreichend ist, die Werkstücke (P1) zu beiden Werkstückhalteschlitten (17) mittels des Ladeförderers (31) zu befördern und bearbeitete Werkstücke (P2), die von beiden Werkstückhalteschlitten (17) entladen worden sind, mittels des Entladeförderers (33), aufzunehmen; bevorzugt weiter umfassend einen jeweiligen Bearbeitungskopf (5), der gemäß einer Anzahl numerisch gesteuerter Achsen (X, Z, A, C) für jeden Werkstückhalteschlitten (17) bewegbar ist; und wobei bevorzugt eine Anzahl an Anschlägen (39A, 39B) entlang des Ladeförderers (31) angeordnet sind, ausgerichtet entlang einer Zufuhrrichtung des Ladeförderers (31) in derselben Anzahl wie die Werkstückhalteschlitten (17).

15. Bearbeitungszentrum (1) gemäß einem oder mehreren der vorhergehenden Ansprüche, wobei eine Anzahl an unteren Klemmelementen (23) und eine Anzahl an oberen Klemmelementen (21) auf dem mindestens einen Werkstückhalteschlitten (17) angeordnet sind.

Revendications

1. Un centre d'usinage (1) pour usiner des pièces allongées (P1, P2), comprenant :

au moins une tête de travail (5) déplaçable suivant une pluralité d'axes commandés numériquement (X, Z, A, C) ;
au moins un coulisseau porte-pièces (17) déplaçable entre une zone de travail et une zone (29) où les pièces à usiner (P1) sont chargées sur le coulisseau porte-pièces (17) et les pièces usinées (P2) sont déchargées du coulisseau porte-pièces (17), et vice-versa, le coulisseau porte-pièces (17) comprenant au moins un organe de blocage (19) pour bloquer les pièces (P1 ; P2) avec au moins un élément de serrage inférieur (23) et au moins un élément de serrage supérieur (21), déplaçables l'un par rapport à l'autre pour bloquer entre eux une pièce (P1, P2) ;
un système d'insertion pour insérer les pièces à usiner (P1) sur le coulisseau porte-pièces (17);
un système de retrait (37) pour retirer les pièces usinées (P2) du coulisseau porte-pièces (17);
dans lequel : le système d'insertion (35) des pièces à usiner (P1) et le système de retrait (37) des pièces usinées (P2) sont agencés à deux hauteurs différentes et dans lequel l'élément de serrage inférieur (23) est déplaçable verticalement et apte à être placé alternativement à la hauteur du système d'insertion (35) des pièces à usiner (P1) et à la hauteur du système de retrait (37) des pièces usinées (P2), **caractérisé en ce que** :
le système d'insertion (35) est associé à un convoyeur de chargement (31) s'étendant d'une zo-

ne de réception de pièces à usiner (41) à la zone (29) de chargement des pièces à usiner (P1) sur le coulisseau porte-pièces (17) et de déchargement des pièces usinées (P2) du coulisseau porte-pièces (17), où les pièces à usiner sont transférées du convoyeur de chargement (31) au coulisseau porte-pièces (17) ; et **en ce que** :
le système de retrait (37) est associé avec un convoyeur de déchargement (33) s'étendant de la zone (29) où les pièces à usiner (P1) sont chargées sur le coulisseau porte-pièces (17) et les pièces usinées (P2) sont déchargées du coulisseau porte-pièces (17) à une zone de regroupement (43) des pièces usinées (P2), le système de retrait étant configuré de telle sorte que les pièces usinées (P2) sont transférées par le système de retrait du coulisseau porte-pièces (17) au convoyeur de déchargement (33) dans ladite zone (29) où les pièces à usiner (P1) sont chargées sur le coulisseau porte-pièces (17) et les pièces usinées sont déchargées du coulisseau porte-pièces (17).

2. Centre d'usinage (1) selon la revendication 1, dans lequel le convoyeur de chargement (31) et le convoyeur de déchargement (33) se superposent au moins partiellement, au moins dans la zone (29) où les pièces à usiner (P1) sont chargées sur le coulisseau porte-pièces (17) et les pièces usinées (P2) sont déchargées du coulisseau porte-pièces (17).

3. Centre d'usinage (1) selon la revendication 1 ou 2, dans lequel à la fois l'élément de serrage inférieur (23) et l'élément de serrage supérieur (21) sont déplaçables par rapport au coulisseau porte-pièces (17) avec un mouvement ayant au moins une composante verticale.

4. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel l'élément de serrage inférieur (23) a une position de butée supérieure pour la référence des pièces (P1 ; P2).

5. Centre d'usinage (1) selon la revendication 4, dans lequel ledit ou lesdits éléments de serrage (23) est(sont) commandé(s) pour atteindre, par rapport au coulisseau porte-pièces (17), au moins deux positions pour chaque cycle d'usinage, respectivement : une première position apte au retrait de la pièce usinée (P2), en correspondance avec le système de retrait (37) des pièces usinées (P2) ; une seconde position apte à l'insertion de la pièce à usiner (P1), en correspondance avec le système d'insertion (35) des pièces à usiner (P1) ; l'une desdites première position et seconde position étant une position de travail et de référence, l'élément de serrage inférieur étant apte à maintenir ladite position de travail et de référence durant l'interaction entre la tête de travail (5) et la pièce (P1 ; P2).

6. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel dans la zone de réception (41) des pièces à usiner (P1), un dispositif d'alimentation (47) est agencé, conçu pour charger des pièces à usiner (P1) individuelles sur le convoyeur de chargement (31).

7. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel dans la zone de regroupement (43), un accumulateur est agencé, conçu pour recevoir les pièces usinées (P1) provenant du convoyeur de déchargement (33).

8. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel le système d'insertion (35) est à une hauteur supérieure à celle du système de retrait (37), et dans lequel le convoyeur de chargement (31) se superpose au moins partiellement au convoyeur de déchargement (33).

9. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel le système de retrait (37) comprend des extracteurs déplaçables pour se déplacer vers une pièce usinée (P2) portée par le coulisseau porte-pièces (17), la retirer du coulisseau porte-pièces (17) et la transférer sur le convoyeur de déchargement (33).

10. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel le système d'insertion (35) comprend des dispositifs d'insertion (36) translatant une pièce à usiner (P1) du convoyeur de chargement (31) vers le coulisseau porte-pièces (17).

11. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel : le coulisseau porte-pièces (17) est déplaçable, par rapport à une structure de support (6) portant la tête de travail (5), le long d'une trajectoire suivant un premier axe de translation (Y) ; le convoyeur de chargement (31) est configuré et agencé pour déplacer les pièces à usiner (P1) dans une direction sensiblement orthogonale à la direction du premier axe de translation (Y), la zone de réception (29) des pièces à usiner (P1) étant située d'un premier côté de la trajectoire du coulisseau porte-pièces (17) ; et le convoyeur de déchargement (33) est configuré et agencé pour déplacer les pièces usinées (P2) dans une direction sensiblement perpendiculaire à la direction du premier axe de translation (Y), la zone de regroupement (43) des pièces usinées (P2) étant située d'un second côté de la trajectoire du coulisseau porte-pièces (17) opposé au premier côté.

12. Centre d'usinage (1) selon la revendication 11, com-

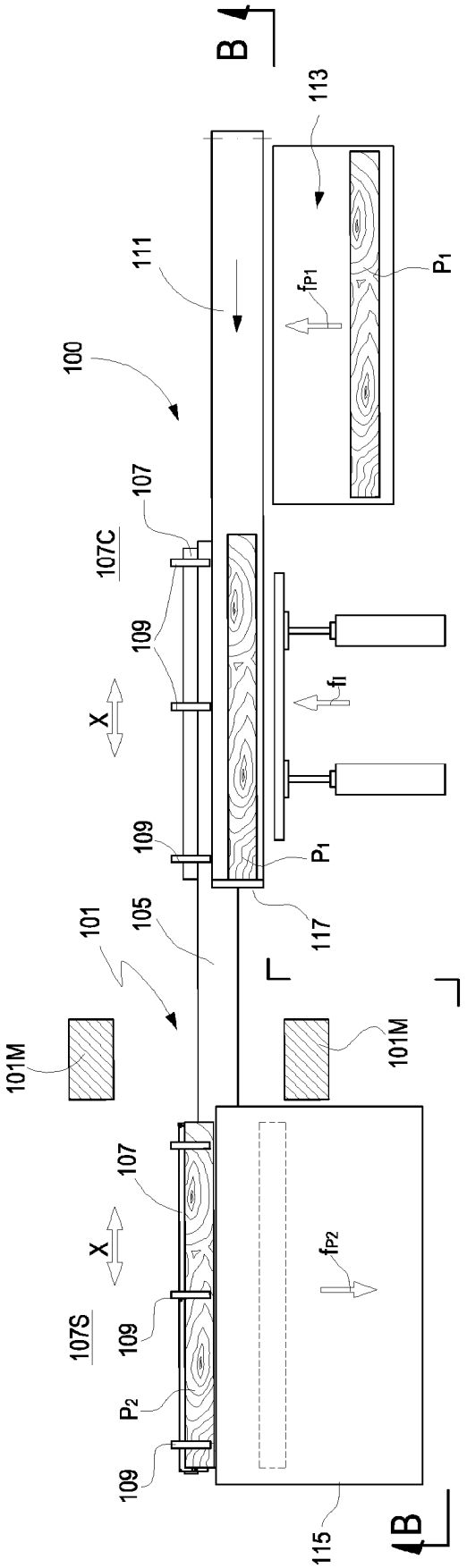
prenant une base (13), sur laquelle des guides (15) sont prévus pour le déplacement du coulisseau porte-pièces (17) suivant un premier axe de translation (Y) ; et dans lequel le convoyeur de chargement (31) et le convoyeur de déchargement (33) se superposent dans une zone au-dessus de ladite base (13) et s'étendent depuis ladite base (13) perpendiculairement aux guides (15) du coulisseau porte-pièces (17), sur des côtés opposés de la base (13).

13. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel le convoyeur de chargement (31) et le convoyeur de déchargement (33) sont sensiblement parallèles.

14. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, comprenant : au moins deux coulisseaux porte-pièces (17), chacun étant déplaçable depuis une zone (29) de chargement des pièces à usiner (P1) et de déchargement des pièces usinées jusqu'à une zone de travail ; et dans lequel le convoyeur de chargement (31) et le convoyeur de déchargement (33) se superposent sur une longueur suffisante pour transférer les pièces à usiner (P1) vers les deux coulisseaux porte-pièces (17) au moyen du convoyeur de chargement (31) et pour saisir les pièces usinées (P2) déchargées des deux coulisseaux porte-pièces (17) au moyen du convoyeur de déchargement (33) ; comprenant en outre de préférence une tête de travail respective (5) déplaçable suivant une pluralité d'axes commandés numériquement (X, Z, A, C) pour chaque coulisseau porte-pièces (17) ; et dans lequel de préférence une pluralité de butées (39A, 39B) sont agencées le long du convoyeur de chargement (31), alignées le long d'une direction d'avancement du convoyeur de chargement (31) au même nombre que les coulisseaux porte-pièces (17).

15. Centre d'usinage (1) selon l'une ou plusieurs des revendications précédentes, dans lequel une pluralité d'éléments inférieurs de serrage (23) et une pluralité d'éléments supérieures de serrage (21) sont agencés sur ledit ou lesdits coulisseau(x) porte-pièces (17).

Fig.1A
STATE OF THE ART



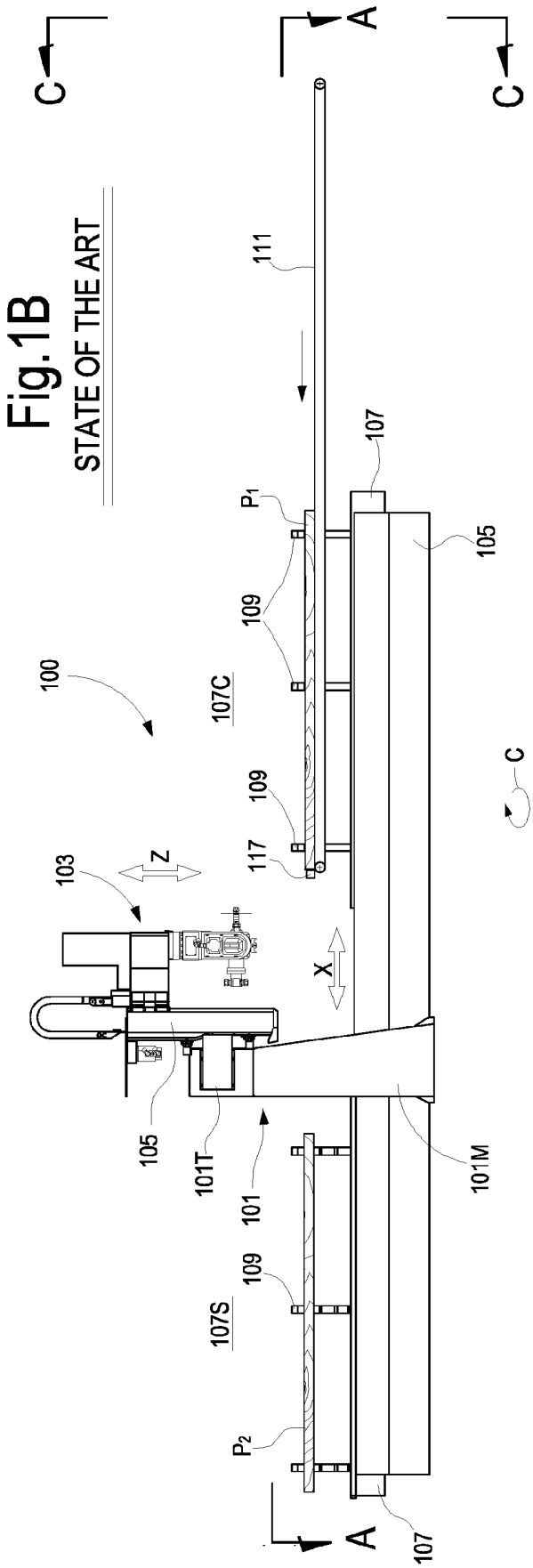


Fig.1B
STATE OF THE ART

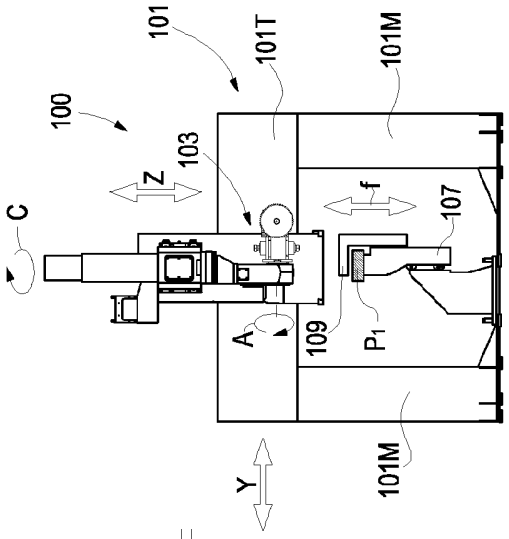
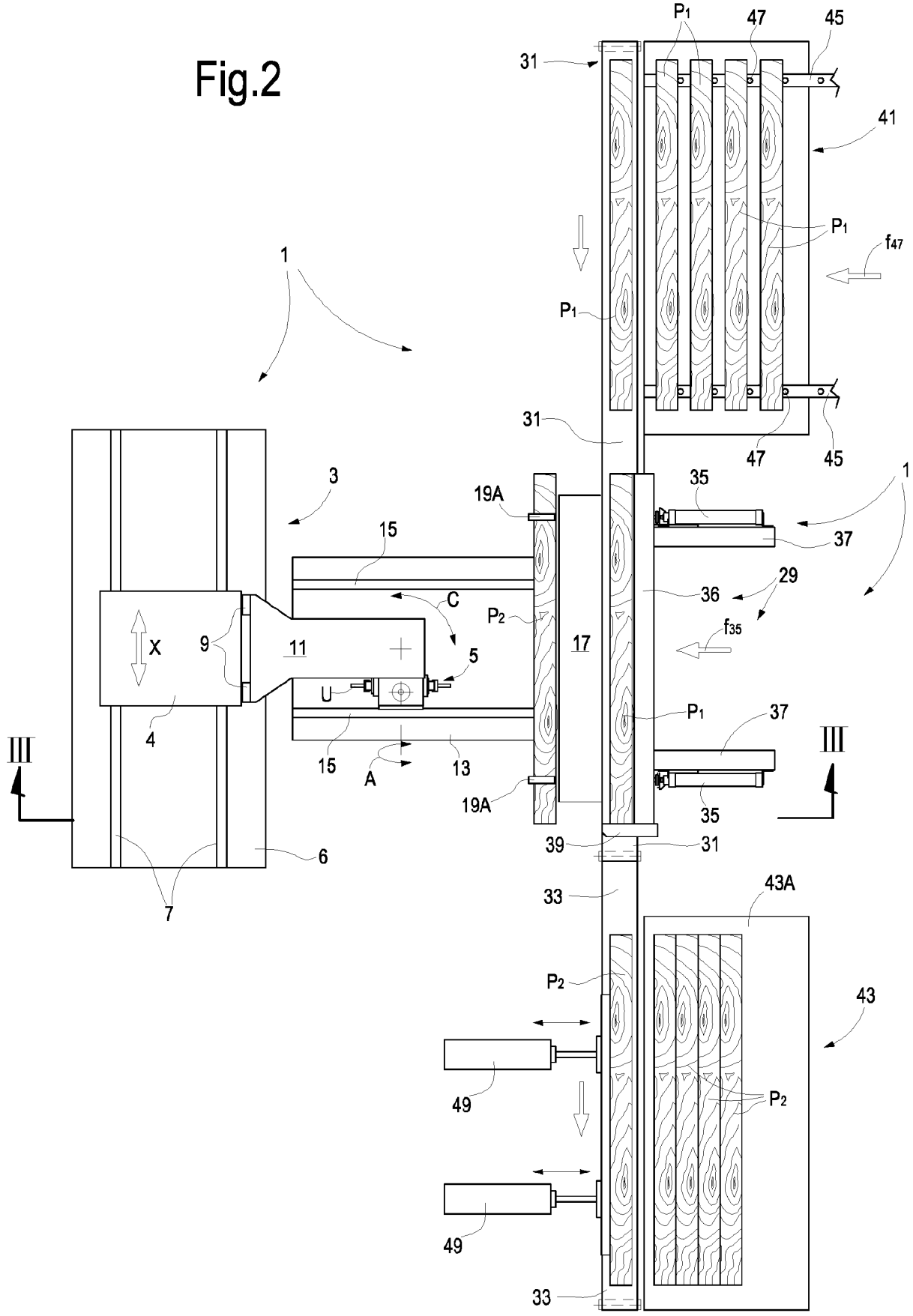


Fig.1C
STATE OF THE ART

Fig.2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U
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4
III
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39
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P2
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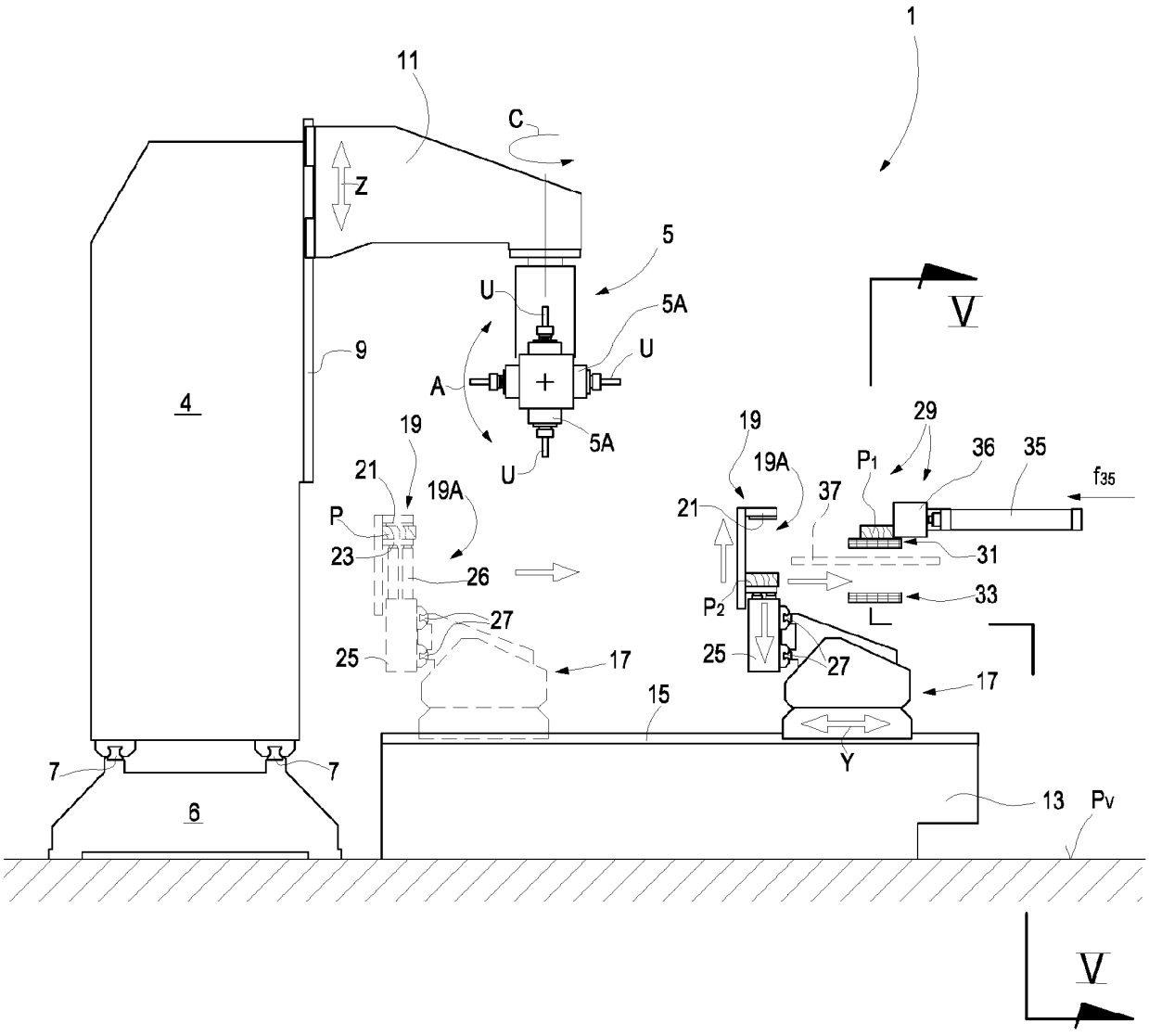
Fig.3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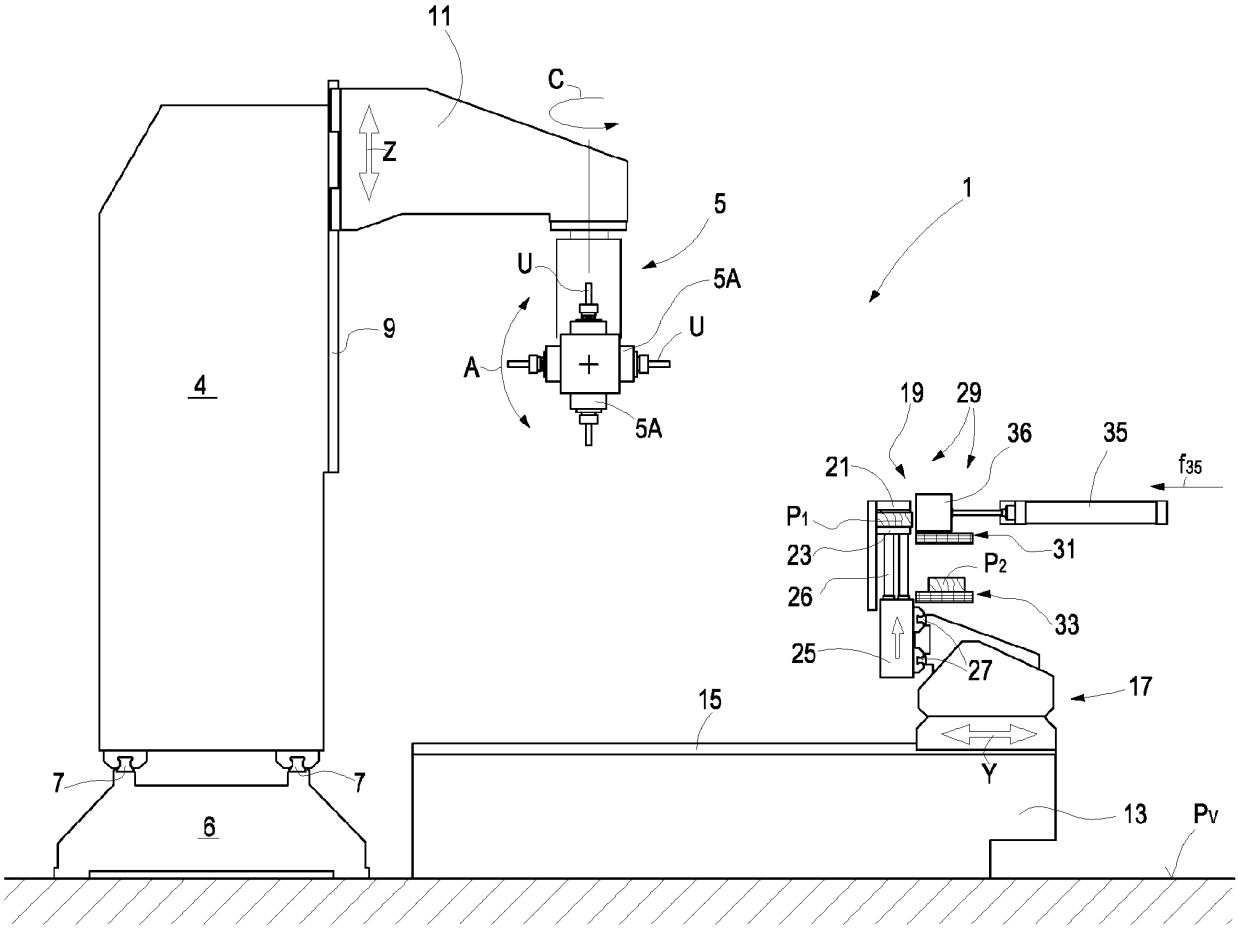
Pv
V
V

Fig.4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P_V

Fig.5

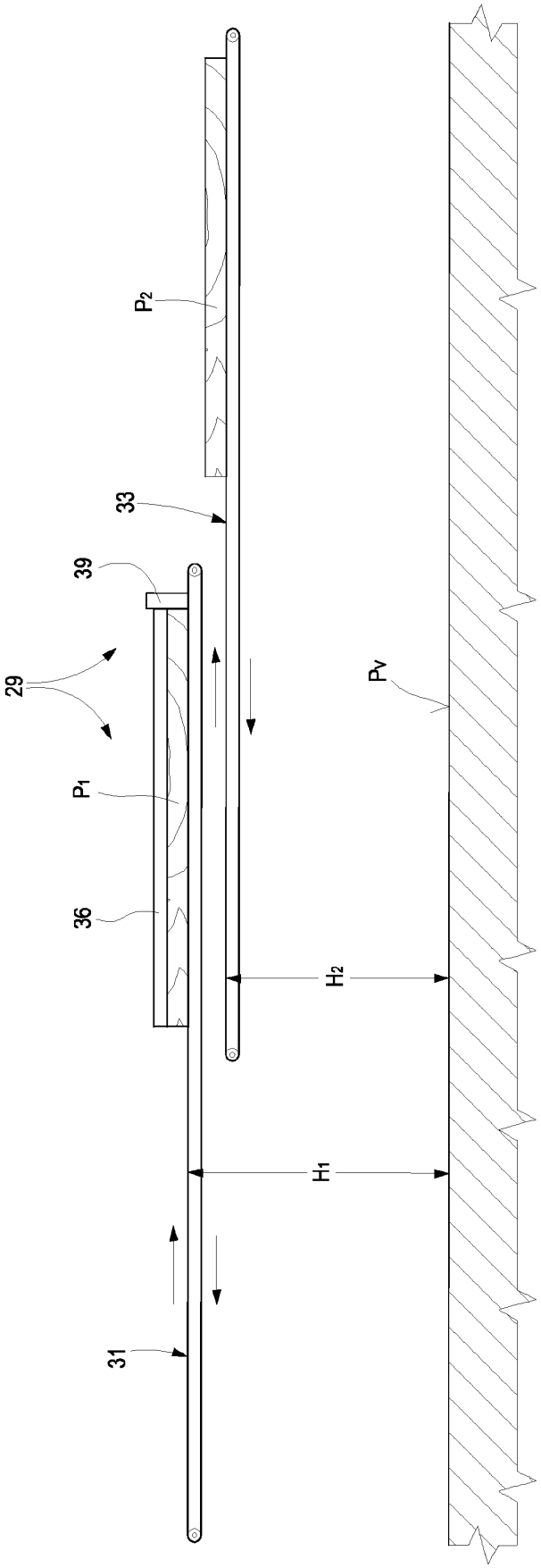

Fig.6

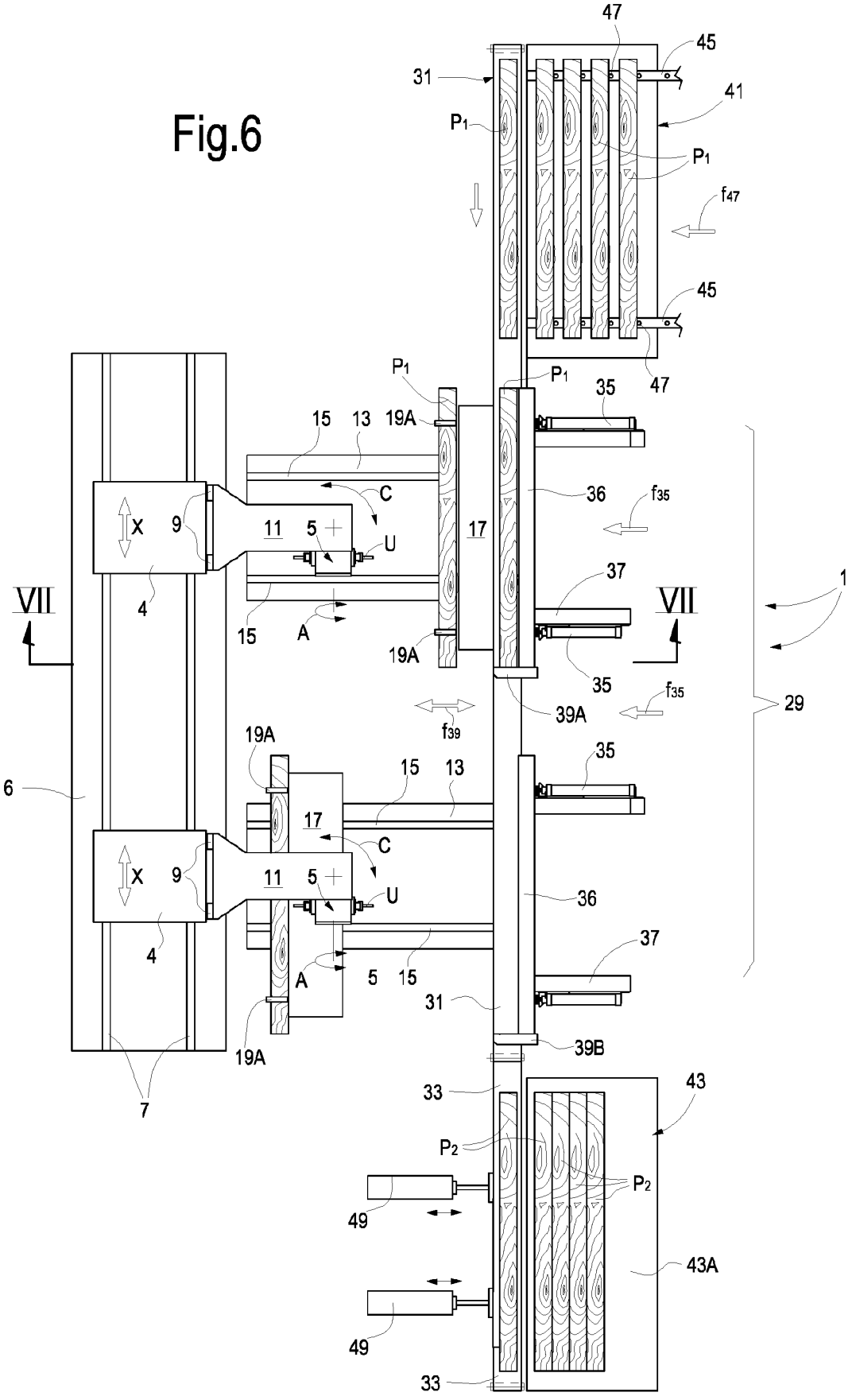
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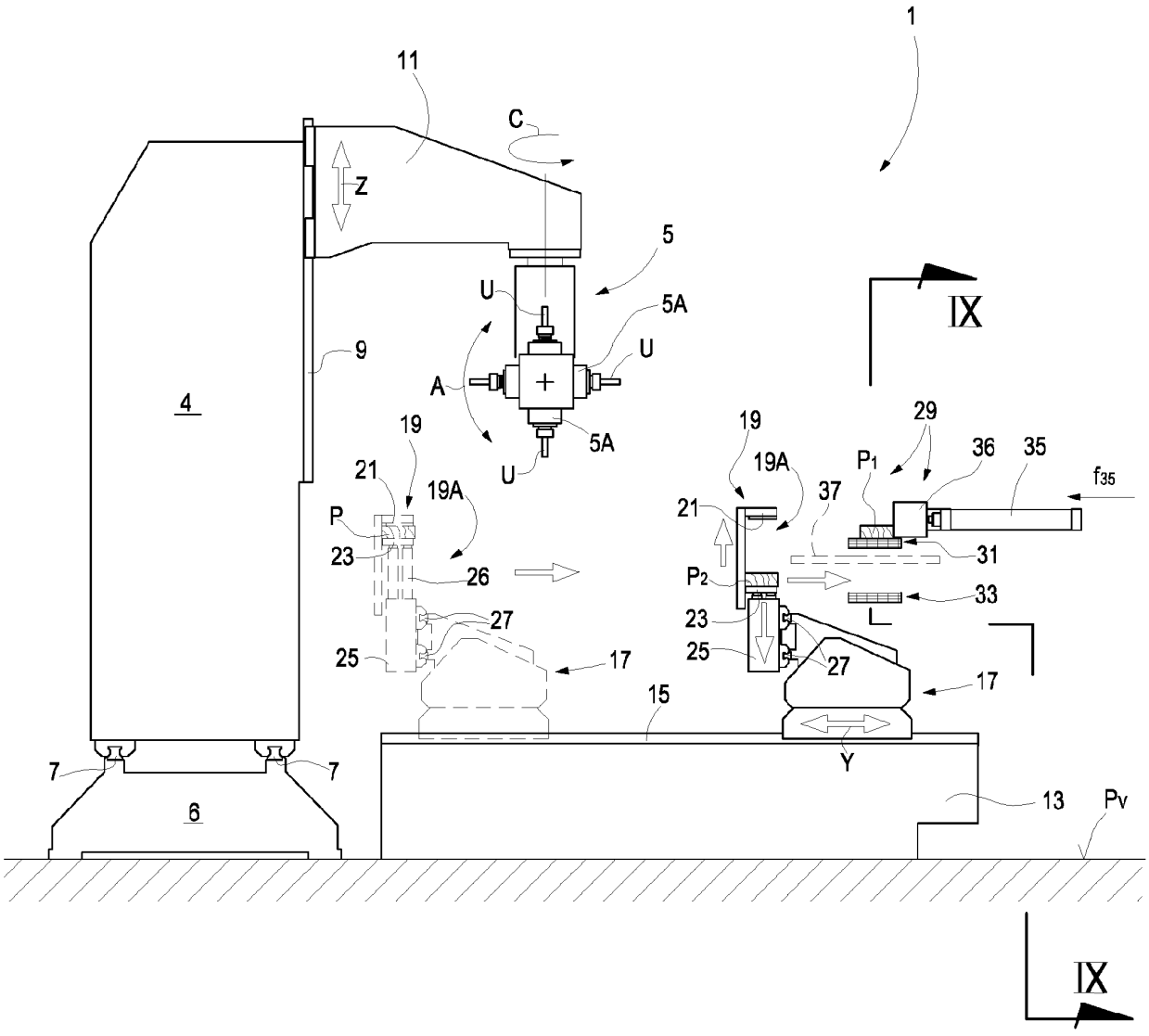
Fig.7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Pv
IX

Fig.8

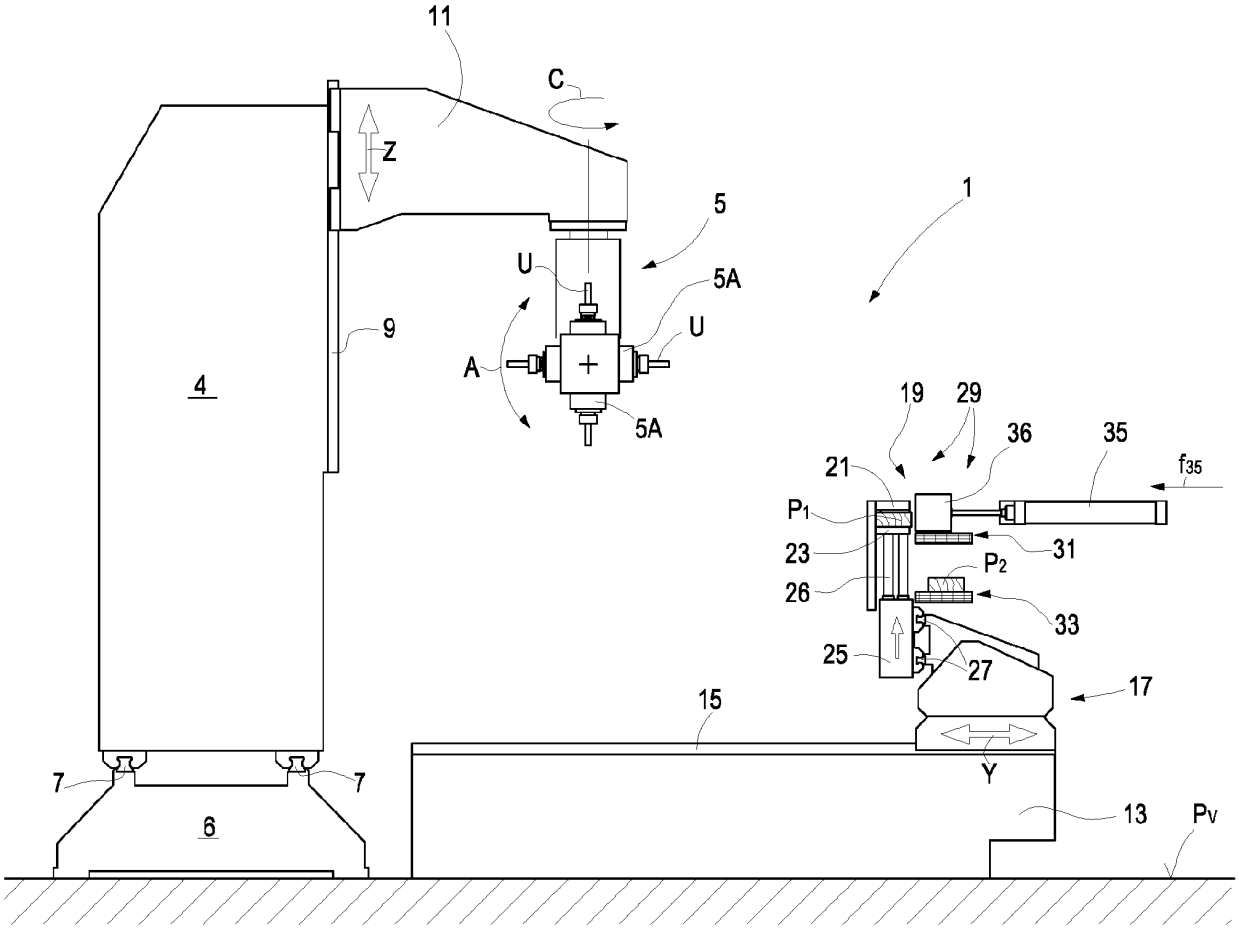
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Fig.9

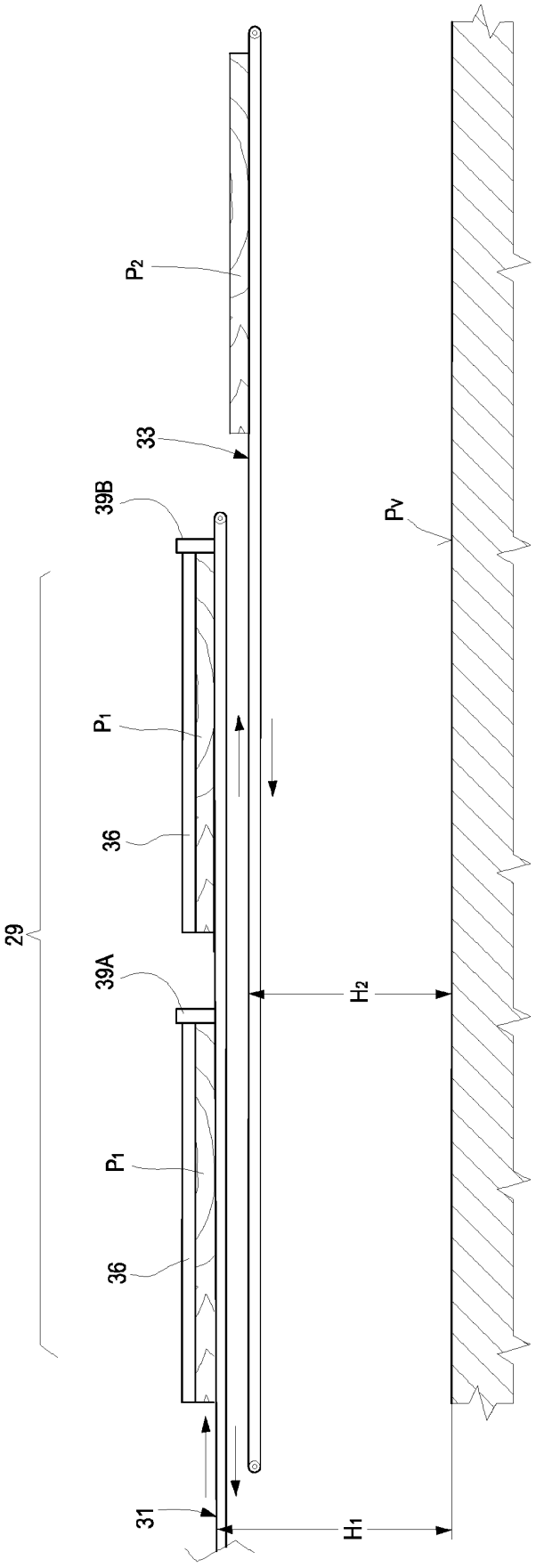
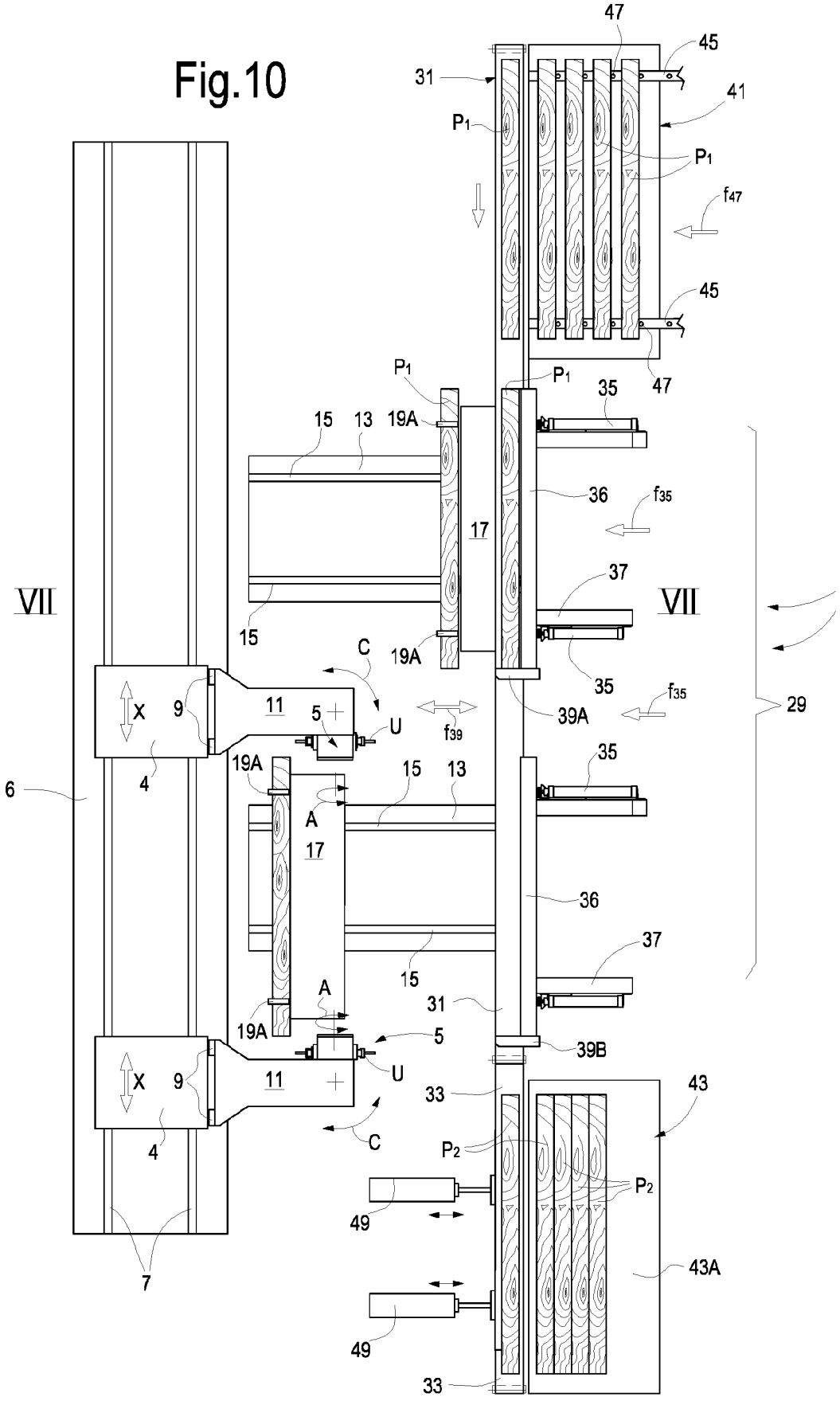


Fig.10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P2
P2
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1719574 A1 **[0001]**
- DE 102011084540 **[0042]**