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(54) NUMERICAL CONTROL APPARATUS FOR AUTOMATED CUTTING OF A SHEET OF MATERIAL OR OF MULTIPLE SUPERIMPOSED SHEETS

(57) Numerical control apparatus (1) for automated cutting of a sheet (2) of material or of multiple superimposed sheets (2), comprising:
- a cutting chamber (3) equipped with an inlet (4) and an outlet (5), said cutting chamber (3) being configured to house at least one portion of the sheet (2) lying on a plane (α);
- cutting means (80) active within said cutting chamber (3) to perform the cutting of said sheet (2) according to a predefined pattern;
- conveying means (6) adapted to feed the sheet (2) into said cutting chamber (3) in a forward direction (A) along a longitudinal direction (Y);
- holding or retaining means (10; 115) active on said sheet (2) in a combined manner with said conveying means (6) to ensure the stability of said sheet during the cutting operation of said cutting means (80);
- a control unit (U) configured to control said apparatus (1);
- wherein said material may be indifferently a hide, a fabric or a synthetic material, and may be fed as a single sheet (2) or as a multilayer of sheets (2), without modifying said forward direction (A).

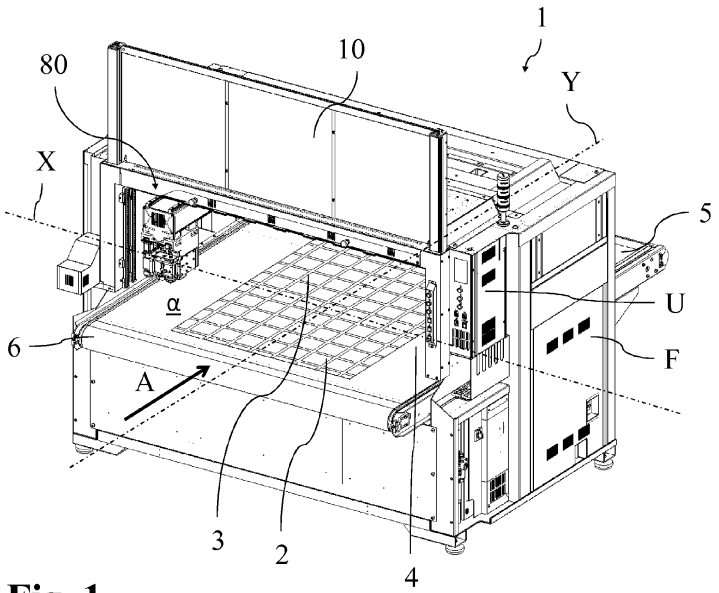

Fig. 1

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Description

Field of application

[0001] The present invention relates to an apparatus for cutting sheet material, for instance for cutting fabrics for clothing and hide goods, footwear items, automotive and furnishing articles, or non-woven fabrics, leather, synthetic materials and the like, and the following description is made with reference to this application field with the only purpose of simplifying the exposition thereof.

Prior art

[0002] As it is well known in this technical field, there are apparatuses capable of performing the automated cutting of sheet material according to a predefined cutting pattern.

[0003] By the way, the types of material in sheets to be cut are the most varied, even remaining in the same industrial field. For example, the clothing, accessory and footwear industries use for example multiple materials such as leather, non-woven fabrics and synthetic materials. These materials, while having evident differences in their manufacture and consistency, nevertheless have the common denominator of appearing in sheets and being subjected to cutting operations.

[0004] To date, the numerical control cutting machines have mostly been dedicated to a single material or to a single class of materials, for instance: hides, fabrics.

[0005] Despite the need for a single machine capable of working on different sheets of material, for obvious reasons of production flexibility, the few apparatuses of this type currently on the market have drawbacks linked to an excessive technical complexity and to the reconversion times of the machine in the passage from one processing to another; for instance, some apparatuses work in opposite directions depending on the type of material to be cut.

[0006] The technical problem of the present invention is to provide an apparatus for cutting sheets of material having structural and functional features so as to allow overcoming the above-mentioned limitations, i.e. that it is versatile and allows cutting materials of different types with limited or no machine reconfiguration operations.

Summary of the invention

[0007] The above technical problem is solved by a numerical control apparatus for the automated cutting of a sheet material or a multilayer of superimposed sheets, comprising:

- a cutting chamber provided with an inlet and an outlet, said cutting chamber being configured to house at least one portion of the sheet lying on a plane;
- cutting means that are active within said cutting chamber to perform the cutting of said sheet according to a predefined pattern;
- conveying means adapted to feed the sheet into said cutting chamber in a forward direction along a longitudinal direction;
- holding or retaining means that are active on said sheet in a combined manner with said conveying means to ensure the stability of said sheet during the cutting operations of said cutting means;
- a control unit configured for the control of said apparatus;
- wherein said material may be indifferently a hide, a fabric or a synthetic material and may be fed as a single sheet or a multilayer of sheets, without modifying said forward direction.

[0008] The apparatus may further comprise a crosspiece which is above said cutting chamber, said cutting means comprising one or more cutting heads supported by said crosspiece; and an artificial vision system intended to acquire an image of the sheet to plan the cutting operations thereon; said artificial vision system comprising at least one image acquisition device inserted in said cutting chamber and associated with said crosspiece.

[0009] The above proposed expedient thus uses a load-bearing crosspiece which, beside supporting the entire cutting assembly, becomes an ideal support for the image acquisition devices inside the cutting chamber. Advantageously, the image acquisition device may be housed in an area inside said crosspiece, said crosspiece comprising at least one visual access opening to said cutting chamber by said image acquisition device.

[0010] In particular, the crosspiece may be conveniently made of a metal profile, per se hollow, in which suitable holes are formed to position the image acquisition devices.

[0011] The positioning of the image acquisition devices inside the crosspiece is due to the fact that the below cutting means, although moving below the crosspiece in the working configuration itself and inevitably hindering a line of sight between the internal image acquisition device and a cutting room, may be brought back to a rest configuration in which said line of sight is not obstructed.

[0012] In particular, said cutting means may comprise at least one upper carriage supported by said crosspiece and movable with respect thereto according to a transversal direction that is orthogonal to the forward direction.

[0013] The upper carriages are preferably two, associated with as many cutting heads, but may also be higher in number depending on the specific processing needs of the apparatuses.

[0014] In the rest configuration, the upper carriage may move to a lateral stroke-end position, transversely offset from said at least one internal image acquisition device. In the preferred case of two upper carriages, the rest configuration may advantageously provide for them to be placed in the two opposite transversal stroke-end positions, i.e. at the two sides of the cutting chamber, leav-

ing free visual access to the sheet conveyed into the apparatus.

[0015] For the motion transmission to said upper carriage a screw/nut screw system comprising a transversal screw arranged below said crosspiece may be advantageously provided. In this case, to avoid interferences, the transversal screw may be suitably offset from the line of sight of the image acquisition device, along the longitudinal direction.

[0016] Preferably, the internal image acquisition devices are more than two, for instance five, aligned along the transversal direction.

[0017] The artificial vision system may further comprise at least one upstream image acquisition device, placed upstream of said cutting chamber, for instance associated with the upper part of a previous portion of the cutting chamber.

[0018] The upstream devices are preferably a plurality, in a number and configuration equal to the internal image acquisition devices.

[0019] The various image acquisition devices are thus advantageously arranged as a grid or a matrix and may thus cover a rectangular surface that spaces and substantially corresponds to the perimetrical dimension of the cutting chamber.

[0020] It should be noted that the upstream devices may cooperate with the downstream devices to obtain a detailed and complete image of the below sheet to be cut; anyway, an advantageous independent use thereof is not excluded, for instance to perform an image acquisition during cutting operations which interfere with the vision field of the internal devices.

[0021] The image acquisition devices, be they internal or upstream, may be a camera or video camera of the digital type, for instance of the CCD type. Moreover, they may incorporate a processor adapted to process an image data file in a format processable by a control unit of the apparatus.

[0022] As previously mentioned, the above upper carriages may be at least two and may support two respective cutting heads. In this way, each upper carriage is mounted on at least two sliding blocks which are sliding with respect to two respective guides that are integral with the crosspiece. The sliding blocks abut, along the transversal direction, with respect to the rest of the upper carriage. The two guides for the sliding blocks of the first upper carriage and the two guides for the sliding blocks of the second upper carriage are however distinct, so that the sliding blocks of the two upper carriages may overlap transversally in a position in which they are side by side with said upper carriages.

[0023] Thanks to this expedient, in the side-by-side position the transversal overall dimensions due to the sliding blocks interpenetrate, and the two cutting heads can be brought closer to each other up to a contact position.

[0024] The above mentioned four guides may be two horizontal guides, associated with a lower face of said crosspiece, and two vertical guides, associated with opposite side faces of said crosspiece, each upper carriage comprising a horizontal sliding block engaged with a vertical guide and a vertical sliding block engaged with a vertical guide.

[0025] The four guides are parallel and successive with each other along a longitudinal direction and are preferably engaged alternately with the sliding blocks of one and the other upper carriages.

[0026] The apparatus may advantageously comprise with an accessory device to facilitate the feeding of the sheets towards the conveying means of the machine, said accessory device comprising a support plane equipped with at least one crosspiece holding element for holding at least one sheet or a multilayer of said sheets, said plane being actuated by motorized means which mutually approach and/or move away with respect to the conveyor belt.

[0027] Advantageously said accessory device may be independent with respect to the rest of the apparatus, since it may be demounted therefrom to modify the production.

[0028] The movable plane may be angularly and retractably displaceable in a rest position below said conveyor belt, still with the purpose of facilitating a quick exchange of material to be processed.

[0029] Said plane may be movably guided on support guides from a rest position, in which it is vertically extended close to a lower frontal portion of the machine, to an operating position in which it is horizontally extended.

[0030] The apparatus may further comprise a coating film roll adapted to coat and hold the sheet on said conveying means; and a support of said coating film roll, said support being configured to move with respect to the conveying means in a direction parallel to the forward direction. The coating film roll may be advantageously mounted on said support plane, movable in translation and possibly foldable in the non-operating configuration.

[0031] The coating film roll may be associated with the support so as to be unwound and to coat a surface of the sheet when said support moves in a direction opposite said forward direction of the sheet.

[0032] The apparatus may still advantageously comprise at least one closure element at the inlet and/or outlet of said cutting chamber, said closure element being movable between an open position, in which at least one portion of the closure element is at a first distance with respect to the plane, and a closed position in which said at least one portion of the closure element is at a second distance with respect to said plane, said second distance being less than said first distance, said distances being measured along a direction that is substantially orthogonal to the plane wherein the sheet lies.

[0033] Said closure element, in addition to an anti-noise screen function, may advantageously have an auxiliary holding function for the sheets of material to be cut.

[0034] The features and advantages of the apparatus according to the invention will become apparent from the following description of an embodiment thereof, given by

way of non-limiting example with reference to the accompanying drawings.

Brief description of the drawings

[0035] In those drawings:

- figure 1 shows a perspective view of an apparatus according to the present invention, wherein a closure element is in the open position;
- figure 2 shows a section of a portion's detail of the cutting chamber of the apparatus of figure 1;
- figure 3 shows a perspective view of the apparatus of figure 1, wherein the closure element is in the closed position;
- figures 4-6 show a perspective view of an apparatus according to an embodiment of the present invention in different operating configurations;
- figure 7 shows a perspective view of the apparatus according to the present invention in a non-operating position, with the closure element removed so as to allow viewing the cutting chamber;
- figure 8 shows a view of the apparatus of figure 7 in an operating configuration, still with the closure element removed;
- figures 9 and 10 show a perspective view of an apparatus according to an embodiment of the present invention in two different operating configurations, with the closure element removed;
- figure 11 shows a perspective view of the apparatus of figure 9 in a non-operating configuration, with the closure element in the open position;
- figures 12 and 13 show respective perspective and detail views of the apparatus according to the present invention in two different operating conditions;
- figure 14 shows a perspective view of an apparatus according to the present invention, sectioned along a longitudinal plane thereof;
- figure 15 shows a sectional side view of the apparatus of figure 14;
- figure 16 shows an enlarged detail of figure 15, relating to a crosspiece of the apparatus and to a carriage associated therewith;
- figure 17 shows a perspective view of two movable carriages of the apparatus of figure 1, in a first relative configuration;
- figure 18 shows a top view of the two movable carriages in the configuration of figure 17;
- figure 19 shows a perspective view of the two movable carriages of figure 17, in a second relative configuration;
- figure 20 shows a top view of the two movable carriages in the configuration of figure 17;
- figure 21 shows a perspective view of the two movable carriages of figure 17, with an alternative mounting of the lower carriage which supports the cutting head.

Detailed description

[0036] With reference to those figures, and in particular to figure 1, an apparatus according to the present invention is globally and schematically indicated with the reference number 1.

[0037] It is worth noting that the figures represent schematic views, their shape varying depending on the application desired. It is also noted that in the figures the same reference numbers refer to elements that are identical in shape or function.

[0038] The positional references used in the present description, comprising indications such as lower or upper, below or above, or similar expressions, are always referred to the operating configuration represented for instance in figure 1, and in no case must they be assigned a limiting value.

[0039] To facilitate the following description of the apparatus 1, three orthogonal directions corresponding to the three working axes of the cutting heads 8a; 8b of the machine are moreover identified: a transversal direction X; a longitudinal direction Y - parallel to the forward direction of the sheet 2 within the apparatus 1; finally, a vertical direction Z.

[0040] In its most general form, the apparatus 1 is adapted to process, and in particular is adapted to automatically cut, foldable or flexible sheets 2 of material, for instance fabrics for clothing and hide goods, footwear items, automotive and furnishing articles, or non-woven fabrics, leather, synthetic materials and the like.

[0041] In the context of the present invention, the term "sheet" indicates any element of any shape and material, having a substantially two-dimensional size and a certain thickness (generally reduced), which must be cut through the apparatus 1. As it will be noticed hereinafter in greater detail, often the cutting of a plurality of sheets stacked on top of each other is performed.

[0042] The apparatus 1 is a numerical control machine equipped with data and program memories. In particular, the apparatus 1 comprises a control unit U including said memories and suitably programmed and responsible for the management and automatic control thereof. The control unit U may be for instance an integrated computerized unit or may be external to the apparatus 1 and operatively connected thereto. Furthermore, the control unit U may be a unique central unit or may comprise a plurality of local units.

[0043] In general, as for instance illustrated in figure 1, the apparatus 1 of the present invention comprises a frame F, made for example of a metallic material, which supports and encloses its main components.

[0044] More particularly, said frame F comprises a bed 25 above which two flanks 26 and a covering 27 rise; these enclose a cutting chamber or working room 3 inside which a cutting room C of the sheet 2 is located. The cutting chamber 3 extends in the longitudinal direction Y between an inlet 4, through which the sheet 2 is fed, and an outlet 5, from which the cut portions of said sheet 2

are recovered 2.

[0045] When the sheet 2 is loaded in the apparatus 1, at least one portion thereof is housed in the cutting chamber 3, said sheet lying on a plane α.

[0046] The frame F further defines a raised position 28 of the cutting chamber 3, placed at the inlet 4. In the present description and in the enclosed claims the cutting chamber 3 must be considered as that area or that area portion within which the successively defined cutting means evolve. In the present embodiment, the cutting heads 8a; 8b may displace and work in the entire cutting chamber 3, including the raised portion 28.

[0047] Furthermore, the apparatus 1 comprises a conveyor belt 6 which crosses the cutting chamber 3 from the inlet 4 to the outlet 5 and is adapted to feed the sheet 2 into said cutting chamber 3. The conveyor belt 6 is covered by a sacrificial and breathable support layer (not shown in the figures), which is subjected to multiple cutting steps during various processing and which is periodically replaced. Below the support layer, conventional suction means are provided (also not illustrated in the figures), which allow holding the sheet 2 in place on the conveyor belt 6 during the forward movement.

[0048] The forward direction del sheet 2 on the conveyor belt 6 towards the cutting chamber 3 occurs in the longitudinal direction Y, in particular in the direction indicated by the arrow A.

[0049] Inside the cutting chamber 3 cutting means 80 for cutting the sheet 2 are operating, said means not being limited to a particular type. By way of example, the cutting may occur through a blade, laser, water jet or in any other suitable way, even if cutting through a blade is the preferred option.

[0050] In particular, the cutting means 80 comprise two cutting heads 8a; 8b, which are movable inside the cutting chamber 3 according to the axes defined by the above transversal, longitudinal and vertical directions X, Y and Z and specifically responsible for cutting the sheet 2. The number of the cutting heads may vary according to the specific processing needs of the apparatus.

[0051] It is noted that the above mentioned frame F comprises a fixed portal having a load-bearing function, around which a non-load-bearing part, which defines the casing of the cutting chamber 3, develops. The fixed portal comprises two side shoulders and an upper crosspiece 18, which connects the two shoulders in the transversal direction X and is above the cutting chamber 3.

[0052] The two cutting heads 8a; 8b are therefore suspended to said crosspiece 18, with interposition of a kinematic structure necessary for their displacement along the three Cartesian axes.

[0053] The two cutting heads 8a; 8b and the respective kinematic structures which support them are substantially identical and differ from each other just in the relative position - on the right side and on the left side, respectively - in which they are attached to the crosspiece 18.

[0054] It is noted that the same elements, relating to the first and second kinematic structures, are consistently identified in this document with the adjective 'first or 'second', and take a final 'a' or 'b' respectively in their numerical reference.

[0055] In the following description, where a term is generally referred to the first or second kinematic structures, the ordinal adjective is omitted and both numerical references relating to the first and second structures are reported.

[0056] The kinematic structure thus comprises, for each cutting head 8a; 8b: an upper carriage 19a; 19b associated below the crosspiece 18 and translatable with respect thereto along a transversal direction X; an arm 22a; 22b associated below the upper carriage 19a; 19b and translatable with respect thereto along a longitudinal direction Y; and a lower carriage 29a; 29b translatable below the arm 22a; 22b along the longitudinal extension thereof (i.e., once again in the longitudinal direction Y). The cutting head 8a; 8b is supported by the lower carriage 29a; 29b, which acts as a support shelf and may be translated with respect thereto along the vertical axis Z.

[0057] The motion transmission to the different elements above described may occur in any known way; in the preferred embodiment herein described, screw and nut screw systems with or without ball recirculation are used, as it will become apparent from the following detailed description. The upper carriage 19a; 19b comprises a base 30a; 30b, on which a rotary nut is arranged 32a; 32b, which receives the motion, by belt drive, from an electric motor 31a; 31b side by side thereto. The rotary nut 32a; 32b engages above a transversal screw 33 which connects the two shoulders of the cutting chamber 3 and which runs below the crosspiece 18.

[0058] It is noted that the transversal screw 33 is arranged in a spaced position with respect to a vertical median plane of the crosspiece 18 (in this case: downstream; but it could also be arranged upstream), for reasons which will become more apparent in the rest of the description. The base 30a; 30b of the upper carriage 19a; 19b is supported by sliding blocks 23a; 23'a; 23b; 23'b which are integral with and arranged at the two side ends of the base 30a; 30b itself. For each upper carriage 19a; 19b two pairs of sliding blocks 23a; 23'a; 23b; 23'b are provided; the sliding blocks of each pair are aligned to each other and mounted at the sides of a single transversal support associated with the base 30a; 30b. The transversal supports develop along the transversal direction X and extend in said direction, from both sides, even beyond the overall dimension of the base 30a; 30b.

[0059] The above sliding blocks 23a; 23'a; 23b; 23'b are arranged to slide engage within respective guides 24a; 24'a; 24b; 24'b that are integral with the crosspiece 18.

[0060] It is worth noting that the first sliding blocks 23a; 23'a and the second sliding blocks 23b; 23'b slide above distinct first guides 24a; 24'a and second guides 24b; 24'b, even if the two upper carriages 19a; 19b move along the same path defined by the crosspiece 18.

[0061] The four guides 24a; 24'a; 24b; 24'b run parallel

along the crosspiece 18, the first guides 24a; 24'a; being alternated with the second guides 24b; 24'b. The first upper carriage 19a is thus associated with the first and third guides, in order of longitudinal position, the second upper carriage 19b is associated with the second and fourth guides.

[0062] The use of different guides 24a; 24'a; 24b; 24'b allows bringing the bases 30a; 30b of the two upper carriages 19a; 19b in the transversal direction X into direct contact: in fact, as visible in the enclosed figures 19 and 20, the first sliding blocks 23a, 23'a may be partially side by side to the second sliding blocks 23b; 23'b, so that the side projections of the two elements do not interfere with each other.

[0063] In particular, in the preferred embodiment herein described, the bases 30a; 30b of the upper carriages 19a; 19b have L-conformations which are specular to each other, with a prevalent horizontal section and a short vertical section directed upwards. The transversal supports whereon the sliding blocks 23a; 23'a; 23b; 23'b are mounted are thus horizontal and vertical, respectively. The sliding blocks 23a; 23b, mounted on the horizontal support are hereinafter defined horizontal sliding blocks 23a; 23b; as for the sliding blocks 23'a; 23'b, mounted on the vertical support, they are herein after defined vertical sliding blocks 23'a; 23'b.

[0064] The guides 24a; 24'a; 24b; 24'b associated with the crosspiece 18 also have two different orientations: two horizontal guides 24a; 24b are mounted parallel below the crosspiece 18, whereas two vertical guides 24'a; 24'b are mounted on the two opposite side faces of the crosspiece 18. The sliding blocks 23a, 23b of each single upper carriage 19a; 19b are associated with a horizontal guide 24a and with the vertical guide 24b respectively on the opposite face of the crosspiece 18.

[0065] In the preferred embodiment herein described, the sliding blocks 23a; 23'a; 23b; 23'b and the guides 24a; 24'a; 24b; 24'b have dovetail female and male profiles respectively.

[0066] The arm 22a; 22b arranged below the upper carriage 19a; 19b has a substantially parallelepiped dimension with prevalent extension along the longitudinal direction Y. It has some upper guides 220 and some lower guides 221 adapted to allow the relative movement both of the upper carriage 19a; 19b - mounted on lower sliding blocks 190 - and of the lower carriage 29 - mounted on upper sliding blocks 290.

[0067] The upper guides 220 and the lower guides 221 are both two in number, and on each guide two sliding blocks, which are aligned to each other, are inserted.

[0068] Both movements are obtained through a recirculating ball screw/nut screw system.

[0069] Power and signal cables connecting the various elements of the kinematic structure are provided, said cables being housed in a drag chain 35 which runs parallel to the arm 22a; 22b and forms, at the two opposite ends, a loop directed to the upper carriage 19a; 19b and a loop directed to the lower carriage 29a; 29b.

[0070] The lower carriage 29a; 29b of the kinematic structure, as previously mentioned, acts as support shelf for the cutting head 8a; 8b. It therefore carries said cutting head in a front or rear position with respect to the longitudinal direction Y.

[0071] Advantageously, to modify the working area of the cutting head 8a; 8b, it is possible to modify the orientation of said lower carriage 29a; 29b; the two alternative configurations are shown in figure 19 and in figure 21.

[0072] The orientation modification occurs by disassembly and subsequent reassembly of the lower carriage 29a; 29b with respect to the arm 22a; 22b.

[0073] The apparatus, in its preferred embodiment herein described, comprises an optional artificial vision system which allows acquiring an image of the surface of the sheet 2 whereon the cutting operations are performed.

[0074] In particular, said artificial vision system comprises a plurality of image acquisition devices 7a, 7b arranged at the top and facing towards the sliding surface of the sheet 2 above the conveyor belt 6.

[0075] Specifically, the image acquisition devices 7a, 7b are cameras or video cameras configured to capture high resolution images of the surface of the sheet 2.

[0076] In the embodiment herein described, the image acquisition devices 7a, 7b are divided into downstream image acquisition devices 7a, arranged in a portion downstream of the cutting chamber 3, and upstream image acquisition devices 7b, arranged in the raised portion 28 of the cutting chamber 3. All of the image acquisition devices face towards the cutting area C.

[0077] The downstream 7a and upwards 7b image acquisition devices cooperate to define a unique detailed image of the surface of the sheet 2.

[0078] The image acquisition devices 7a, 7b are video cameras or cameras of the digital type, for instance CCD, and incorporate therein a processor that transforms and immediately makes an image data file available in a processable format by the control unit, for instance a JPEG format or the like.

[0079] It is noteworthy that the downstream image acquisition devices 7a are advantageously placed in an internal area 20 of the crosspiece 18 that supports the cutting assembly.

[0080] Indeed, as better visible in the detail of figure 16, the crosspiece 18 is at least centrally made of metal profiles, within which the internal area 20, which houses a suitable attachment box 34 for the downstream image acquisition devices 7a, is defined. On the lower face of the profile, which directly faces above the cutting chamber 3, a visual access opening 21 is provided, in the form of a simple drilling of the sheet, which opens a line of sight L from the respective acquisition device to the cutting area C.

[0081] The line of sight L of the downstream image acquisition device 7a is not hindered by the transversal screw 33, which runs downstream thereof. Instead, the upper carriages 19a; 19b of the cutting assembly, which

are sliding movable below the crosspiece 18. However, at least one rest position of the cutting assembly is advantageously provided, for instance with the upper carriages 19a; 19b positioned at the two transversal stroke-end positions respectively, in which the lines of sight L of all of the downstream image acquisition devices 7a are free.

[0082] The downstream image acquisition devices 7a - which, in the preferred embodiment herein described, are five in number - are aligned and distributed equidistant along the crosspiece 18.

[0083] The upstream image acquisition devices 7b are also housed in an area, suitably made from sheet metal above the raised portion 28 of the cutting chamber 3. In the preferred embodiment herein described, the upstream devices 7b are five in number, aligned with each other and in transversal positions corresponding to that of the downstream devices 7a.

[0084] Anyway, for cutting a multilayer it is preferred to use a single video camera that corrects any errors in moving the belt by reading a tachometer band on one side of the conveyor belt 6.

[0085] It is known that the cutting heads 8a; 8b work at frequencies such that the noise of the apparatus 1 during the cutting step is very high, as well as it is known to introduce into the apparatus 1 a plurality of sheets 2 to be cut which are stacked on top of each other. An advantageous feature of the present apparatus, hereinafter described, is therefore inspired by the fact that it would be desirable to easily reduce the noise of the apparatus 1, meanwhile obtaining an improved holding of all the overlapped sheets 2.

[0086] According to an embodiment of the present invention, the inlet 4 and/or the outlet 5 of the cutting chamber 3 comprises a closure element 10, which may be for instance a glass or plexiglass plate or screen connected to the frame F of the apparatus 1, or equipped with its own frame which is in turn connected to the frame F. The following disclosure will mainly relate to a closure element 10 at the inlet 4, although said closure element may also be arranged at the outlet 5, as it will be illustrated hereinafter.

[0087] The closure element 10 arranged at the inlet 4 is movable between a first position or open position, in which the access to the cutting chamber 3 from the inlet 4 is allowed, and a second position or closed position (stroke-end position), in which the access to the cutting chamber 3 is not allowed. In this way, it is possible to equip the apparatus 1 with a movable closure element which approaches or moves away from the plane α in which the sheet 2 lies.

[0088] In particular, in the open position, the closure element 10 is at a first distance with respect to a surface of the sheet 2 to be cut, the first distance being such as to allow the access of the operator's hands into the cutting chamber 3, whereas in the closed position the closure element 10 is at a second distance with respect to the surface of the sheet 2 to be cut, the second distance being less than the first distance. It is noted that, in the context of the present invention, the first and the second distances are measured along a direction which is substantially orthogonal to the longitudinal direction Y. In other words, said distance is measured in a direction which is substantially orthogonal to the plane α in which the sheet 2 of material to be cut housed in the apparatus 1 lies. In general, the plane α is the plane which coincides with the surface of the conveyor belt.

[0089] Still more particularly, in the closed position at least one portion of the closure element 10 is closer to the surface of the sheet 2, and thus to the plane a, compared to when it is in the open position. Preferably, in the closed position all of the points of the closure element 10 are closer to the surface of the sheet 2, and thus to the plane α, compared to when it is in the open position.

[0090] The first distance is generally a fixed distance and may correspond for instance to the complete opening of the cutting chamber 3, whereas, in an embodiment, the second distance is freely selectable by the operator, as it will be described hereinafter.

[0091] In a preferred embodiment of the present invention, in the closed position the closure element abuts onto the surface of the sheet 2, i.e. the second distance is equal to the thickness of the material to be cut (in case the closure element 10 directly abuts onto the plane, this means that the abutting portion of the closure element 10 is at a distance from the plane which is substantially equal to zero). In other words, in this preferred embodiment, in the open position an end portion of the closure element 10 (in particular the lower side according to the local reference of the figures) is at the first distance from the surface of the sheet 2, thus leaving room to access the cutting chamber 3, whereas in the closed position said end portion abuts onto the surface of the sheet 2 (indicated with reference S in the figures), thus exerting a certain pressure thereonto.

[0092] Still more preferably, the closure element 10 is square or rectangular-shaped and abuts onto the surface of the sheet 2 through its lower side. Suitably, the closure element 10 is configured to be automatically kept in the open position when the cutting means 80 are not actuated, and thus when the processing of the sheet 2 does not occur. In this way, the closure element 10 remains raised if the apparatus 1 is off or stopped, as well as it automatically raises once the cutting of the sheet 2 is finished and thus once the cutting means 80 are stopped.

[0093] The closure element 10 is further configured to be automatically kept in the closed position during the actuation of the cutting means 80, and thus during the processing of the sheet 2. In this way, the closure element 10 automatically lowers as soon as the cutting means are operated.

[0094] The above-mentioned automatic opening and closing operations of the closure element 10 according to the operating condition of the cutting means 80 are managed by the above control unit U, which is operatively connected both with the cutting means 80 and with move-

ment means of said closure element 10, as it will be described hereinafter in greater detail.

[0095] Furthermore, the apparatus 1 comprises at least one first detector element arranged at the closure element 10 with the purpose of detecting the operator's presence, in particular the presence of the operator's hands.

[0096] In a preferred embodiment of the present invention, the first detector element comprises an array of photocells capable of detecting the presence of the operator's hand, in particular a pair of arrays of photocells arranged at the opposite sides of the conveyor belt 6 (i.e. opposite with respect to the direction Y), for instance supported by the frame F of the apparatus 1.

[0097] Suitably, the photocells are operatively connected to the control unit, which is programmed to automatically control the opening and closure of the closure element 10 according to the signal coming from said photocells. In particular, once the presence of the operator's hand has been detected, the photocells send a signal to the control unit, which is suitably configured to automatically perform the opening of the closure element 10 in case the operator's presence is detected by the photocells, as well as the closure thereof in case the operator's presence is not detected.

[0098] In this way, the closure element 10 is capable of automatically raising (even during the cutting step) when the operator approaches his hands thereto, and to automatically close when the operator moves his hands away therefrom.

[0099] To this end, the apparatus 1 comprises suitable movement means (for instance an electric motor not illustrated in the figures) adapted to automatically move the closure element 10. The movement means are connected to the control unit U for automatically controlling the movement of the closure element as above illustrated, for instance according to the operating condition of the cutting means 80 or according to the signal of the photocells.

[0100] The movement of the closure element 10 occurs in a direction which is substantially orthogonal to the longitudinal direction Y, preferably in the vertical direction Z, even if other configurations are possible and fall within the scope of the present invention.

[0101] Obviously, the closure element 10 provided in the apparatus 1 could also not be present, the present invention not being limited to the presence of said closure element.

[0102] As previously noticed, the control unit may be a single central unit U or may comprise a central unit and various local units, for instance it may comprise a unit specifically configured to control the movement means of the closure element 10.

[0103] According to an embodiment of the present invention, the apparatus 1 further comprises at least one second detector element (not illustrated in the figures) which is adapted to detect the presence of the operator's hands inside the cutting chamber 3 in order to control the actuation of the cutting means 80. In particular, the second detector element is arranged inside the cutting chamber 3, between the closure element 10 and the cutting means 80, and is operatively connected with the central unit, so that when the closure element 10 is in the open position and the operator inserts his hands into the cutting chamber 3, it detects the presence of the operator's hands and communicates it to the central unit, which is able to stop the cutting means 80. The second detector element, which also comprises an array of photocells, is thus provided to ensure the maximum safety of the operators that use the apparatus 1, thus preventing them from cutting themselves during the processing of the sheet 2.

[0104] Clearly, the skilled person well understands that the second detector element could also not be there; in this case, the photocells ensure the operator's safety, i.e. besides causing the closure element 10 to raise, they also cause the interruption of the operation of the cutting means. As previously mentioned, in an embodiment of the present invention, in the closed position, the second distance of the closure element 10 with respect to the surface of the sheet 2 is manually selectable through selection means and may also be greater than zero with respect to the surface of the sheet. The selection means may comprise for instance a common button arranged in any position in the apparatus 1, said button allowing adjusting at will the distance between the closure element 10 and the sheet 2. In this case, the closure element 10 only acts as an anti-noise screen.

[0105] The embodiment of figure 3, wherein the closure element 10 abuts onto the sheet 2, is preferable since, besides reducing the noise, said sheet 2 also exerts a pressure onto the material thus reducing the possibility for said material (especially when it is a multilayer) to move during the cutting step.

[0106] Furthermore, in an embodiment of the present invention, illustrated in figures 4-11, in order to feed and suitably arrange the sheet 2 onto the conveyor belt 6, the apparatus 1 also comprises an accessory device 113 provided with feeding means for said sheet 2.

[0107] Preferably, said accessory device 113 is removably associated with the apparatus 1.

[0108] The accessory device 113 comprises a movable element or plane 114, which is supported in the operating position close to a proximal end 213 of the conveyor belt 6 through a suitable support structure F' connected to a lower frontal portion 120 of the frame F of the apparatus 1.

[0109] The movable plane 114 is substantially a rectangular plate-like support, on which surface the sheet 2 to be loaded onto the conveyor belt 6 is arranged. An edge 119 is optionally provided on only one side of the movable plane 114 to facilitate the alignment of the sheet 2.

[0110] The movable plane 114 is movably guided on support guides 124 from a rest position, in which it is vertically extended close to the above lower frontal por-

tion 120, to an operating position in which it is horizontally extended. Support motorized means 123 for said movable plane 114 for actuating said plane are provided between the two extreme positions.

[0111] Said motorized means 123 are electric stepper motors which are adjustable with particular precision and interlocked to the control unit U of the apparatus 1.

[0112] Said motorized means 123, and the respective support guides 124, are structured to actuate the movable plane 114 in roto-translation starting from a laying rest position and to make it take up an operating position in which it is partially above the proximal end 213 of the conveyor belt 6. In the rest position the plane 114 is folded away parallel to the lower frontal portion 120 of the frame F.

[0113] In combination or alternatively, the accessory device 113 may comprise a motor 116 which is configured to move worm screws, which are responsible for the movement of the movable plane 114. More particularly, through a system of screws and gears, a pair of worm screws 116' (or the respective nuts), which a pair of sliding blocks is associated with, is moved. The movable plane 114 is thus connected to the pair of sliding blocks and the rotation of the worm screws 114 sets in motion said sliding blocks (and thus the movable plane itself).

[0114] The motorized plane 114 is configured to facilitate the feeding of a sheet 2 to be processed on the conveyor belt 6, said movable plane 114 being movably and mutually guided towards and away from the proximal end 213 of the conveyor belt 6.

[0115] Still more particularly, the movable plane 114 is moved in horizontal translation in a direction parallel to the movement direction of the conveyor belt 6 (i.e. the direction Y) and is particularly movably guided between a backward or retracted position, visible for instance in figure 9, in which it is spaced apart from the proximal end 213 of the conveyor belt 6, and a feeding position, visible for instance in figure 10, in which it is partially overlapped to said proximal end 213 of the conveyor belt 6. A separation interspace or port is defined between a greater side of the movable plane 114 and the proximal end 213 of the belt 6 when the movable plane is in the backward position.

[0116] Instead, when it is in the feeding position, a distal portion of the movable plane 114 is capable of partially overlapping the conveyor belt 6, for instance by a section of some tens of centimeters, so as to easily feed the sheet 2 by placing the free end of the sheet 2 onto said conveyor belt 6.

[0117] During the horizontal translation movement of the movable plane 114, the sheet material to be processed or cut is held by a clamp or holding element 15 associated with the movable plane 114.

[0118] In an embodiment, the holding element 115 is a crosspiece which is above the movable plane 114 and is movably guided along an axis that is substantially orthogonal to the arrangement or sliding direction of said movable plane 114 (i.e. substantially orthogonal to the direction Y). We may say that the crosspiece 115 is angularly moved by a pneumatic actuator 129 and is capable of raising and lowering, abutting against the material arranged on said movable plane 114, as it is well shown in figures 12 and 13.

[0119] More generally, the crosspiece 115 is movably and mutually guided away from and towards with respect to the surface of the movable plane 114, regardless of whether or not it is extended horizontally. Therefore, the previously used expression raising and lowering is to be referred to the arrangement or extension of the surface of the movable plane 114 whatever its spatial arrangement.

[0120] More particularly, the movable plane 114 and the crosspiece 115 are integral while the plane 114 moves forward; a pneumatic actuator 129 keeps them joined. Therefore, when the plane 114 moves, the crosspiece 115 also moves. However, it is possible to release the crosspiece 115 from the plane 114 by deactivating the pneumatic actuator 129. When the plane 114 is completely backward, although in the horizontal operating position, it could be convenient to release the crosspiece 115 and manually push it forward in order to have the plane 114 completely free. The sheet 2, or multilayer of sheets, is placed onto the plane 114, the crosspiece is set backward (even manually) and it couples again to the plane through the actuator. This operation is optional and useful to facilitate the loading of a new sheet without having to put it under the crosspiece.

[0121] When it abuts onto the movable plane 114 and the multilayered sheet lying thereon, the crosspiece 115 exerts a pressure, realizing in this way the desired holding of the material during the movement of the movable plane 114, i.e. while feeding the sheet.

[0122] Alternatively, in another embodiment, the crosspiece 115 is fixed at a prefixed distance from the plane 114 and comprises a plurality of presser elements, for instance five or six, housed for instance in respective perforated seats obtained in the crosspiece 115.

[0123] The pressers are for instance pistons which are movably guided in the above seats and configured to abut onto the surface S of the sheet 2 with the purpose of holding the material adhering on the movable plane 114 in the initial step when it approaches the proximal end 213 of the belt 6. The number of pressers may vary depending on the needs and/or circumstances, for example, in one embodiment, five pistons are distributed in equidistant positions along the crosspiece.

[0124] Furthermore, in an embodiment, the crosspiece 115 may not be integral with the movable plane 114 and thus may be idle, said crosspiece 115 being moved by the plane when it holds the material to be cut, or it may be connected to the plane 114 when it holds the material to be cut. In other words, in this embodiment, the crosspiece is fastened to the movable plane 114 just through the pressure exerted on said plane, for instance through the above mentioned pistons. The idle crosspiece 115

may be connected to the plane also through suitable connection elements (such as for instance suitably arranged pistons). In this embodiment, the crosspiece 115 is thus not motorized and is hand moved by the operator, said crosspiece being connected to sliding blocks which are sliding in the support structure F'; the operator pushes the crosspiece 115 towards the conveyor belt 6 to place a new sheet onto the movable plane 114; afterwards it is brought to the initial position and may be fastened to the movable plane with tow side pistons. When the pistons are activated, the movable plane 114 and the crosspiece 115 are thus integral with each other.

[0125] Furthermore, the accessory device 9 comprises a motor 116 configured to move a kinematic mechanism 128 having worm screws, which are responsible for the translation movement of the movable plane 114. More particularly, through this kinematic mechanism 128 having screws and gears, a pair of worm screws 126, which a pair of sliding blocks 127 is connected to, is moved. The movable plane 114 is connected to the pair of sliding blocks 127 and the rotation of the worm screws 126 actuates in translation the sliding blocks 127 and, as a result, the movable plane itself in the direction Y.

[0126] Thanks to the presence of the accessory device 113, the sheet 2 may be positioned on the conveyor belt 6 in a simple and effective manner. In fact, the movable plane 114 is substantially cantilever supported outside the machine 1 and makes it easy for the operator to prepare the new sheet to be loaded. Furthermore, it also facilitates the alignment of the various layers of sheets 2 with each other and their alignment with respect to the movement of the conveyor belt.

[0127] The crosspiece holding element 115 further allows effectively holding the sheet to be fed while approaching the proximal end 213 of the conveyor belt 6.

[0128] Once the movable plane 114 overlaps the conveyor belt 6 in the feeding position, the crosspiece 115, or the pistons 128 associated therewith, is raised, eliminating the pressure exerted onto the movable plane 114 and onto the sheet 2.

[0129] The advantage of using the above feeding system is that the sheet loading is independent from their cutting.

[0130] As previously mentioned, the support structure F' of the movable plane 14 is rotatably coupled to the apparatus 1 (for instance it is hinged thereto), so as to form a flap. Specifically, when the movable plane 114 is in the retracted position, its frame structure F' is capable of rotating between a first position, in which the movable plane 114 is substantially parallel to the conveyor belt 6 (position in which the movable plane may slide towards the conveyor belt, as illustrated for instance in figures 9 and 10), and a second position, in which the movable plane is substantially orthogonal to the conveyor belt 6 and does not represent an obstruction for the operator (as illustrated in figure 11, in which the movable plane is in a lowered position).

[0131] Thanks to the presence of the accessory device 113, the sheet 2 may be positioned on the conveyor belt 6 in a simple and effective manner. In fact, the movable plane 114 is substantially cantilever supported outside the apparatus 1 and makes it easy for the operator to prepare the new sheet to be loaded. Moreover, it also facilitates the alignment of the various layers with each other and their alignment with respect to the movement of the conveyor belt 6. The crosspiece 115 also allows effectively holding the sheet 2 during the feeding step.

[0132] Once the movable plane 114 overlaps the conveyor belt 6 in the feeding position, the holding element 115 (or the pistons therewith associated) raises eliminating the pressure exerted onto the plane 114.

[0133] In an embodiment of the present invention, the closure element 10 cooperates with the accessory device 113, holding the sheet 2 while the movable plane 114 draws back. In other words, as soon as the closure element 10 presses onto the sheet 2, the pressure of the holding element 115 is released and the movable plane 114 draws back, the sheet 2 being in fact suitably held by said closure element 10, so as to be suitably loaded on the conveyor belt. In other words, the closure element 10 acts as a fixed holding element.

[0134] In an embodiment, suitably, the movable plane 114 has indentations 21 at the end thereof which faces towards the conveyor belt 6, to allow a better holding of the fed sheet. Thus, the closure element 10 comprises, at the end of the portion thereof which faces towards the sheet 2 (i.e. the side abutting onto the sheet 2), some projections corresponding to the indentations 121 of the movable plane 114, so as to press the material onto the conveyor belt 6 without pressing onto the movable plane 114, which may thus draw back without any problem. Alternatively, the holding of the sheet 2 may not be performed by the closure element 10 but by a further holding element which is fixed to the frame of the apparatus 1, which can also be provided with suitable pistons for holding the material, said pistons may be arranged at the indentations 121. However, it is noted that the particular holding mode of the sheet 2 may vary according to the needs and/or circumstances. Suitably, the above movements of the holding element 113 may occur in a completely automated manner and may be managed by the central unit U.

[0135] Guides which facilitate the alignment of the sheet 2 are also provided along the movable plane 114.

[0136] Generally, to entirely cut the sheet 2 the conveyor belt 6 is moved more than once (for instance, for synthetic materials there may be sheets that are even 50 m long). As a result, in case of particularly long sheets 2, even the movable plane 114 is made to slide several times away from and towards the conveyor belt 6.

[0137] Suitably, the movement of the movable plane 114 is controlled in an automated manner by the central unit U and, in an embodiment, it is synchronized with that of the conveyor belt 6.

[0138] The intervention of the holding element 10 (or of further fixed holding means) as a holding presser for

the material is particularly useful when the frontal part of a new sheet 2 is inserted. In the successive movements of the conveyor belt 6, the sheet 2 is very much overlapped to the conveyor belt 6 and therefore the usefulness of the movable plane 114 and of the fixed holding element is less.

[0139] As above anticipated, when a sheet 2 has been loaded on the conveyor belt 6, the movable plane 114 moves away from the conveyor belt 6 leaving a gap, where the remaining portion of the loaded sheet may be dropped. As a result, it is not necessary to wait for the processing of the previous sheet to be ended, in order to have a free portion of the movable plane 114, thus optimizing the entire process.

[0140] The possibility to provide a foldable system as the one above described allows reducing the overall dimensions of the movable plane 114, at the same time keeping it fastened to the apparatus 1, thus resulting in an effective and compact system. In fact, when the movable plane 114 is in the folded position, the crosspiece 115 as well is in the folded position and does not entail any obstruction for the operator. This is particularly useful since, for some materials, the use of the movable plane 114 may not be needed, so as to obtain a particularly versatile machine. Furthermore, it is noted that the rotating movement of the support structure F' of the feeding means 113 may be automatic or manual. Still more advantageously, in order to ensure the correct holding of the sheets 2 while being cut, the apparatus 1 comprises means for applying a coating film 117 adapted to coat the sheet 2 of material to be cut on the conveyor belt 6.

[0141] By way of example, the coating film 117 may be a film of cellophane, or a film made of plastic materials like cartene, or in general any film adapted to cover the sheets of material to be cut.

[0142] It is further noted that, in the context of the present invention, the term "film" indicates any sheet or thin layer of plastic material adapted to coat a sheet of material to be cut, as known in the state of the art.

[0143] In particular, the coating film 117 is wound so as to form a roll (still indicated herein with reference number 117). The reference number 117 thus indicates both a portion of coating film arranged on the sheet 2 and the coating film roll still to be applied.

[0144] In an embodiment of the present invention, the coating film roll 17 is supported by a support, which is associated (connected) with the accessory device 113. The support of the roll may include a tubular element around which the roll is arranged.

[0145] In particular, the coating film roll 117 is connected to the holding element 115 of the accessory device 113 (for instance connected to the same support with which the crosspiece is connected to the support structure F') and is configured to move integrally thereto.

[0146] Alternatively, the coating film roll 117 is directly connected to the movable plane 114, for instance connected to the sliding blocks which cause the movement of the movable plane 114, and is configured to move integrally thereto, and thus the support thereof is not connected to the holding element 115.

[0147] However, it is noted that the particular connection mode of the roll may vary according to the needs and/or circumstances.

[0148] Suitably, the coating film roll 117 is associated with the accessory device 113 so that the unwinding thereof occurs when the movable plane 114 moves away from the conveyor belt 6. In this way, while the movable plane 114 (and thus the coating film roll 117) moves away from the conveyor belt 6, said roll is unwound, coating at least one portion of the surface S of the sheet 2 of material to be cut.

[0149] In other words, the unwinding direction of the roll 117 is opposite the forward direction of the sheet 2 on the conveyor belt 6.

[0150] Compared to the known solutions, the roll is not fixed but is movable and unwinds in an opposite direction. When the movable plane 114 (and thus the sheet 2 of material arranged thereon) moves forward, the roll 117 is fixed with respect to the movable plane 114 and moves forward therewith without unwinding. When the movable plane 114 draws back, the roll 117, lying on the sheet 2, unwinds without being pulled, causing a particularly easy coating of the sheet 2. The weight of the roll itself and the suction of the suction means below the conveyor belt further facilitate the application of the coating film.

[0151] This is particularly advantageous especially at the beginning of the loading of a new sheet 2, further preventing the coating film 117 from moving.

[0152] According to an embodiment of the present invention, the apparatus 1 further comprises movement means adapted to move the coating film roll 117 away from and towards the surface S of the sheet 2, in particular with respect to a plane α whereon the sheet 2 lies. More particularly, said movement means are configured to move the coating film roll 117 from a first position, in which it is spaced from the surface of the sheet 2 (for instance by some centimeters) and a second direction, in which it lies on the surface S of the sheet 2 and is ready to coat said sheet, said movement occurring in particular in a direction that is substantially orthogonal to the movable plane 114. Said movement means contribute in limiting the overall dimensions of the roll.

[0153] In a preferred embodiment of the present invention, the movement means of the roll comprise pistons which are configured to automatically move the roll 117 in response to a control signal. For example, if it is not desired to cover the sheet 2 with the coating film 117, it is possible to raise the roll through the pistons, for instance further to pressing a button (not illustrated in the figures) or to selecting a particular function through a user interface (also not illustrated); further to the operator's command, the central unit U is capable of sending the suitable control signal to the pistons.

[0154] Suitably, the coating film roll 17 is arranged on the accessory device 113, which, as above illustrated, is a retractable device that, upon request, may disappear.

In this way, if necessary, it is possible to remove the roll, which is bulky and very heavy (for instance in case of cutting single sheets which do not need to be held), from the working area.

[0155] Furthermore, the apparatus 1 comprises further cutting means (not illustrated in the figures) which are configured to separate a portion of the coating film 117, already disposed on the sheet 2, from the coating film roll 117 still to be applied. For instance, said cutting means may be arranged on the holding element 115 and may comprise a movable cutter suitably moved (for instance moved parallel to the holding means 115) in order to trim the coating film. In this case, the plane 114 may comprise a Teflon film for protective purposes.

[0156] Finally, in an embodiment of the present invention, not illustrated in the figures, the feeding means 113 are not present and the holding of the sheet 2 occurs for instance through a crosspiece which is above the conveyor belt 6 and is capable of sliding with respect to said conveyor belt in a direction that is substantially parallel to the forward direction. In this case, the support of the coating film roll 117 is associated with the movable crosspiece and is configured to move therewith. The unwinding of the roll thus occurs when the crosspiece moves in a direction opposite the forward direction, analogously to what occurs while the movable plane 114 moves away from the conveyor belt 6, as described above.

[0157] In conclusion, the present invention provides for associating a coating film roll for sheets to be cut with a movable support, which is capable of sliding in a direction parallel to that in which the sheet to be cut in the apparatus is moved. For instance, the roll may be associated with feeding means for feeding said sheets into the apparatus, said feeding means comprising a movable feeding plane with which the roll moves integrally. In this way, it is possible to cover the sheets of material in an automated manner during a movement of the support opposite that of the sheet on the belt (for instance while the movable plane draws back in the feeding step), thus facilitating the unwinding of the roll. A suitable movement system allows reducing the overall dimensions of the roll.

[0158] Suitably, the possibility to provide a foldable plane as the one above described allows reducing the overall dimensions of the plane itself, though keeping it fastened to the apparatus 1, thus reducing the overall dimensions and providing an efficient and compact system.

[0159] Advantageously according to the present invention, the coating film ensures that the material to be cut be held during the cutting step, which is particularly useful in case of multilayered materials in which the upper layers tend to move, or in case of particularly breathable materials. In fact, it is known that the traditional suction means do not have any effect on the upper layers, so that it is the pressure of the closure element that exerts the desired holding of the material during the processing.

[0160] The closure element also facilitates the holding of the material during the cutting step, according to what has been described above.

[0161] Still more advantageously, the apparatus of the present invention allows a particularly effective application of the coating film, the unwinding of the roll being facilitated by the particular configuration adopted.

[0162] In this way, the coating film is arranged onto the sheet of material without being pulled (the roll is in fact configured so as to be unwound smoothly without friction and without being pulled while the support draws back, for instance while the movable plane draws back). The movement of the roll is independent from the movement of the conveyor belt and of the sheet lying thereon, thus facilitating and optimizing the use thereof; moreover, it is not necessary to arrange the film onto the sheet by the operator, since the movement of the belt automatically implies the unwinding of the roll.

[0163] This is very advantageous compared to the known configurations, in which the film roll is mounted on a tube that is not able to make any movement other than a rotary movement about its longitudinal axis, said tube crossing the core of the roll. In particular, the operator unwinds the first few meters of film by hand and covers the material (operation which requires time since the film is very thin, flutters and creates folds when it is placed); afterwards, when the belt moves forward, the film is unwound only due to the friction it has on the material and thanks to the suction in a limited space below the film and outside the material to be cut, which may cause a displacement of the film or may create some folds.

[0164] Finally, the possibility of arranging the roll on the retractable feeding means and the presence of the lifting pistons makes the apparatus of the present invention particularly versatile.

[0165] Advantageously, the closure element further allows holding the material even during the feeding thereof on the conveyor belt, keeping the material under pressure on the belt while the feeding movable plane draws back.

[0166] The movement of the closure element is suitably automated, so that the operator does not need to use commands to open and close the screen when he needs to intervene inside the working area.

[0167] Furthermore, the presence of the closure element, which is configured to remain in the closed position during the cutting step, ensures a drastic reduction in the noise of the apparatus, said closure element substantially acting as an acoustic barrier.

[0168] A further advantage is that the closure element may be made of materials that are not totally transparent, for example smoky plexiglass; in this way, the acquisition of images inside the cutting chamber is prevented from being influenced by the external light that may create shaded areas or in general may vary the light intensity in some areas. In other words, the closure element may be configured for blocking the external light and for creating a sort of dark room in the cutting chamber.

[0169] Finally, the apparatus according to the present

invention also allows intervening on the material arranged outside the cutting area without moving the material into said cutting area. In fact, if the closure element presses onto the material, a separation between the cutting chamber and the area outside it is formed.

[0170] This is even more advantageous in case a closure element is used both at the inlet of the cutting chamber and at the outlet. In fact, especially in case of particularly long sheets, there is material upstream of the cutting chamber, both in the cutting chamber, and downstream of the cutting chamber. When the closure elements are in the closed position, they actually create a separation between the sheet portion in the cutting step, the sheet portion already cut downstream of the cutting chamber and the sheet portion which shall be cut after the next movement of the conveyor belt. In this way, the closure element at the outlet allows collecting the cut material portions without moving the material into the cutting chamber. In fact, although moving the material in the areas close to the cut portion to be taken, the closure element at the outlet, which presses onto the material, prevents a movement of the material downstream of the cutting chamber from affecting the material inside the cutting chamber. As above mentioned, this advantage is also found upstream of the cutting chamber: the closure element at the outlet allows placing the material that will enter the cutting chamber at the next movement of the belt, for instance it allows flattening it as much as possible in order not to encounter problems during the cutting, thus preventing also the material inside the cutting chamber from being accidentally moved.

[0171] An advantage of the present invention lies in the extreme compactness, limited weights, constructive simplicity and robustness.

[0172] A related advantage is linked to the extreme versatility of the apparatus according to the present invention, which is able to perform each type of application, both those requiring high cutting speeds, and those requiring high precision, as well as being able to cut single hides, multilayered materials, and performing cuts such as the so-called trimming of already cut portions, and the like.

[0173] Still another advantage derives from the large working area reachable by the cutting heads and from the possibility of putting two heads side by side to each other at a relatively short distance, approximately less than 10 centimeters.

[0174] Still another advantage derives from the possibility of re-configuring the cutting heads by modifying the orientation thereof, so as to vary the working area by adapting the apparatus to different cutting needs. Obviously, a person skilled in the art, in order to meet particular needs and specifications, can carry out several changes and modifications to the apparatus described above, all included in the protection scope of the invention as defined by the following claims.

Claims

1. Numerical control apparatus (1) for automated cutting of a sheet (2) of material or of multiple superimposed sheets (2), comprising:

   - a cutting chamber (3) equipped with an inlet (4) and an outlet (5), said cutting chamber (3) being configured to house at least one portion of the sheet (2) lying on a plane (α);
   - cutting means (80) active within said cutting chamber (3) to perform the cutting of said sheet (2) according to a predefined pattern;
   - conveying means (6) adapted to feed the sheet (2) into said cutting chamber (3) in a forward direction (A) along a longitudinal direction (Y);
   - holding or retaining means (10; 115) active on said sheet (2) in a combined manner with said conveying means (6) to ensure the stability of said sheet during the cutting operation of said cutting means (80);
   - a control unit (U) configured to control said apparatus (1);
   - wherein said material may be indifferently a hide, a fabric or a synthetic material, and may be fed as a single sheet (2) or as a multilayer of sheets (2), without modifying said forward direction (A).

2. Apparatus (1) according to claim 1, further comprising a crosspiece (18) which is above said cutting chamber (3), said cutting means (80) comprising one or more cutting heads (8a; 8b) supported by said crosspiece (18); and an artificial vision system intended to acquire an image of the sheet (2) to plan the cutting operations thereon; said artificial vision system comprising at least one image acquisition device (7a) inserted in said cutting chamber (3) and associated with said crosspiece (18).

3. Apparatus (1) according to claim 2, wherein said at least one image acquisition device (7a) is housed in an area (20) inside said crosspiece (18), said crosspiece (18) comprising at least one visual access opening (21) to said cutting chamber (3) by said image acquisition device (7a).

4. Apparatus (1) according to claim 3, wherein a line of sight (L) between the image acquisition device (7a) and a cutting room (C) is obstructed in at least one working configuration of the cutting means (80), said cutting means (80) may take up at least one rest configuration in which said line of sight (L) is not obstructed.

5. Apparatus (1) according to claim 4, wherein the image acquisition devices (7a) are a plurality, all housed in said crosspiece (18) and aligned along a

development transversal direction (X) of the crosspiece (18).

6. Apparatus (1) according to one of claims 4 or 5, wherein said cutting means (80) comprise two upper carriages (19a; 19b) supported by said crosspiece (18) and movable with respect thereto according to a transversal direction (X) that is orthogonal to the longitudinal direction (Y); wherein, in the rest configuration, said upper carriages (19a; 19b) are in opposite lateral stroke-end positions, transversally offset from said at least one internal image acquisition device (7a).

7. Apparatus (1) according to claim 6, wherein a screw/nut screw system for the motion transmission to said upper carriages (19a; 19b) is provided, said screw/nut screw system comprising a transversal screw (33) arranged below said crosspiece (18), said transversal screw (33) being offset from the line of sight (L) of the internal image acquisition device (7a), along the longitudinal (Y) direction.

8. Apparatus (1) according to one of claims 2-7, wherein said artificial vision system further comprises at least one upstream image acquisition device (7b), arranged upstream with respect to the crosspiece (18).

9. Apparatus (1) according to one of the previous claims, further comprising an accessory device (113) to facilitate the feeding of the sheets (2) towards the conveying means (6) of the machine, said accessory device (113) comprising a support plane (114) equipped with at least one crosspiece holding element (115) for holding at least one sheet (2) or a multilayer of said sheets (2), said plane (114) being actuated by motorized means mutually approaching and/or moving away with respect to the conveyor belt.

10. Apparatus (1) according to claim 9, wherein said movable plane (114) is angularly and retractably movable in a rest position below said conveyor belt (6).

11. Apparatus (1) according to one of claims 9 or 10, wherein said plane (114) is movably guided on support guides (124) from a rest position, in which it is vertically extended close to a lower frontal portion (120) of the machine (1) to an operating position in which it is horizontally extended.

12. Apparatus (1) according to one of the previous claims, further comprising a coating film roll (117) adapted to coat and hold the sheet (2) on said conveying means (6); and a support of said coating film roll (117), said support being configured to move with respect to the conveying means (6) in a direction parallel to the forward direction (Y).

13. Apparatus (1) according to claim 12, wherein the coating film roll (117) is associated with the support so as to be unwound and to coat a surface (S) of the sheet (2) when said support moves in a direction opposite said forward direction (A) of the sheet (2).

14. Apparatus (1) according to one of the previous claims, comprising at least one closure element (10) at the inlet (4) and/or the outlet (5) of said cutting chamber (3), said closure element (10) being movable between an open position, in which at least one portion of the closure element (10) is at a first distance with respect to the plane (α), and a closed position in which said at least one portion of the closure element (10) is at a second distance with respect to said piano (α), said second distance being less than said first distance, said distances being measured along a direction that is substantially orthogonal to the plane (a) in which the sheet (2) lies.

15. Apparatus (1) according to one of the previous claims, wherein said cutting means (80) comprise at least one first cutting head (8a) and one second cutting head (8b); and a system for displacing the cutting heads (8a; 8b) within the cutting chamber (3), comprising a first upper carriage (19a) for the first cutting head (8a) and a second upper carriage (19b) for the second cutting head (8b); the first and second upper carriages (19a; 19b) being both supported by said crosspiece (18) and translatable with respect thereto along a transversal direction (X); the first upper carriage (19a) being fastened to one or more first guides (24a; 24'a) of the crosspiece (18); the second upper carriage (19b) being fastened to one or more second guides (24b; 24'b) of the crosspiece (18); said first guides (24a; 24'a) being parallel and distinct with respect to said second guides (24b; 24'b).

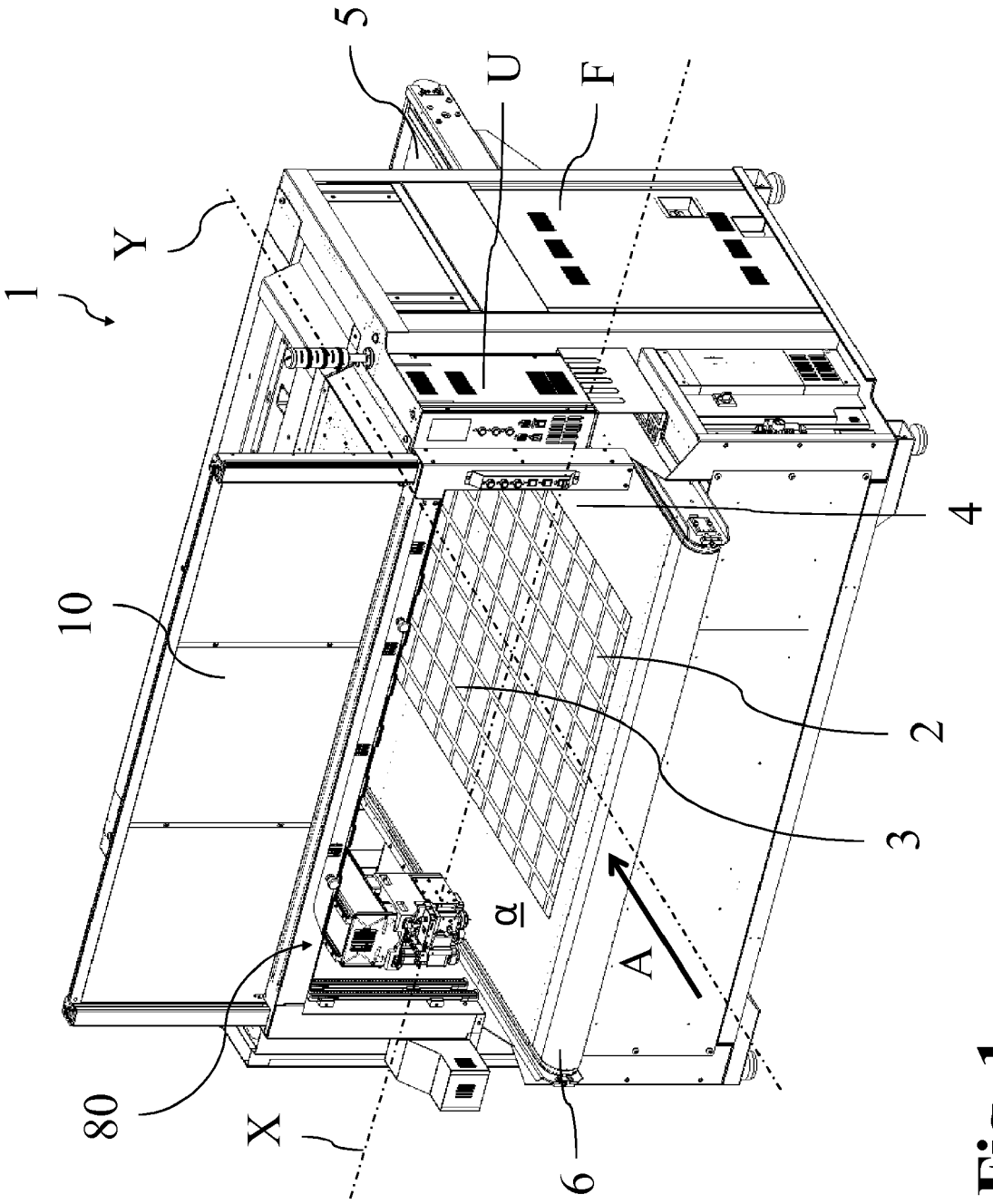


Fig. 1

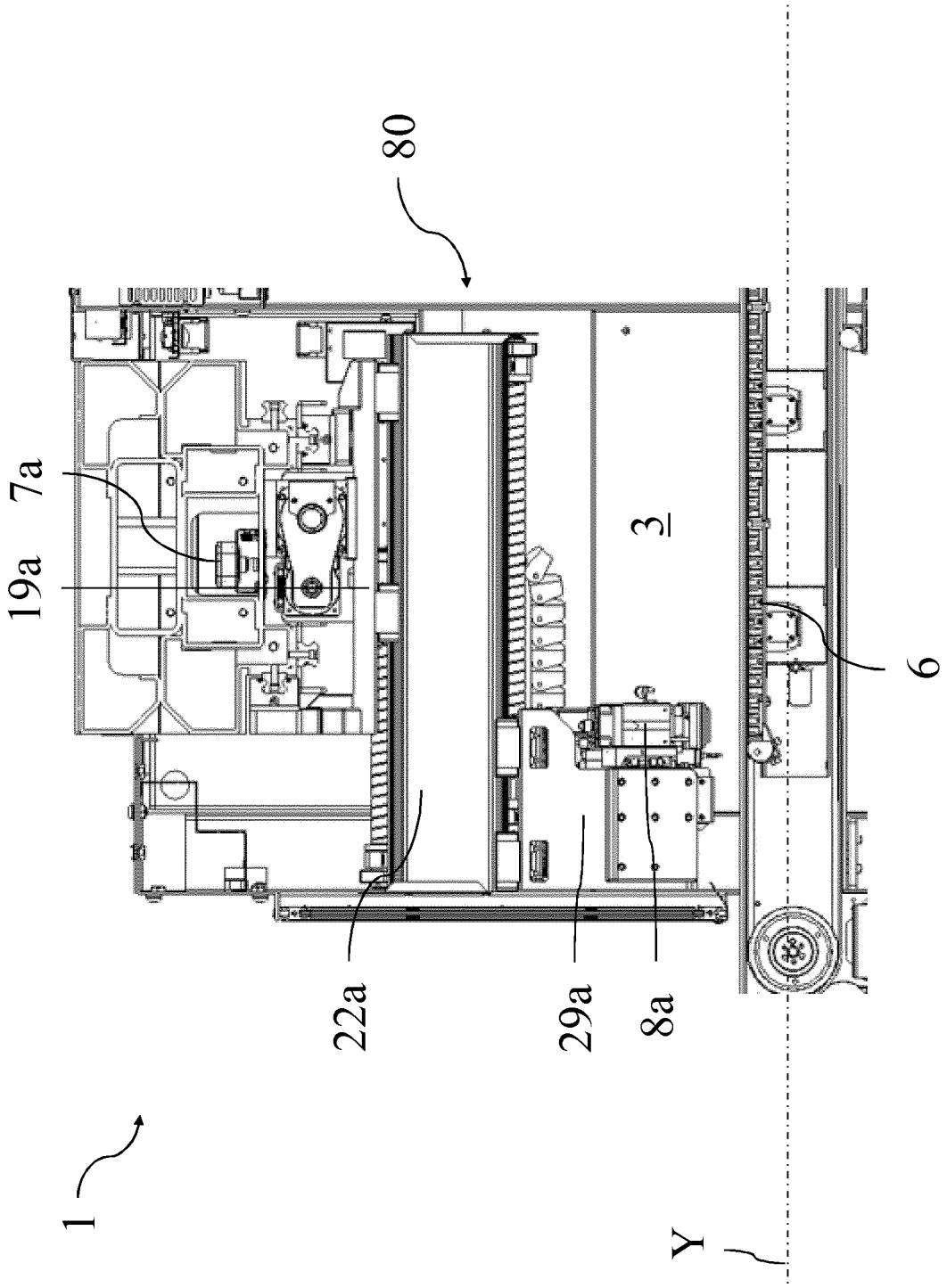


Fig. 2

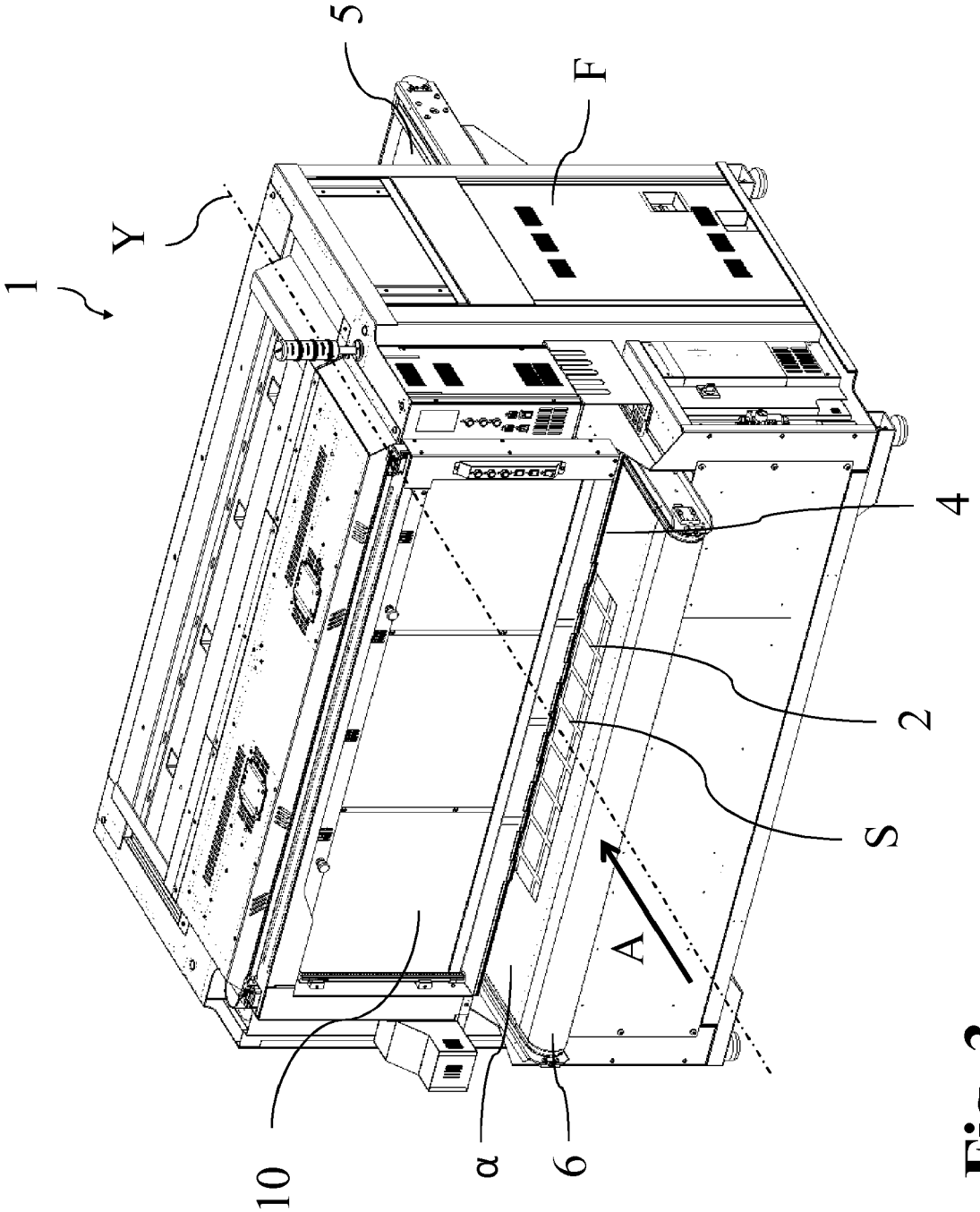


Fig. 3

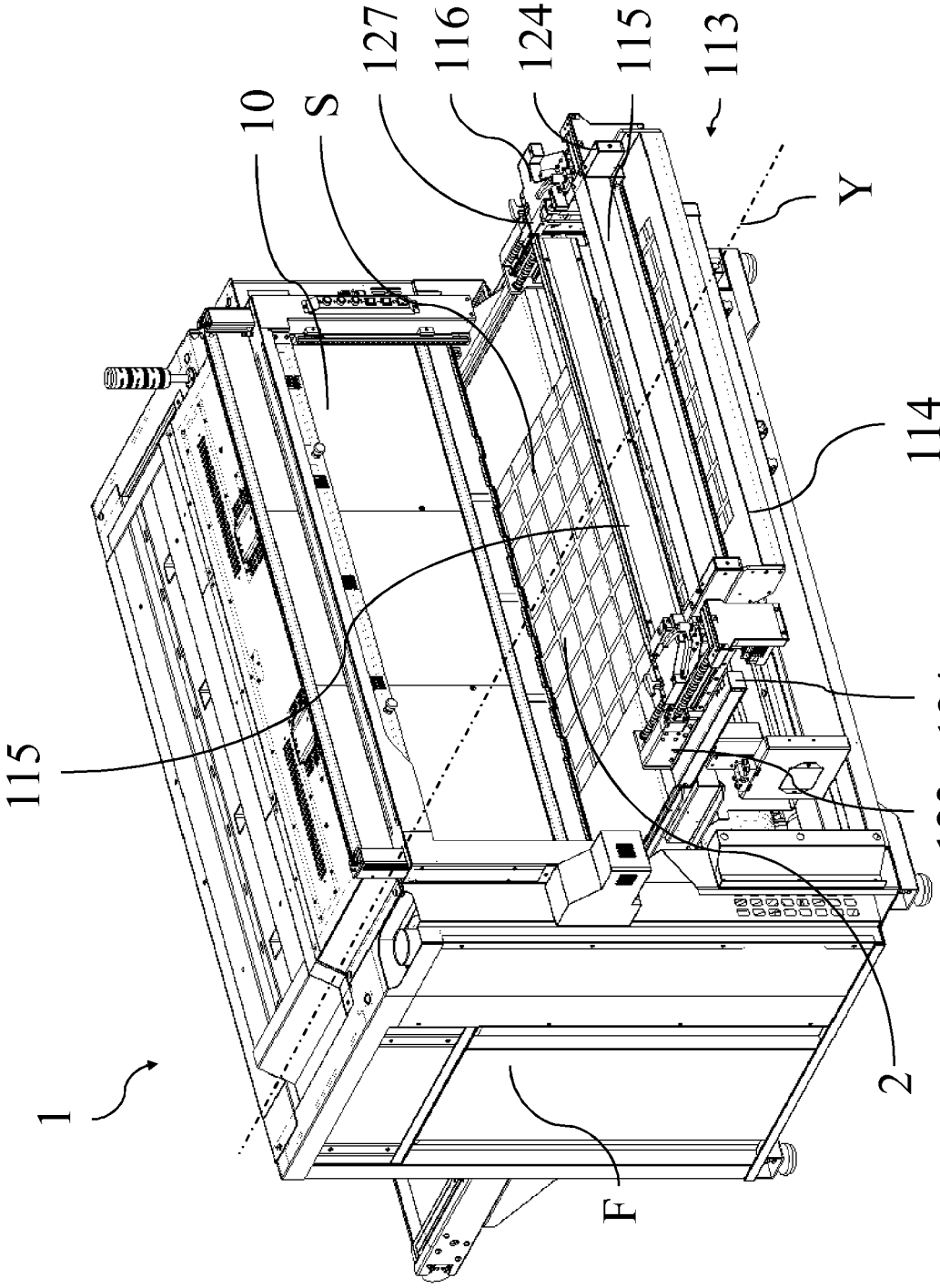


Fig. 4

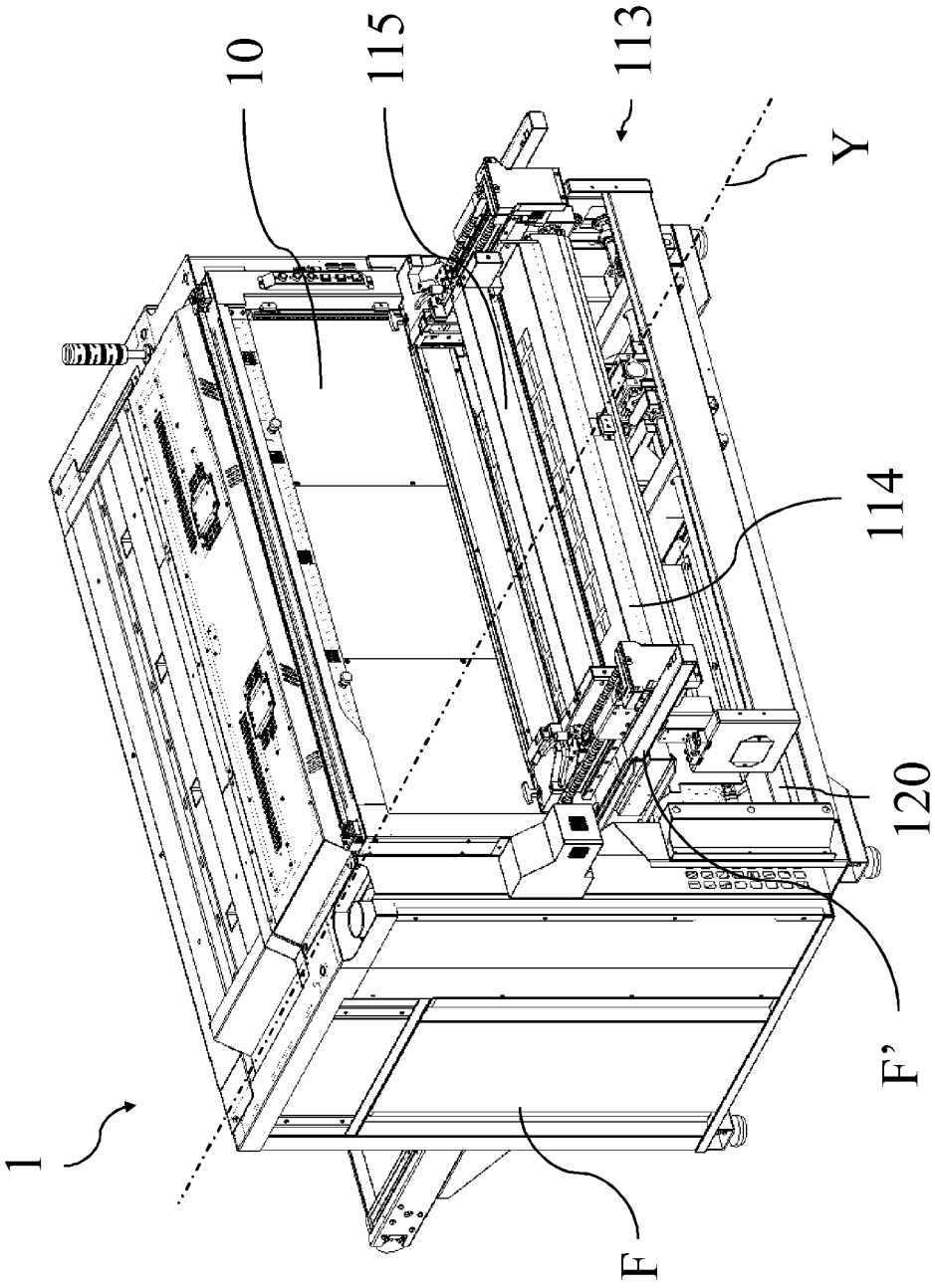


Fig. 5

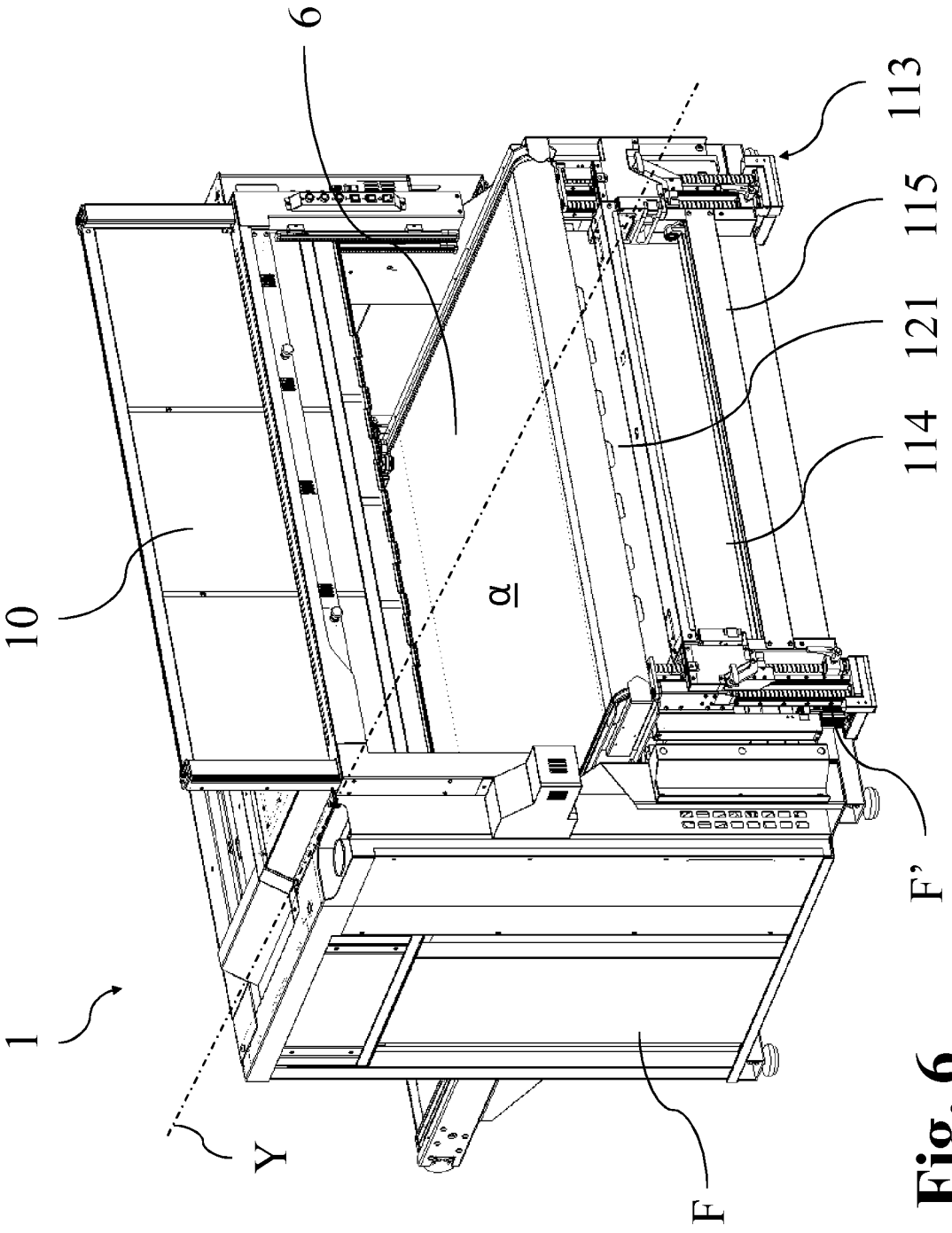


Fig. 6

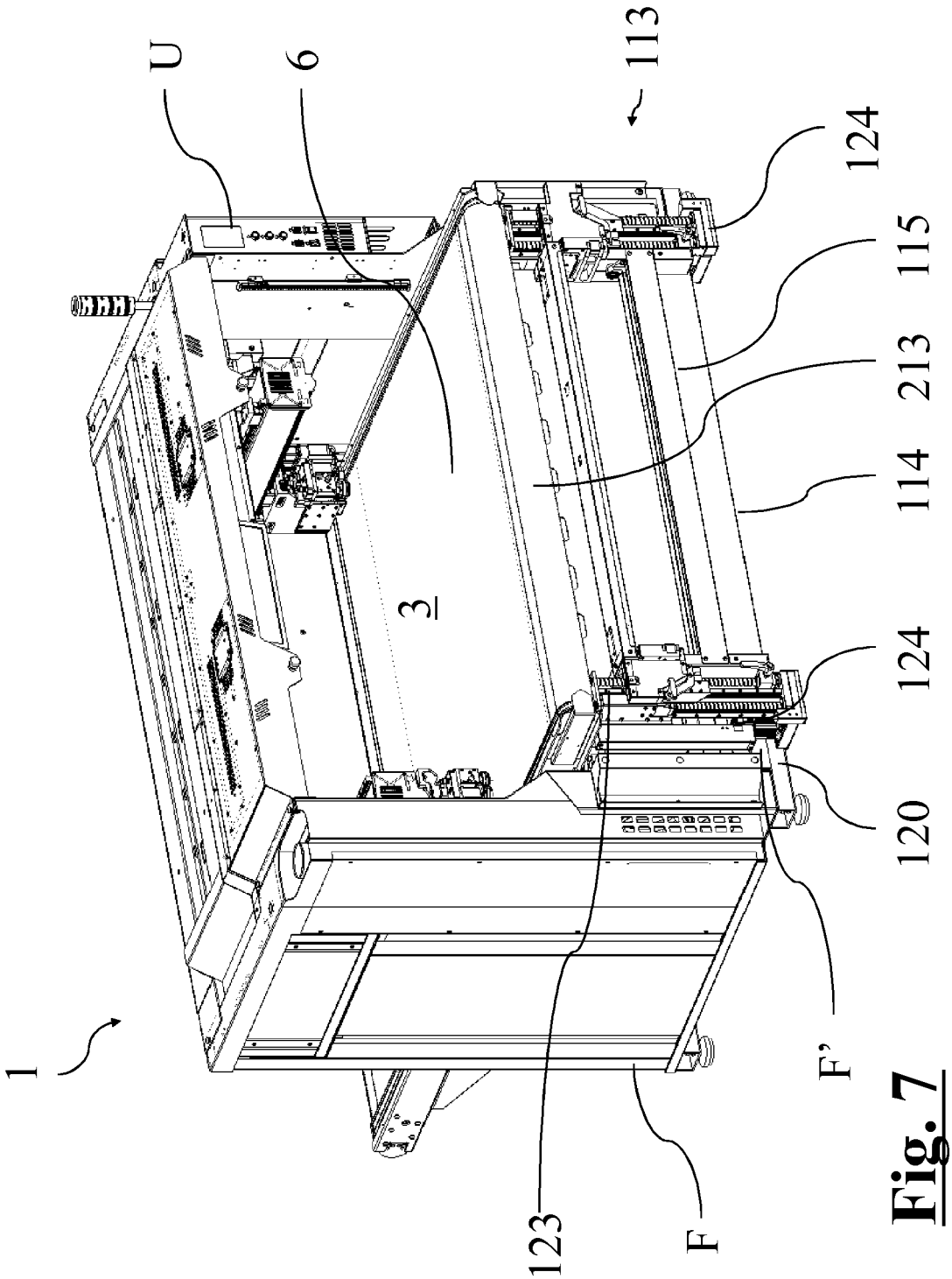


Fig. 7

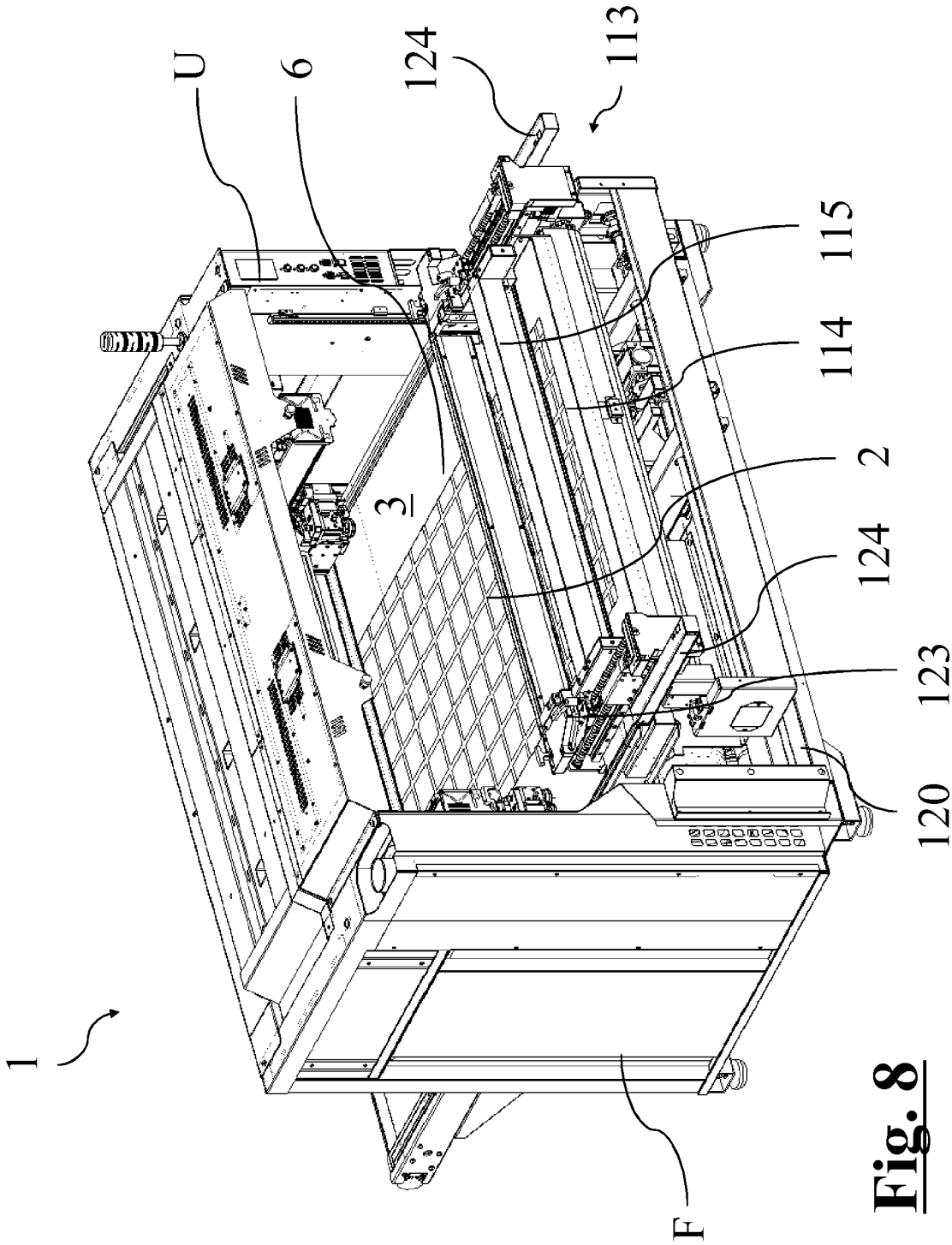
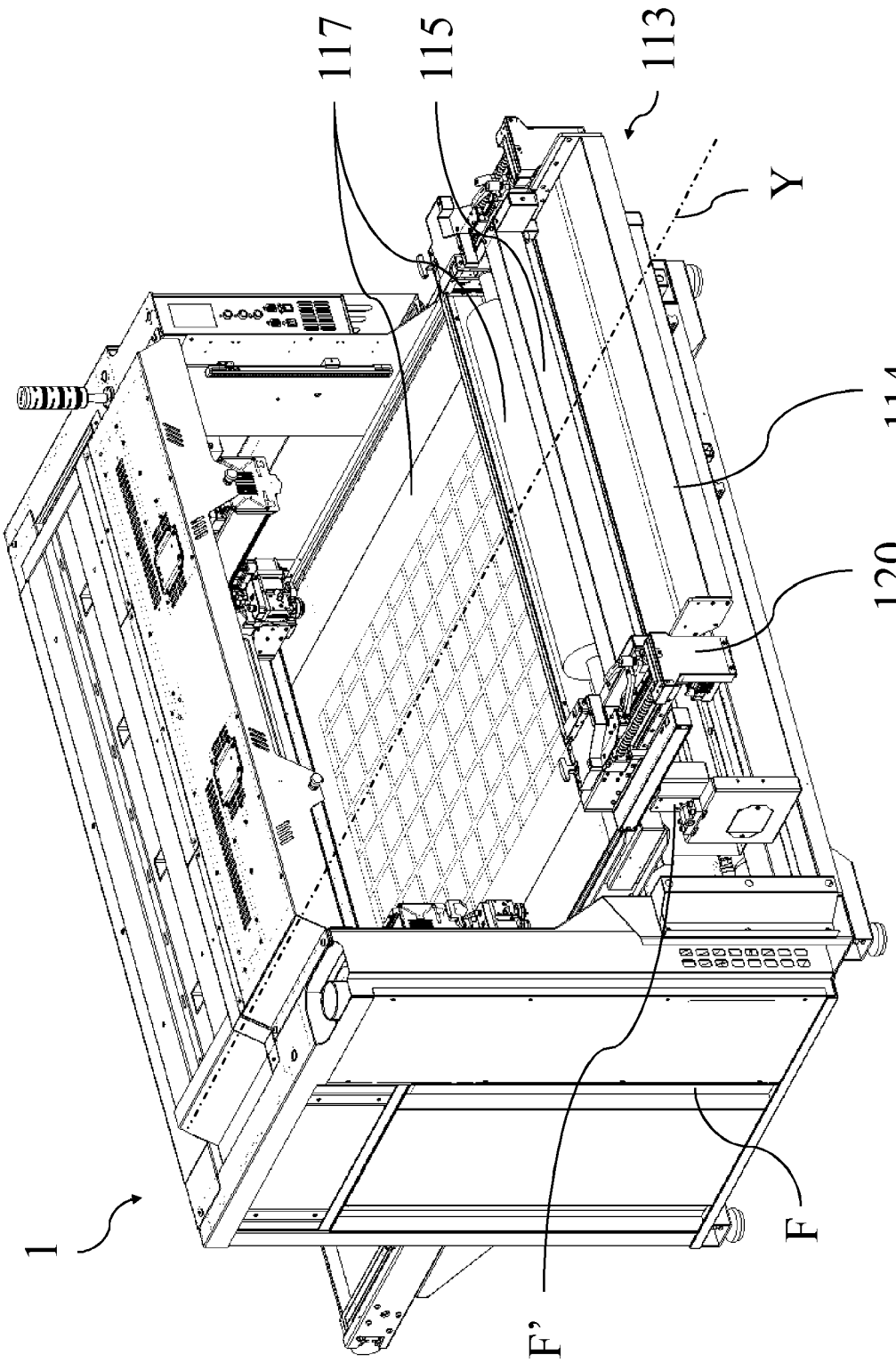


Fig. 8



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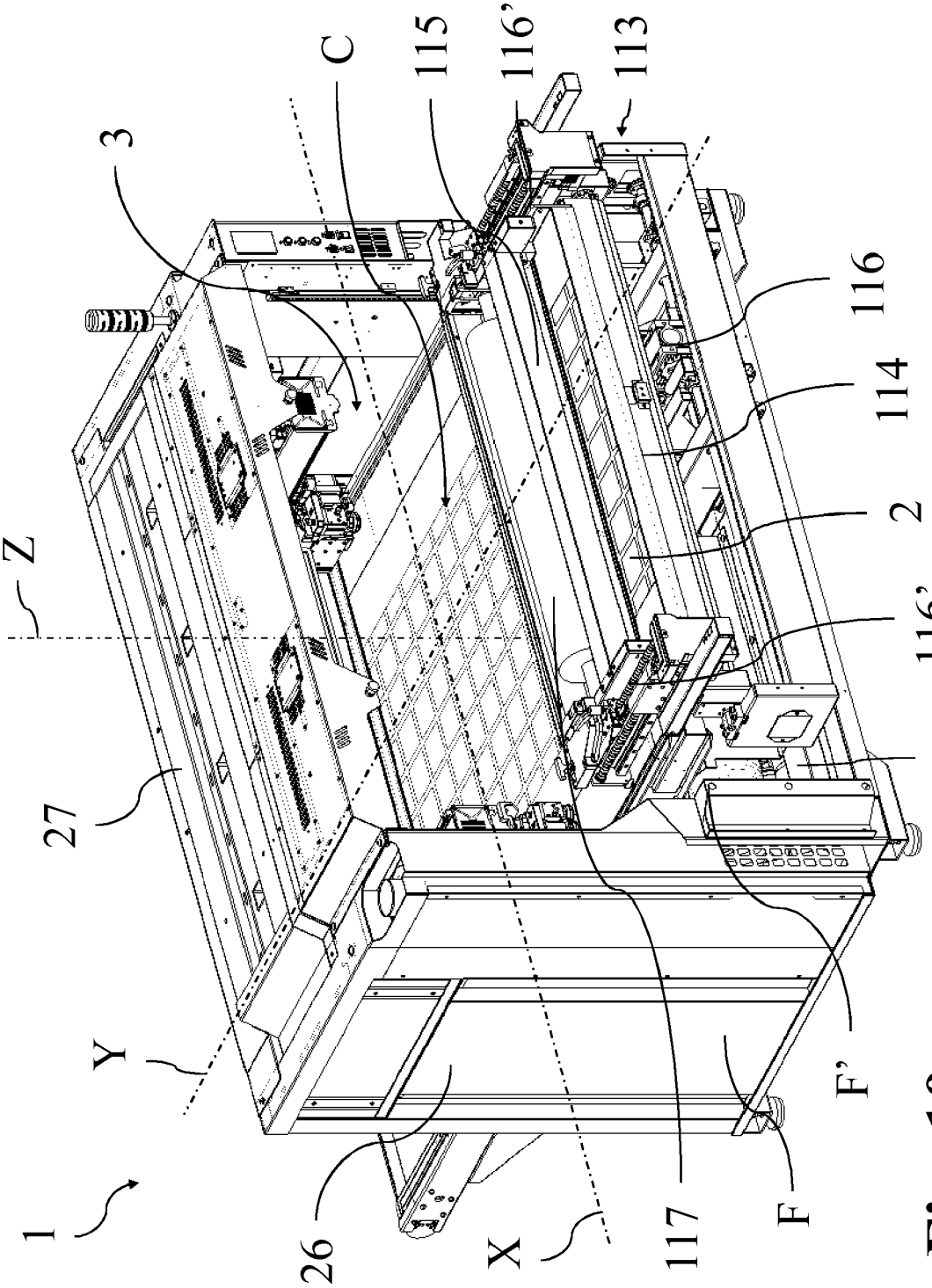


Fig. 10

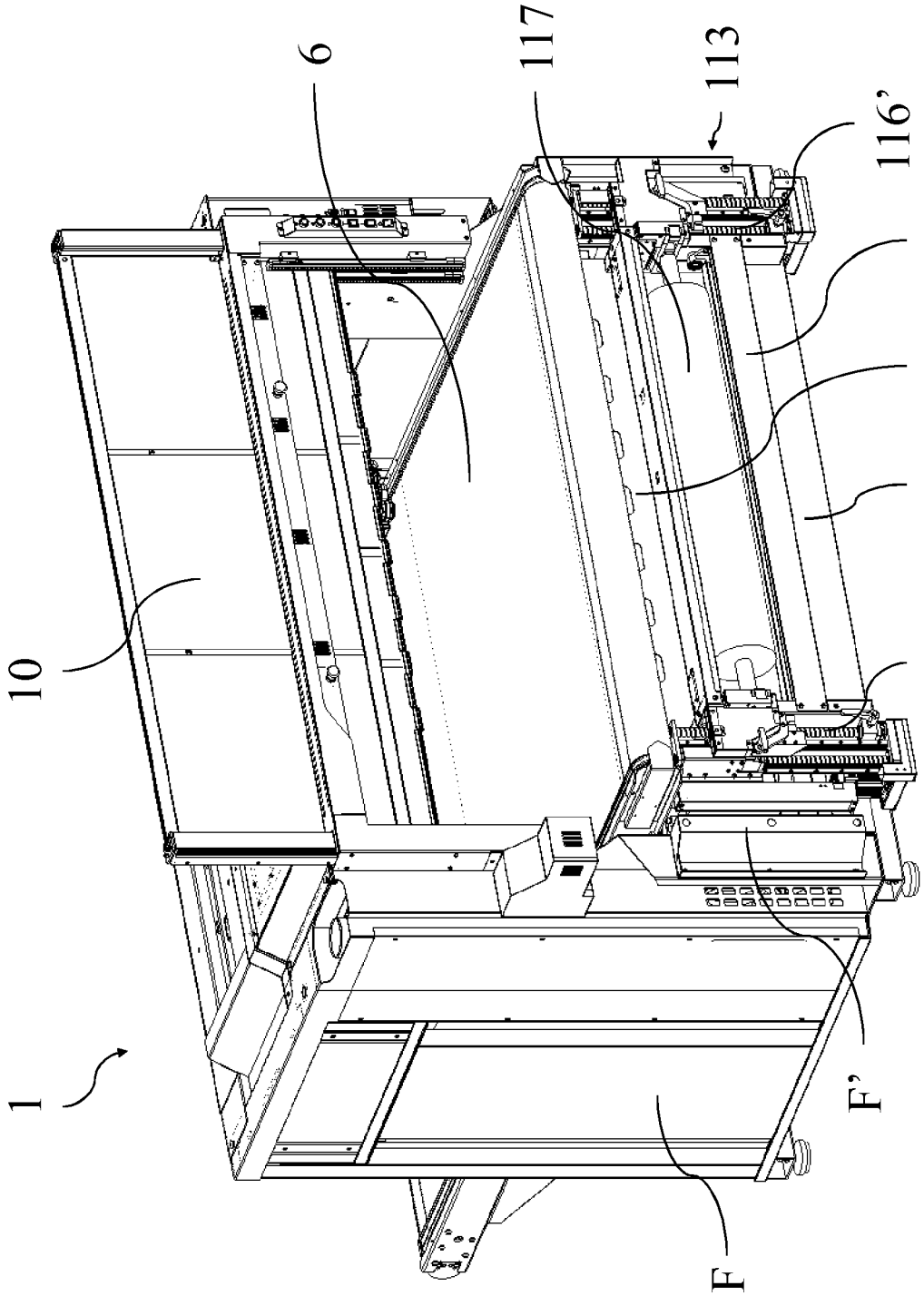


Fig. 11

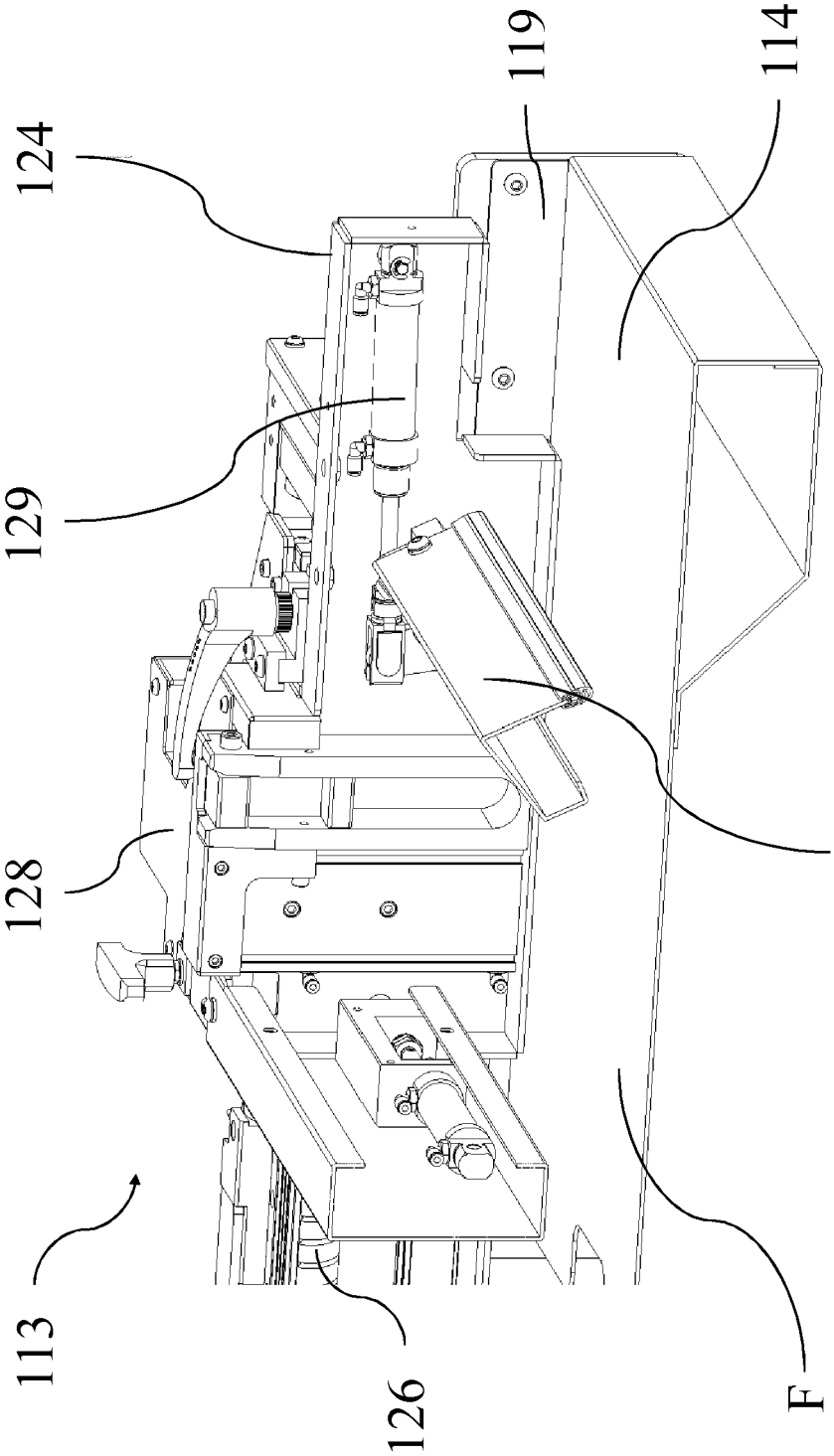


Fig. 12

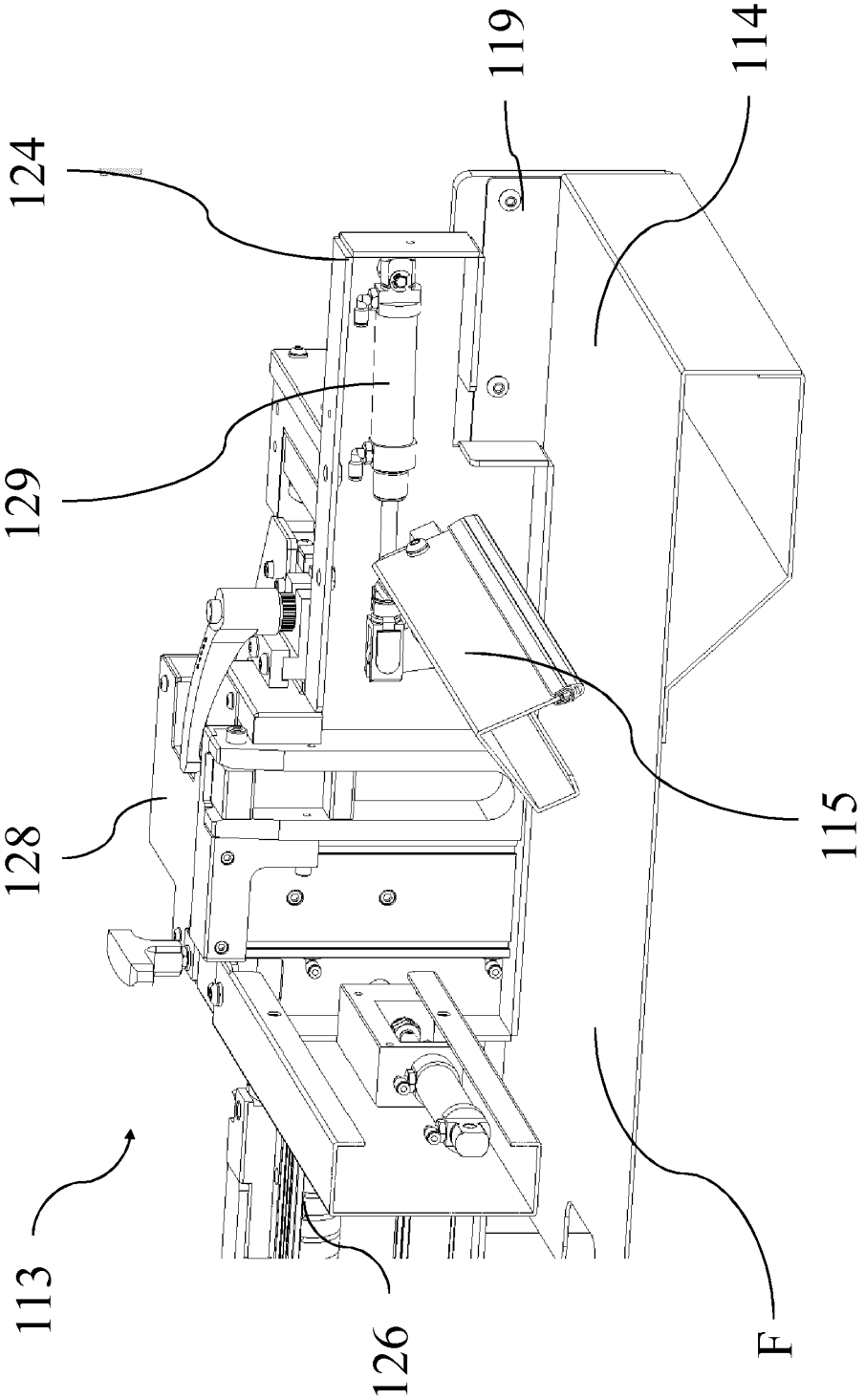


Fig. 13

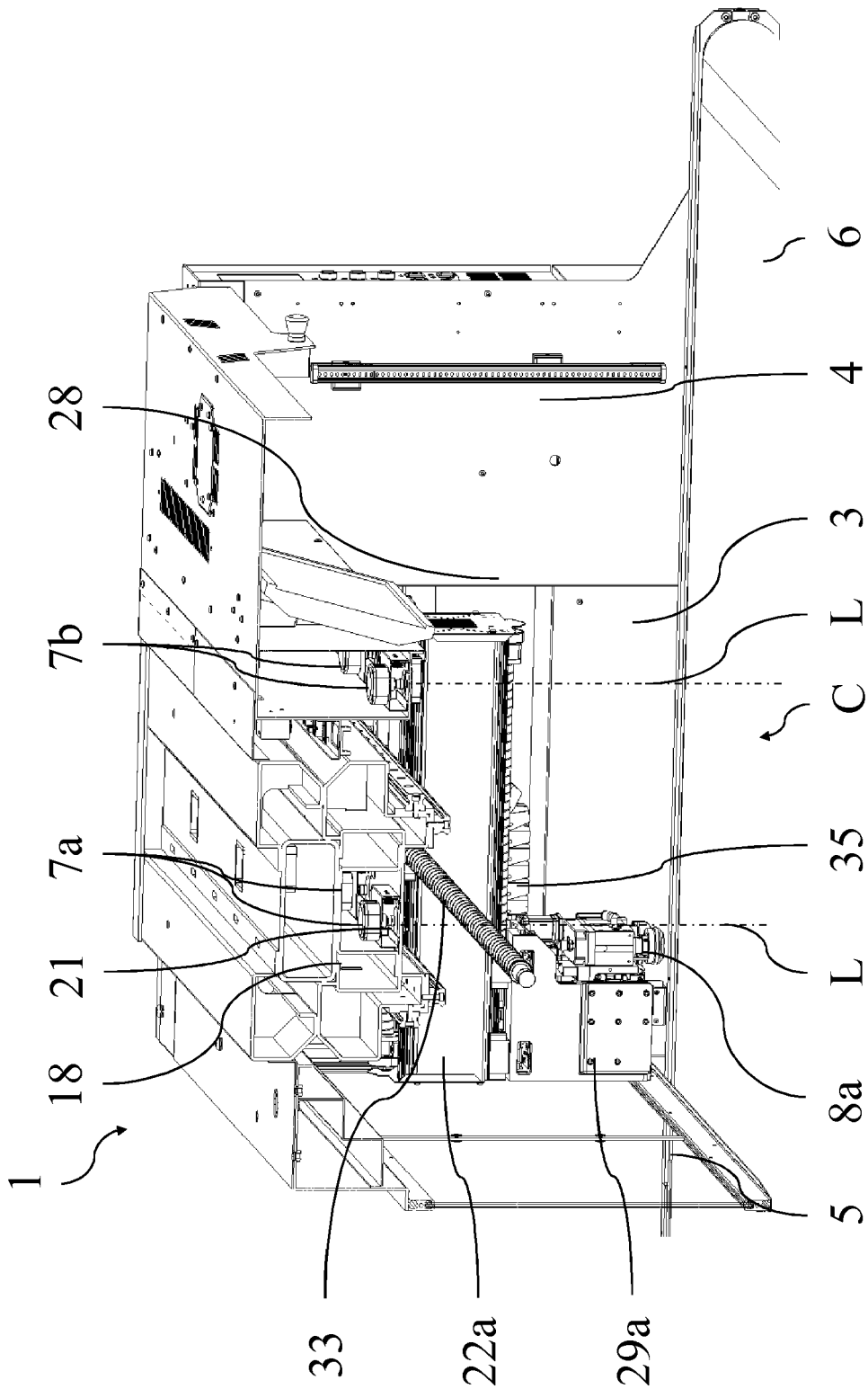


Fig. 14

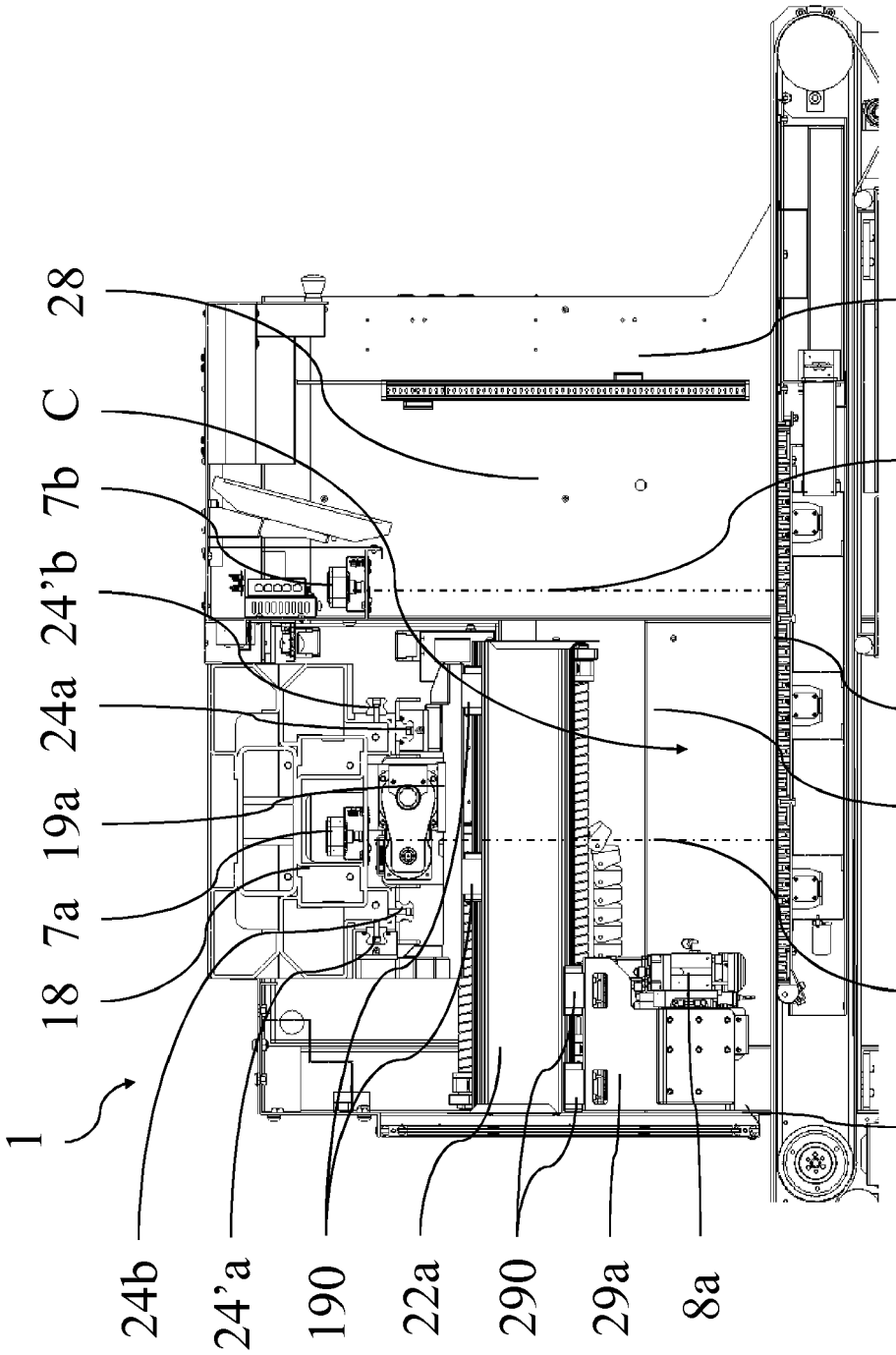


Fig. 15

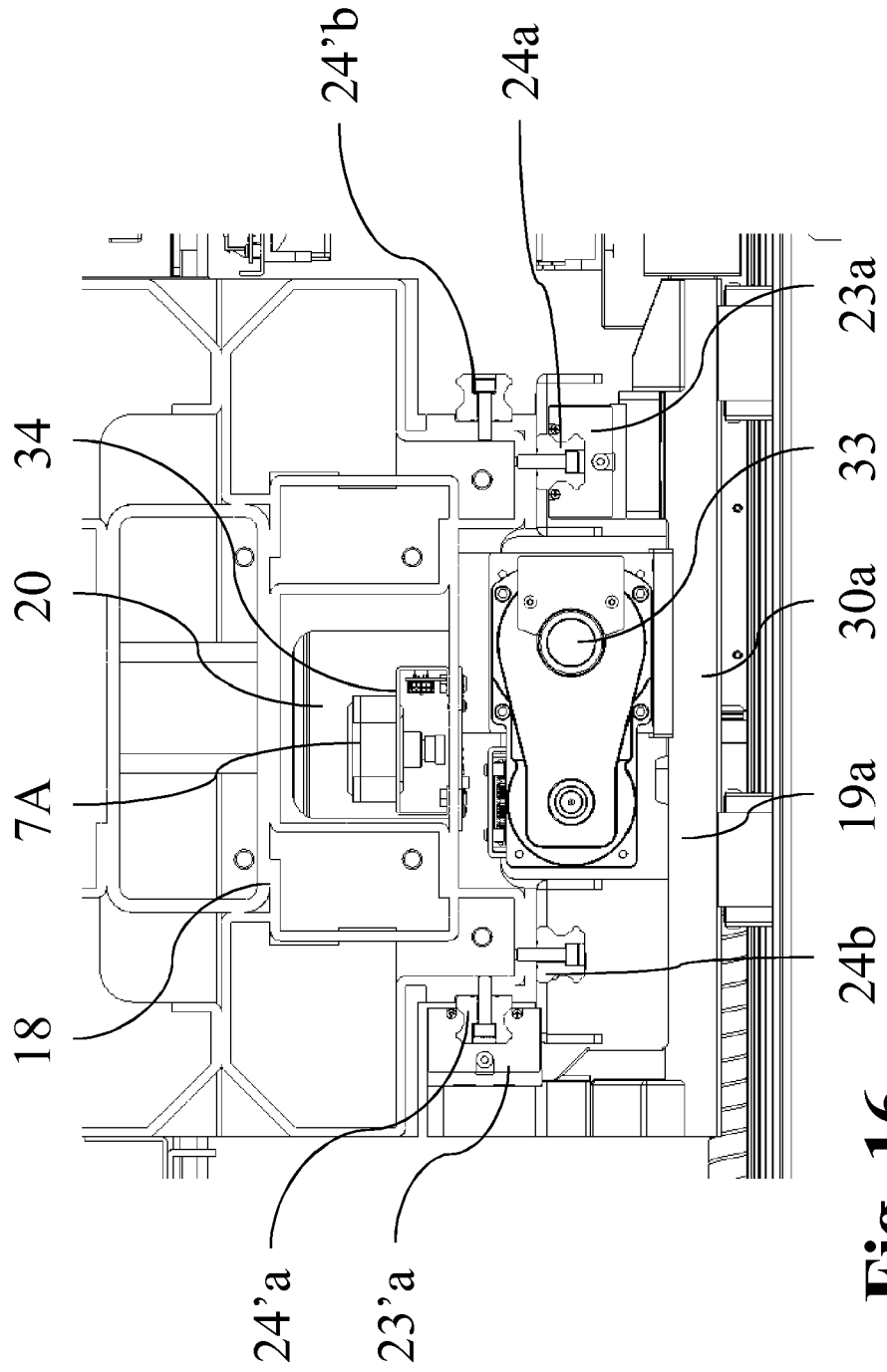
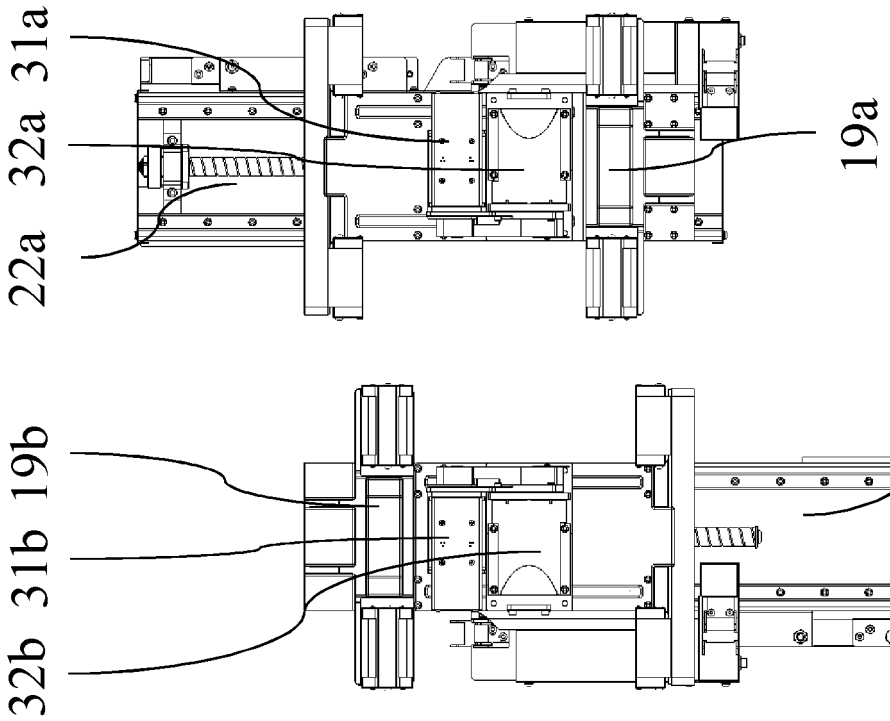


Fig. 16


22a
32a
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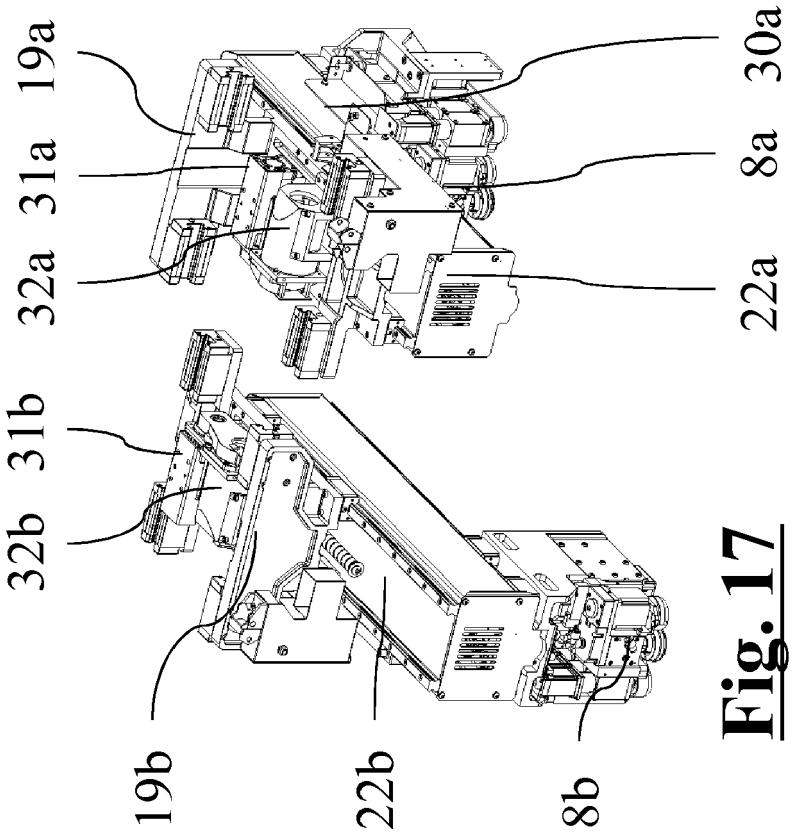
19a
32b
31b
19b
22b

Fig. 18


32b
31b
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31a
19a
22a
8a
30a
19b
22b
8b

Fig. 17

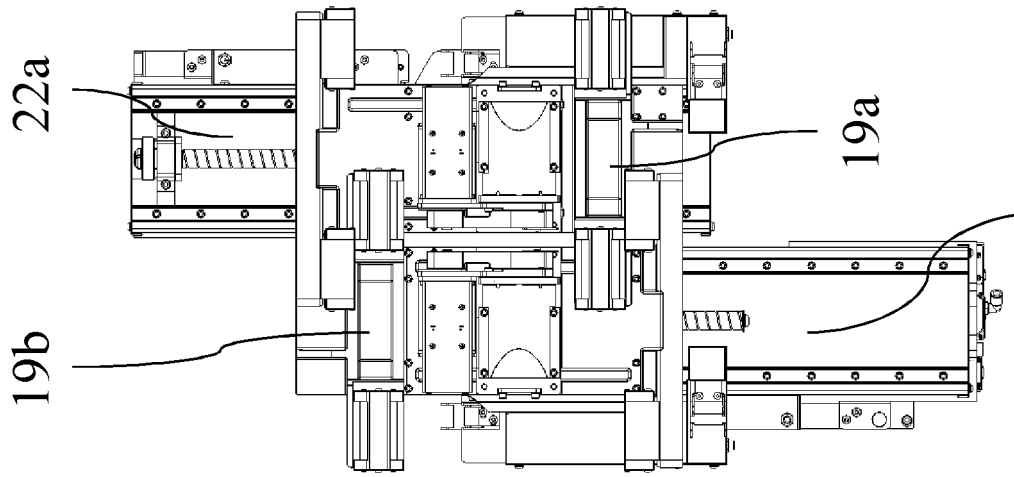


Fig. 20

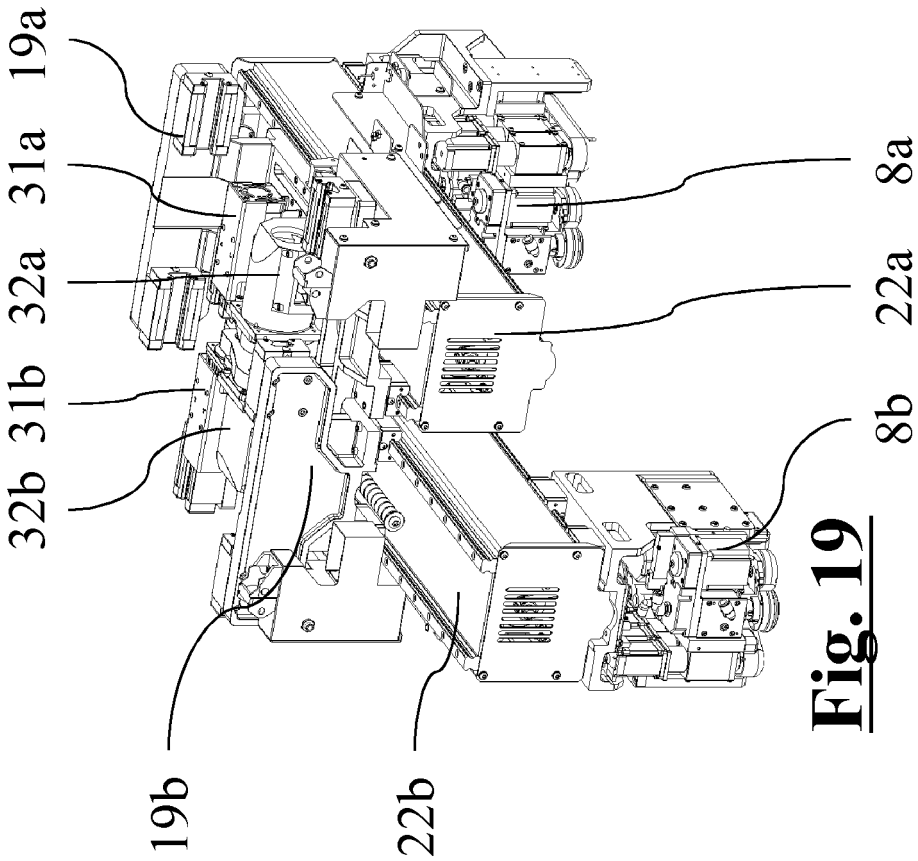
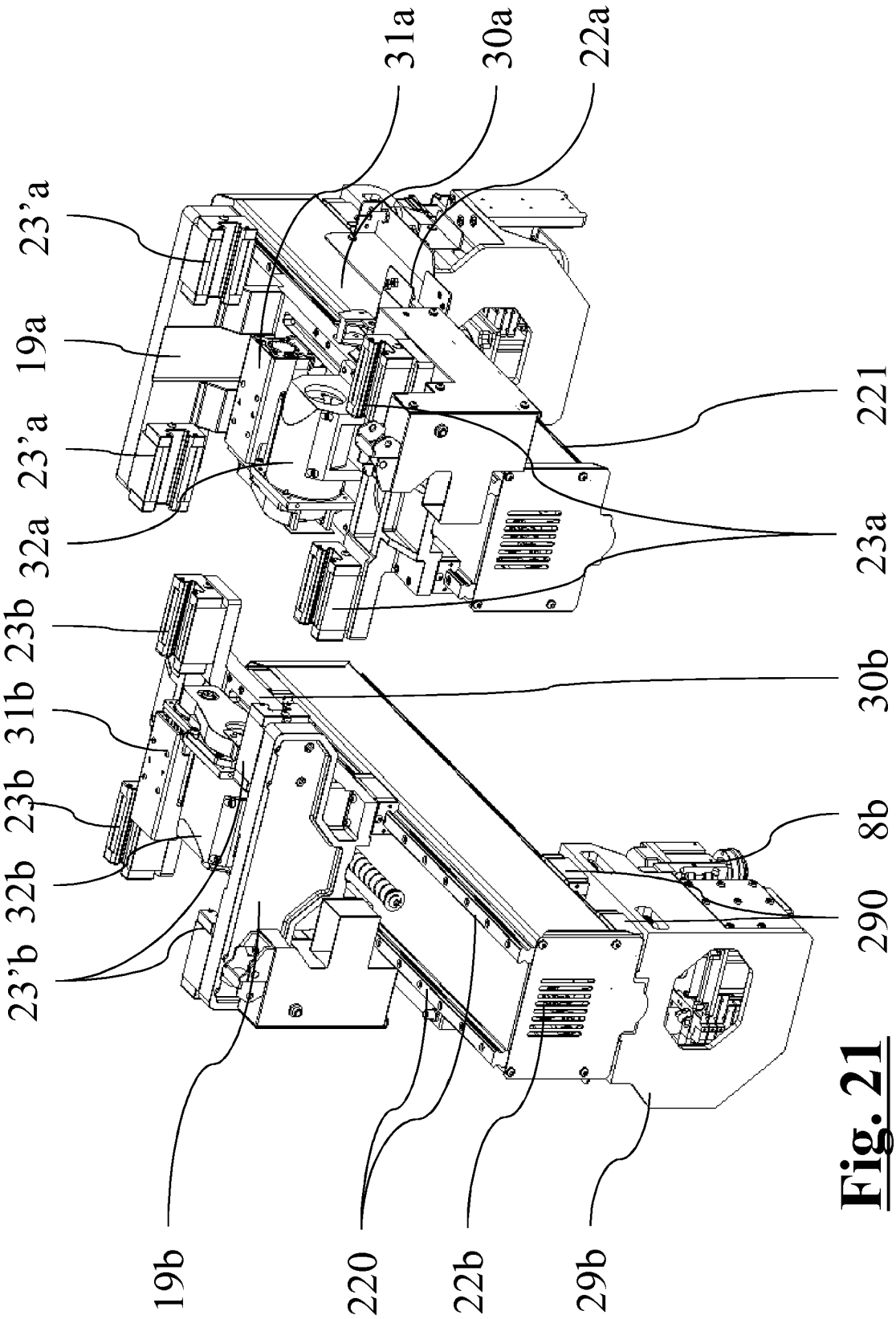


Fig. 19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23'a
19a
23'a
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23b
31b
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32b
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23a
30b
8b
290
19b
220
22b
29b

Fig. 21

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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 8075

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Y	CN 105 690 480 B (ZHAN JING) 10 November 2017 (2017-11-10) * abstract; figures 2,3,4 *	2	

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C14B
B26F
B26D
D06H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 August 2019	Iamandi, Daniela

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