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(54) **BLANKING UNIT**

STANZEINHEIT

UNITÉ DE DÉCOUPAGE

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Description

[0001] The present invention relates to a blanking unit according to the preamble of claim 1, in particular to a blanking unit for a sheet material, for example metal sheet.

[0002] The present invention finds a preferred, although not exclusive, application in a sheet blanking unit for the production of caps for the wine industry, which will be referred to in the following without any loss of generality.

[0003] As already known, bottles of sparkling beverages, e.g. sparkling wines, are usually closed by means of stoppers made of cork or synthetic materials, retained on the neck of the bottle by metal wire cages. A shaped metal disc, or cap, is normally interposed between the stopper and the cage.

[0004] The cages, and in particular the caps, are manufactured in automatic machines with an extremely high cadence, thus requiring an optimization of the sheet feeding and of the arrangement of the shearing areas. A quick, accurate and repeatable positioning of the sheet is therefore essential.

[0005] The shearing is generally carried out by means of a material-saving cycle comprising the steps of obtaining a first row of discs arranged side by side in a direction perpendicular to the sheet feeding direction and of obtaining a second row of discs staggered by half a step with respect to the previous row.

[0006] This cycle usually comprises a step advancement of the sheet in its feeding direction and a lateral translation of the sheet, once longitudinally arranged. Both movements are controlled by respective electric motors.

[0007] The sheet step advancement is generally carried out by thrust means, each time operating in the free sheared holes.

[0008] This known solution has two problems.

[0009] The electric motors do not generally ensure a precise positioning of the sheet by varying the speed of the machine; therefore, errors can occur, in particular when the production starts again after a machine stop.

[0010] Moreover, the sheet feeding from just-sheared holes propagates to the subsequent rows any longitudinal positioning error of the sheet, thus determining a progressive accumulation of errors.

[0011] An example of such handling group is disclosed in US4708043 A.

[0012] The object of the present invention is to obtain a more precise positioning of the sheet and a better repeatability. Said object is achieved by a blanking unit according to claim 1.

[0013] For a better understanding of the present invention, a preferred embodiment is described hereinafter by way of a non-limiting example and with reference to the accompanying drawings, in which:

cording to the present invention;

Figure 2 is a perspective view of a shearing machine of the unit of Figure 1;

Figure 3 is a cross-section of the shearing machine of Figure 2;

Figure 4 is a top perspective view of a sheet feeding group of the unit of Figure 1;

Figure 5 is a bottom perspective view of the group of Figure 4;

Figure 6 is a longitudinal section of the group of Figure 4;

Figure 7 is a top view of the sheet blanking carried out by the unit of Figure 1;

Figures 8a - 8f schematically show successive steps of the sheet feeding into the blanking unit of Figure 1; and

Figure 9 is a plan view of a cam driving the feeding group of Figure 4.

[0014] Figure 1 shows a blanking unit 1 according to the invention, comprising a shearing machine 2 and a feeding group 3 of a metal sheet 4. The shearing machine 2 is arranged in a free space 5 of the feeding group 3.

[0015] For the sake of simplicity, a set of three coordinate axes x, y, z comprises x which is a horizontal axis parallel to the plane of the sheet 4 and to the feeding direction of the sheet 4, y which is a horizontal axis parallel to the plane of the sheet 4 and orthogonal to the axis x, and z which is an axis perpendicular to x and y and parallel to the shearing direction.

[0016] Referring to Figures 2 and 3, the shearing machine 2 comprises a support structure 6 comprising in turn a main vertical wall 7 parallel to the plane xz. The structure 6 further comprises a lower wall 8 projecting from the main wall 7, close to its lower end, and supporting a punch 9 having a fixed axis A parallel to the axis z and constituting the shearing axis. The structure 6 also comprises a pair of parallel vertical walls 11 extending from the wall 7 above the lower wall 8. The walls 11 support a pin 12 whose axis is parallel to the axis x on which a rocker arm 13 is articulated.

[0017] An end 14 of the rocker arm 13 is coupled to an upper end of a hollow shaft 15, having an axis A, by means of a pin 16. The shaft 15 vertically slides along the axis A, in a support 17 fixed to the walls 11. The shaft 15 has an inner chamber 18 (Figure 3) selectively connectable to a positive or negative pressure source.

[0018] A lower end of the shaft 15 is coupled to a die 19, cooperating with the punch 9 and containing a stop rubber ring 21 for the sheared discs (Figure 3).

[0019] An opposite end 22 of the rocker arm 13 is coupled to a rod 23 by a pin 24. The rod 23 is vertically slidable within a support 25 integral with the main wall 7. At a lower end, the rod 23 carries a cam follower 26 driven by a cam, not shown, for operating the shearing machine 2.

[0020] Referring to Figures 4, 5 and 6, the feeding group 3 comprises two plates 27, 28 parallel to the plane

Figure 1 is a perspective view of a blanking unit ac-

xy, elongated in a direction parallel to the axis x and longitudinally spaced to define the space 5 between them.

[0021] Each of the plates 27, 28 has a top surface 29 on which the sheet 4 and a lower surface 31 rest. The plates 27, 28 are rigidly coupled and are movable in a direction parallel to the axis y along a guide 32 fixed to the structure of the unit 1. To this purpose, the plate 27 carries a pair of cam follower 33, 34 cooperating with a cam 35 rotatable about an axis B parallel to the axis y and arranged below the plate 27.

[0022] The cam 35 is defined by an annular rib radially projecting from a cylindrical body 36 and having a variable profile in the direction y, with which the cam followers 33, 34 cooperate on opposite sides so as to create a desmodromic control defining the law of motion 27, 28 of the plates in the direction y. The cylindrical body 36 is coupled through a grooved profile 37 to a shaft, for example a shaft of an electric motor, here not shown. Conveniently, this shaft also controls the actuating cam of the shearing machine 2 by means of a not shown synchronous transmission.

[0023] The plate 28 carries a third cam follower 38 having a vertical axis cooperating with a cam 39 defined by a shaped opening 41 formed in a fixed plate 42, parallel to the plane xy and connected to the structure of the unit 1. With reference to Figures 5 and 9, the opening 41 is substantially parallelogram-shaped, with two bases 43, 44 parallel to each other and to the axis y and two oblique sides 45, 46. The oblique side 45 extends beyond the base 43 to form a guiding groove 50 provided with an oblique side 47, parallel to the oblique side 45, and an end portion 48 parallel to the bases and extending from the groove 50 on the side opposite to the bases. Between the base 44 and the oblique side 46, the opening 41 forms a loop 49 extending in the direction y beyond the oblique side 46. The oblique side 45 and the base 44 define as a whole a first edge 60a, whereas the oblique sides 46, 47 and the base 43 define as a whole a second edge 60b of the opening 41, the first and the second edges 60a, 60b defining the opening 41 along the direction x with opposite orientations.

[0024] The cam follower 38 cyclically and continuously cooperates with the sides of the opening 41 as described hereinafter.

[0025] The plate 27 (Figure 5) carries a slide 51, prismatically engaged with the guide 32 to slide in the direction y.

[0026] The plate 27 also carries an advancement mechanism 52 of the sheet 4 in the direction x. The mechanism 52 comprises a slide 53, slidably housed in a longitudinal seat 54 of the plate 27 and having a sequence of feeding teeth 55, each parallel to the direction y and equally spaced in the direction x by a step p equal to the advancement step of the sheet 4.

[0027] The teeth 55 are vertically slidable within respective seats 56 of the slide 53 and are thrust upwards by elastic means not shown to be able to protrude upwards relative to the slide 53 but to move back under

the weight of the sheet 4.

[0028] The mechanism 52 (Figure 6) also comprises a feeding group 57 comprising in turn a block 58 sliding longitudinally in a guide 59 mounted in an end portion of the seat 54 on the opposite side with respect to the space 5. The block 58 integrally carries a thrusting tooth 61 cooperating with an end edge of the sheet 9 and a tooth 62 spaced from the tooth 61 by a step p and vertically retractable like the teeth 55.

[0029] The block 58 is actuated by a pneumatic cylinder 63 to move longitudinally with a reciprocating rectilinear motion within the guide 59 during the loading stage of a new sheet 4, as it will be better described below.

[0030] Permanent magnets 64 are arranged at the sides of the seat 54 to attract the sheet 4, thus keeping it in contact with the surface 29 of the plate 27.

[0031] The mechanism 52 further comprises a pneumatic cylinder 65, housed below the plate 28 and provided with a rod 66 constrained to the plate 28, and a barrel 67 in which the rod is telescopically slidable in a direction parallel to the axis x; the barrel 67 is integral with a slide 68 movable along the axis x and driven by a pair of bars 71, 72 parallel to said axis and engaging respective guides 73, 74 integral with the plates 27, 28.

[0032] The bar 72 longitudinally extends until connecting to a block 69 fixed to the slide 53, which is therefore controlled by the cylinder 65.

[0033] A side guiding device 75 of the sheet 4 is arranged on one side of the plate 27. The device 75 comprises (Figures 4 and 6) a pair of levers 76, 77 pivoting on a support 81 fixed to the plate 27. Respective first arms 78, 79 of the levers 76, 77 are connected by the rod 82 of an air spring 83; respective second arms 84, 85 of the levers 76, 77 have respective rollers 86, 87 cooperating with a side edge 88 of the sheet 4 to keep an opposite side edge 89 in contact with a longitudinal guide 91 integral to the plate 27.

[0034] Two projections 92 extending along the direction z are formed on the plate 28, close to the open space 5, and engage with corresponding holes 93 of the plate 4.

[0035] The blanking unit 1 operates as follows.

[0036] As already stated, the cam 35 synchronously controls the lateral translation of the plates 27 and 28 along the direction y and the shearing machine 2 (through the transmission and the cam not shown). The cylinder 65 controls the longitudinal advancement of the sheet 4 to carry out a cycle comprising the following steps:

- shearing a first row of three discs 101, 102, 103 equally spaced in the direction y so as to leave a distance g (the minimum distance to ensure an adequate structural strength of the sheet to facilitate its handling during the shearing) between two adjacent holes;
- longitudinally moving the sheet 9 and shearing a second row of two discs 104, 105 spaced by the same distance g and staggered with respect to the first row of holes 101, 102, 103 by an amount p/2 in the di-

rection x, where p is the step between the teeth 55 and $p/2$ is at least equal to $(d+g)/\sqrt{2}$, where d is the diameter of the sheared discs and g is the distance defined above.

[0037] More in particular, with regard to the shearing machine 2, the cam produces an alternative vertical translation of the shaft 23 which, through the rocker arm 13, drives the shaft 15 carrying the die 19. This latter, at each downward stroke, shears the sheet 4 placed between the die 19 and the punch 9.

[0038] During the shearing operation, the sheared sheet discs remain attached to the rubber ring 21 due to the depression created in the chamber 18. When the shaft 15 comes back to the rest position, a positive pressure is generated inside the chamber 18, so that the sheared disc is ejected and collected by a plate, not shown, which is cyclically interposed between the punch 9 and the die 19 and is part of a device transporting the sheared discs to a subsequent work station.

[0039] Since the shearing occurs in a fixed position, the plate 4 must be moved both in the direction x and in the direction y.

[0040] The sheet 4 is positioned on the plate 27 and constrained in the direction y by the contact with the guide 91 ensured by the rollers 86, 87 of the device 75. The sheet 4 is positioned above the teeth 62, 55, which retract under its weight, and with its own end edge 94 close to the tooth 61, so that this latter, when actuated by the cylinder 63, comes in contact with said end edge 94 and thrusts the sheet 4 in the direction x towards the space 5, thus defining a starting position of the working cycle.

[0041] The handling of the sheet in the direction x and y is controlled by the cams 35 and 39.

[0042] The rotating cam 35 controls, by means of the cam followers 33, 34, the translation along the axis y of the slide 51 and, therefore, of the whole group 3.

[0043] The position of the slide 53 along the direction x is controlled by the interaction of the cam follower 38, actuated by the cylinder 65, with the opening 41. The cylinder 65 gives the cam follower 38 a movement in the direction x which, combined with the movement in the direction y of the whole group 3, determines a closed trajectory of the cam follower 38 along the periphery of the opening 41, followed cyclically and step-by-step.

[0044] Figures 8a-8f and 9 show the effect of the combination of the movement between the cams 35 and 39. The shearing cycle starts from a position p101 of the cam follower 38, where the disc 101 is sheared. The sheet 4 is in contact with the tooth 61 and is blocked on the plate 27 by the magnets 64.

[0045] Thereafter, the cylinder 65 thrusts the cam follower 38 while keeping it in contact with the oblique side 45 of the opening 41 and determining a translation in the direction x of the slide 53 in the direction opposite to the advancement of the sheet 4. The sheet 4 is restrained by the magnets 64 and by the projections 92 which prevent its movement while the slide 53 withdraws under

the sheet 4 of a step p so as to allow the tooth 62 to come out of the sheet 4.

[0046] At the same time, the group 3 is moved in the direction y until the cam follower 38 reaches a new position p102 for shearing the disc 102; thereafter the group 3 is further moved in the direction y, without any movement in the direction x. When the cam follower 38 reaches a position p103, the disc 103 is sheared. The first shearing series of three along the direction y is thus complete.

[0047] Now the cylinder 65 drives the cam follower in the opposite direction, i.e. in the feeding direction of the sheet 4, while keeping it in contact with the oblique side 46 of the opening 41 while the cam 35 moves the group 3 in the direction y. During this operation, the tooth 62 moves the sheet 4 in the feeding direction x by half a step. When the cam follower 38 reaches a position p104, the disc 104 is sheared.

[0048] The cam 35 moves again the group 3 until bringing it in a position p105 where the disc 105 is sheared.

The second shearing series of two along the direction y is thus complete.

[0049] In a final step of the cycle, the cam 35 moves the group 3 in the direction y, while the cylinder 65 keeps the cam follower 38 in contact with the side 47 of the opening 41.

[0050] During this operation, the tooth 62 further thrusts the metal sheet by half a step in the direction x. The cam follower 38 reaches again the cycle starting position p101 and the previously described operations are repeated.

[0051] With each successive cycle, the sheet advances by one step p thanks to the intervention of successive teeth 55, each time exposed by the translation of the slide 53 in the direction opposite to the feeding direction.

[0052] The foregoing description clearly shows the advantages obtained by means of the blanking unit according to the present invention. In particular, by handling the sheet starting from one of its end edges, any position error occurred by shearing a disc does not propagate to all subsequent discs. Moreover, the use of a cam control allows a higher precision than the use of electric motors.

[0053] It is clear that this exemplary embodiment may be subject to modifications or variations that fall within the scope of protection defined by the claims. For example, the cams 35 and 39 may be differently manufactured, and the transmission of movement in the sheet direction x may be differently performed as well without departing from the scope of the invention as defined by the appended claims. The pneumatic cylinder 65 may be replaced by a different reciprocating linear actuator, electrical for example.

Claims

1. A blanking unit (1) for manufacturing semi-finished products sheared from a sheet (4) comprising a shearing machine (2) defining a vertical shearing ax-

- is (A) and a handling group (3) of said sheet (4) to advance it in a first feeding direction and displace it in a second direction transversal to the first direction to define a sequence of shearing positions (p101, p102, p103, p104, p105), wherein said handling group (3) comprises a step advancement mechanism (52) of said sheet (4) in said first direction, controlled by a cam and a mechanical cam control (33, 34, 35) for handling said sheet (4) in said second direction, **characterized in that** said step advancement mechanism (52) is configured to act on an end edge (94) of said sheet (4).
2. A unit (1) according to claim 1, **characterized in that** said mechanical control (33, 34, 35) is desmodromic and comprises a rotating cam (35) and a pair of cam followers (33, 34) integral with said group (3) and cooperating on opposite sides with said cam (35).
 3. A unit (1) according to claim 1 or 2, **characterized in that** said advancement mechanism (52) comprises at least one plate (27) defining an advancement plane of said sheet (4) and a feeding device moveable with respect to said plate (27) with a reciprocating motion in said first direction, said feeding device comprising thrust means adapted to unidirectionally cooperate with said end edge (94) of the sheet (4) in said feeding direction of the same.
 4. A unit (1) according to claim 3, **characterized in that** said advancement mechanism (52) comprises a fixed cam (39) and a cam follower (38) integral with said feeding device, said cam follower (38) being configured to follow the profile of said cam (39) thanks to the motion of said group (3) in said second direction.
 5. A unit (1) according to claim 4, **characterized in that** said cam (39) comprises an opening (41) engaged by the cam follower (38), said profile of said cam (39) being defined by a plurality of sides (43, 44, 45, 46, 47, 48) of the cam (39) against which said cam follower (38) slides.
 6. A unit (1) according to claim 5, **characterized in that** it comprises a reciprocating linear actuator (65) interposed between said group (3) and said cam follower (38) for varying the position of said cam follower (38) with respect to the group (3) in said first direction.
 7. A unit (1) according to claim 6, **characterized in that** said linear actuator (65) can take a first position in which the cam follower (38) is pushed into contact with a first edge (60a) delimiting the opening (41) in said first direction with a first orientation, and a second position in which the cam follower (38) is pushed into contact with a second edge (60b) delimiting the opening (41) in said first direction with a second orientation.
 8. A unit (1) according to claim 7, **characterized in that** each of said edges (60a, 60b) comprises a base (43, 44) parallel to said second direction and at least one oblique side (45, 46, 47), the contact of the cam follower (38) with said oblique sides (45, 46, 47) determining a translation of the feeding device in said first direction, the contact of the cam follower (38) with said bases (43, 44) allowing a translation of said group (3) in said second direction.
 9. A unit (1) according to any one of claims 3-8, **characterized in that** said feeding device comprises a slide (53), said thrust means comprising a plurality of teeth (55) cooperating in sequence with said edge (94) of said sheet (4), said teeth (55) being moveable between an extended feeding position and a retracted rest position under the weight of said sheet (4) and against the action of an elastic retaining means.
 10. A unit (1) according to any one of the preceding claims, **characterized in that** said group (3) comprises a group (57) feeding said sheet (4) to said feeding device controlled by a reciprocating linear actuator (63).
 11. A unit (1) according to any one of the preceding claims, **characterized in that** said group (3) comprises a plurality of magnets (64) retaining said sheet (4) on said plate (27) during the stroke of said feeding device with an opposite orientation with respect to the feeding orientation of the sheet (4).
 12. A unit (1) according to any one of the preceding claims, **characterized in that** said group (3) comprises a side guiding device (75) of the sheet (4) comprising a fixed guide (92) and thrust means operating on said sheet (4) to keep it in contact with said fixed guide (91).
 13. A unit (1) according to claim 12, **characterized in that** said thrust means comprise an air spring (83).

Patentansprüche

1. Eine Stanzeinheit (1) zur Herstellung von aus einem Blech (4) gescherten Halbfertig-Produkten, aufweisend eine Schermaschine (2), die eine vertikale Scherachse (A) definiert, und eine Handhabungs-Gruppe (3) des Bleches (4), um dieses in eine erste Vorschub-Richtung zu befördern und es in eine zweite Richtung transversal zu der ersten Richtung zu verschieben, um eine Abfolge von Scherpositionen (p101, p102, p103, p104, p105) zu definieren, wobei die Handhabungs-Gruppe (3) einen Schritt-Beförde-

- rungsmechanismus (52) des Bleches (4) in die erste Richtung aufweist, der in der zweiten Richtung durch eine Nocke und eine mechanische Nockensteuerung (33, 34, 35) zur Handhabung des Bleches (4) gesteuert ist, **dadurch gekennzeichnet, dass** der Schrittbeförderungsmechanismus (52) dazu ausgestaltet ist auf eine Endkante (94) des Bleches (4) einzuwirken.
2. Einheit (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** die mechanischen Steuerung (33, 34, 35) desmodromisch ist und eine rotierende Nocke (35) und ein Paar Nockenmitnehmer (33, 34) aufweist, die mit der Gruppe (3) integral ausgebildet sind und auf gegenüberliegenden Seiten mit der Nocke (35) zusammenwirken.
 3. Einheit (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der Beförderungsmechanismus (52) zumindest eine eine Vorschubebene des Bleches (4) definierende Platte (27) und eine in Bezug auf die Platte (27) bewegliche Zuführvorrichtung mit einer Hin-und-HerBewegung in der ersten Richtung aufweist, wobei die Zuführvorrichtung ein Schubmittel aufweist, das dazu angepasst ist unidirektional mit der Endkante (94) des Bleches (4) in deren Vorschub-Richtung zusammenzuwirken.
 4. Einheit (1) nach Anspruch 3, **dadurch gekennzeichnet, dass** der Beförderungsmechanismus (52) eine feste Steuerkurve (39) und einen mit der Zuführvorrichtung integralen Nockenmitnehmer (38) aufweist, wobei der Nockenmitnehmer (38) dazu ausgestaltet ist dem Profil der Steuerkurve (39) aufgrund der Bewegung der Gruppe (3) in der zweiten Richtung zu folgen.
 5. Einheit (1) nach Anspruch 4, **dadurch gekennzeichnet, dass** die Steuerkurve (39) eine Öffnung (41) aufweist, in die der Nockenmitnehmer (38) eingreift, wobei das Profil der Steuerkurve (39) durch eine Mehrzahl von Seiten (43, 44, 45, 46, 47, 48) der Steuerkurve (39) definiert ist, an denen der Nockenmitnehmer (38) gleitet.
 6. Einheit (1) nach Anspruch 5, **dadurch gekennzeichnet, dass** sie einen sich hin und her bewegendes Linearaktuator (65) aufweist, der zwischen der Gruppe (3) und dem Nockenmitnehmer (38) angeordnet ist, um die Position des Nockenmitnehmers (38) in Bezug auf die Gruppe (3) in der ersten Richtung zu ändern.
 7. Einheit (1) nach Anspruch 6, **dadurch gekennzeichnet, dass** der Linearaktuator (65) eine erste Position, in der der Nockenmitnehmer (38) in Kontakt mit einer die Öffnung (41) in der ersten Richtung begrenzenden ersten Kante (60a) mit einer ersten Ausrichtung in Kontakt gedrückt wird, und eine zweite Position, in der der Nockenmitnehmer (38) in Kontakt mit einer die Öffnung (41) in der ersten Richtung begrenzenden zweiten Kante (60b) mit einer zweiten Orientierung in Kontakt gedrückt wird, einnehmen kann.
 8. Einheit (1) nach Anspruch 7, **dadurch gekennzeichnet, dass** jede der Kanten (60a, 60b) eine zu der zweiten Richtung parallele Grundseite (43, 44) und zumindest eine schräge Seite (45, 46, 47) aufweist, wobei der Kontakt des Nockenmitnehmers (38) mit der schrägen Seite (45, 46, 47) eine Verschiebung der Zuführvorrichtung in der ersten Richtung bestimmt, wobei der Kontakt des Nockenmitnehmers (38) mit der Grundseite (43, 44) eine Verschiebung der Gruppe (3) in die zweite Richtung erlaubt.
 9. Einheit (1) nach einem der Ansprüche 3 bis 8, **dadurch gekennzeichnet, dass** die Zuführvorrichtung eine Laufschiene (53) aufweist, wobei das Schubmittel eine Mehrzahl von nacheinander mit der Kante (94) des Bleches (4) zusammenwirkenden Zähnen (55) aufweist, wobei die Zähne (55) zwischen einer ausgefahrenen Zuführposition und einer eingefahrenen Ruheposition unter dem Gewicht des Bleches (4) und gegen die Wirkung des elastischen Haltemittels bewegt werden können.
 10. Einheit (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Gruppe (3) eine Gruppe (57) aufweist, die das Blech (4), gesteuert durch einen sich hin und her bewegendes Linearaktuator (63), der Zuführvorrichtung zuführt.
 11. Einheit (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Gruppe (3) eine Mehrzahl von Magneten (64) aufweist, die das Blech (4) während des Hubs der Zuführvorrichtung mit einer entgegengesetzten Ausrichtung zu der Ausrichtung der Zuführung des Bleches (4) auf der Platte (27) halten.
 12. Einheit (1) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Gruppe (3) eine feste Führung (92) und ein Schubmittel aufweisende Seitenführungseinrichtung (75) des Bleches (4) aufweist, die auf das Blech (4) wirkt, um es mit der festen Führung (91) in Kontakt zu halten.
 13. Einheit (1) nach Anspruch 12, **dadurch gekennzeichnet, dass** das Schubmittel eine Luftfeder (83) umfasst.

Revendications

1. Unité de découpage (1) pour fabriquer des produits semi-finis cisailés à partir d'une feuille (4) comprenant une machine de cisaillement (2) définissant un axe de cisaillement vertical (A) et un groupe de manipulation (3) de ladite feuille (4) pour la faire avancer dans une première direction d'alimentation et la déplacer dans une deuxième direction transversale à la première direction afin de définir une séquence de positions de cisaillement (p101, p102, p103, p104, p105), ledit groupe de manipulation (3) comprenant un mécanisme d'avance pas à pas (52) de ladite feuille (4) dans ladite première direction, commandé par une came et une commande de came mécanique (33, 34, 35) pour manipuler ladite feuille (4) dans ladite deuxième direction, **caractérisée en ce que** ledit mécanisme d'avance pas à pas (52) est configuré pour agir sur un bord d'extrémité (94) de ladite feuille (4). 5
2. Unité (1) selon la revendication 1, **caractérisée en ce que** ladite commande mécanique (33, 34, 35) est desmodromique et comprend une came rotative (35) et une paire de suiveurs de came (33, 34) intégrée auxdits groupes (3) et coopérant sur des côtés opposés avec ladite came (35). 10
3. Unité (1) selon la revendication 1 ou 2, **caractérisée en ce que** ledit mécanisme d'avance (52) comprend au moins une plaque (27) définissant un plan d'avance de ladite feuille (4) et un dispositif d'alimentation déplaçable par rapport à ladite plaque (27) avec un mouvement alternatif dans ladite première direction, ledit dispositif d'alimentation comprenant des moyens de poussée prévus pour coopérer de manière unidirectionnelle avec ledit bord d'extrémité (94) de la feuille (4) dans ladite direction d'alimentation de cette dernière. 15
4. Unité (1) selon la revendication 3, **caractérisée en ce que** ledit mécanisme d'avance (52) comprend une came fixe (39) et un suiveur de came (38) intégré audit dispositif d'alimentation, ledit suiveur de came (38) étant configuré pour suivre le profil de ladite came (39) grâce au mouvement dudit groupe (3) dans ladite deuxième direction. 20
5. Unité (1) selon la revendication 4, **caractérisée en ce que** ladite came (39) comprend une ouverture (41) dans laquelle s'engage le suiveur de came (38), ledit profil de ladite came (39) étant défini par une pluralité de côtés (43, 44, 45, 46, 47, 48) de la came (39) contre lesquels glisse ledit suiveur de came (38). 25
6. Unité (1) selon la revendication 5, **caractérisée en ce qu'elle** comprend un actionneur linéaire à mouvement alternatif (65) interposé entre ledit groupe (3) et ledit suiveur de came (38) pour faire varier la position dudit suiveur de came (36) par rapport au groupe (3) dans ladite première direction. 30
7. Unité (1) selon la revendication 6, **caractérisée en ce que** ledit actionneur linéaire (65) peut adopter une première position dans laquelle le suiveur de came (38) est poussé en contact avec un premier bord (60a) délimitant l'ouverture (41) dans ladite première direction avec une première orientation, et une deuxième position dans laquelle le suiveur de came (38) est poussé en contact avec un deuxième bord (60b) délimitant l'ouverture (41) dans ladite première direction avec une deuxième orientation. 35
8. Unité (1) selon la revendication 7, **caractérisée en ce que** chacun desdits bords (60a, 60b) comprend une base (43, 44) parallèle à ladite deuxième direction et au moins un côté oblique (45, 46, 47), le contact du suiveur de came (38) avec lesdits côtés obliques (45, 46, 47) déterminant une translation du dispositif d'alimentation dans ladite première direction, le contact du suiveur de came (38) avec lesdites bases (43, 44) permettant une translation dudit groupe (3) dans ladite deuxième direction. 40
9. Unité (1) selon l'une quelconque des revendications 3 à 8, **caractérisée en ce que** ledit dispositif d'alimentation comprend un coulisseau (53), lesdits moyens de poussée comprenant une pluralité de dents (55) coopérant, séquentiellement, avec ledit bord (94) de ladite feuille (4), lesdites dents (55) pouvant être déplacées entre une position d'alimentation sortie et une position de repos rentrée sous l'effet du poids de ladite feuille (4) et à l'encontre de l'action d'un moyen de retenue élastique. 45
10. Unité (1) selon l'une quelconque des revendications précédentes, **caractérisée en ce que** ledit groupe (3) comprend un groupe (57) alimentant ladite feuille (4) audit dispositif d'alimentation commandé par un actionneur linéaire à mouvement alternatif (63). 50
11. Unité (1) selon l'une quelconque des revendications précédentes, **caractérisée en ce que** ledit groupe (3) comprend une pluralité d'aimants (64) retenant ladite feuille (4) sur ladite plaque (27) au cours de la course du dispositif d'alimentation, avec une orientation opposée par rapport à l'orientation d'alimentation de la feuille (4). 55
12. Unité (1) selon l'une quelconque des revendications précédentes, **caractérisée en ce que** ledit groupe (3) comprend un dispositif de guidage latéral (75) de la feuille (4), comprenant un guide fixe (92) et des moyens de poussée agissant sur ladite feuille (4) pour la maintenir en contact avec ledit guide fixe (91). 60

13. Unité (1) selon la revendication 12, **caractérisée en ce que** lesdits moyens de poussée comprennent un ressort pneumatique (83).

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FIG. 1

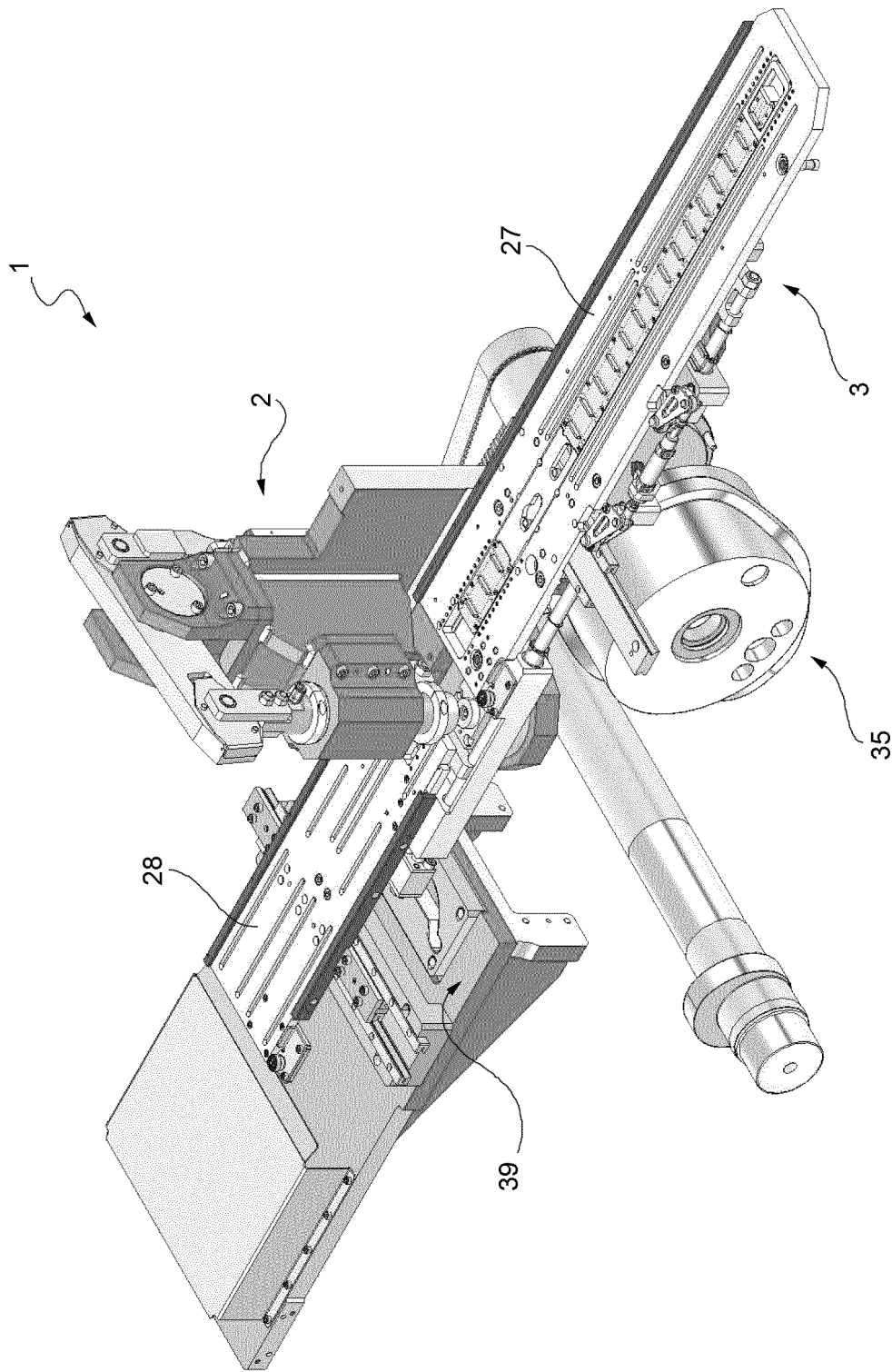


FIG. 2

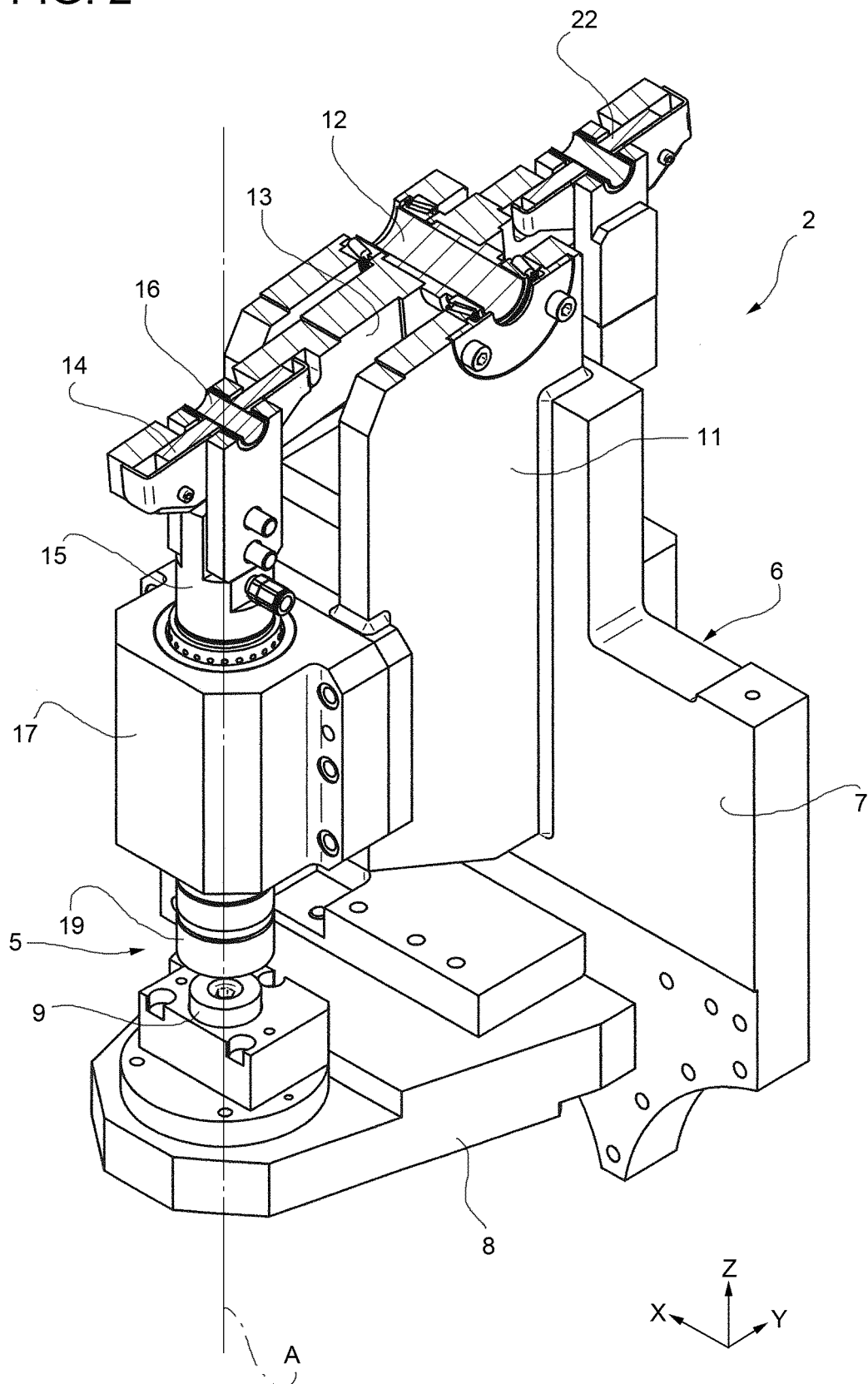


FIG. 3

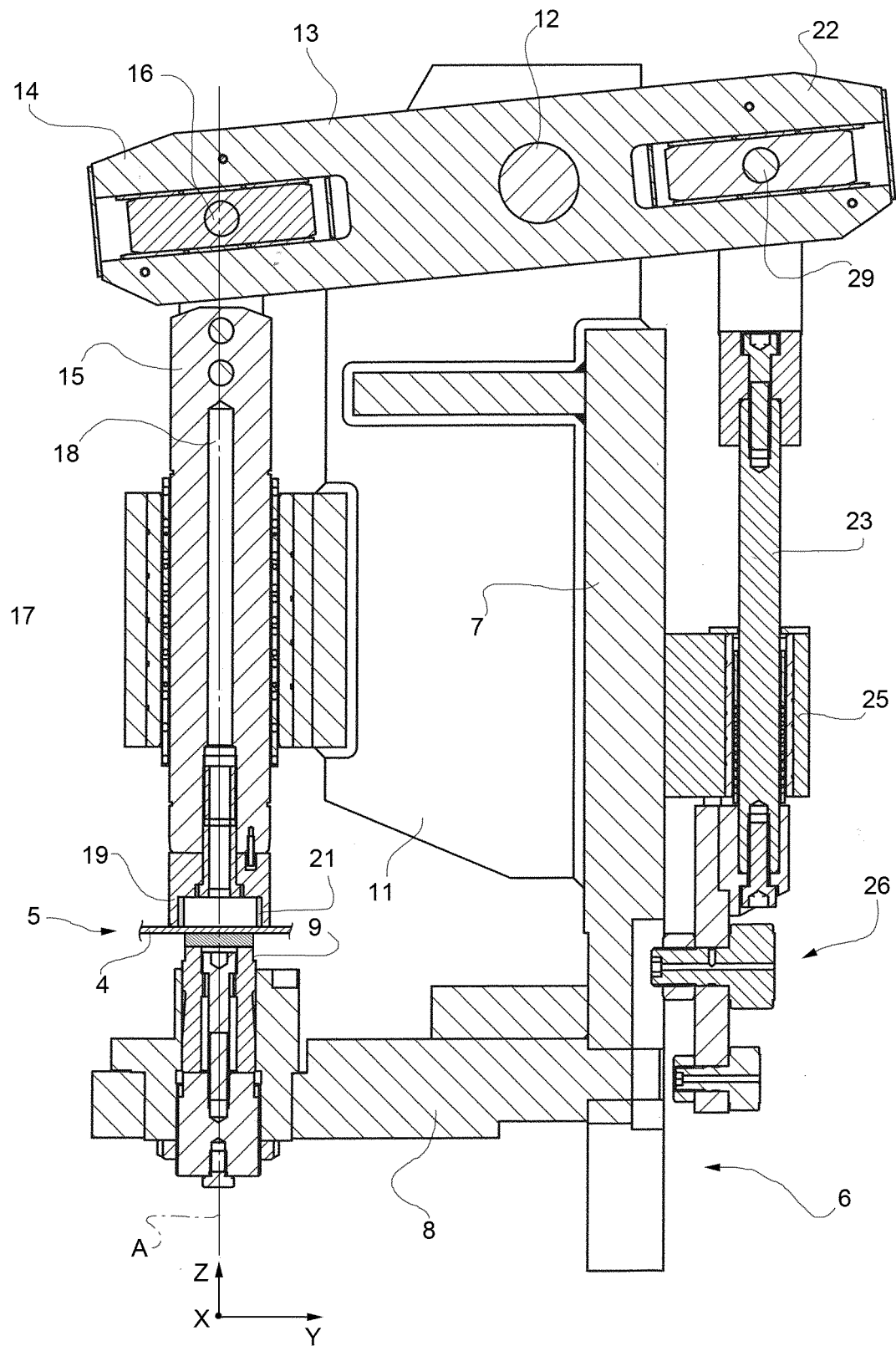
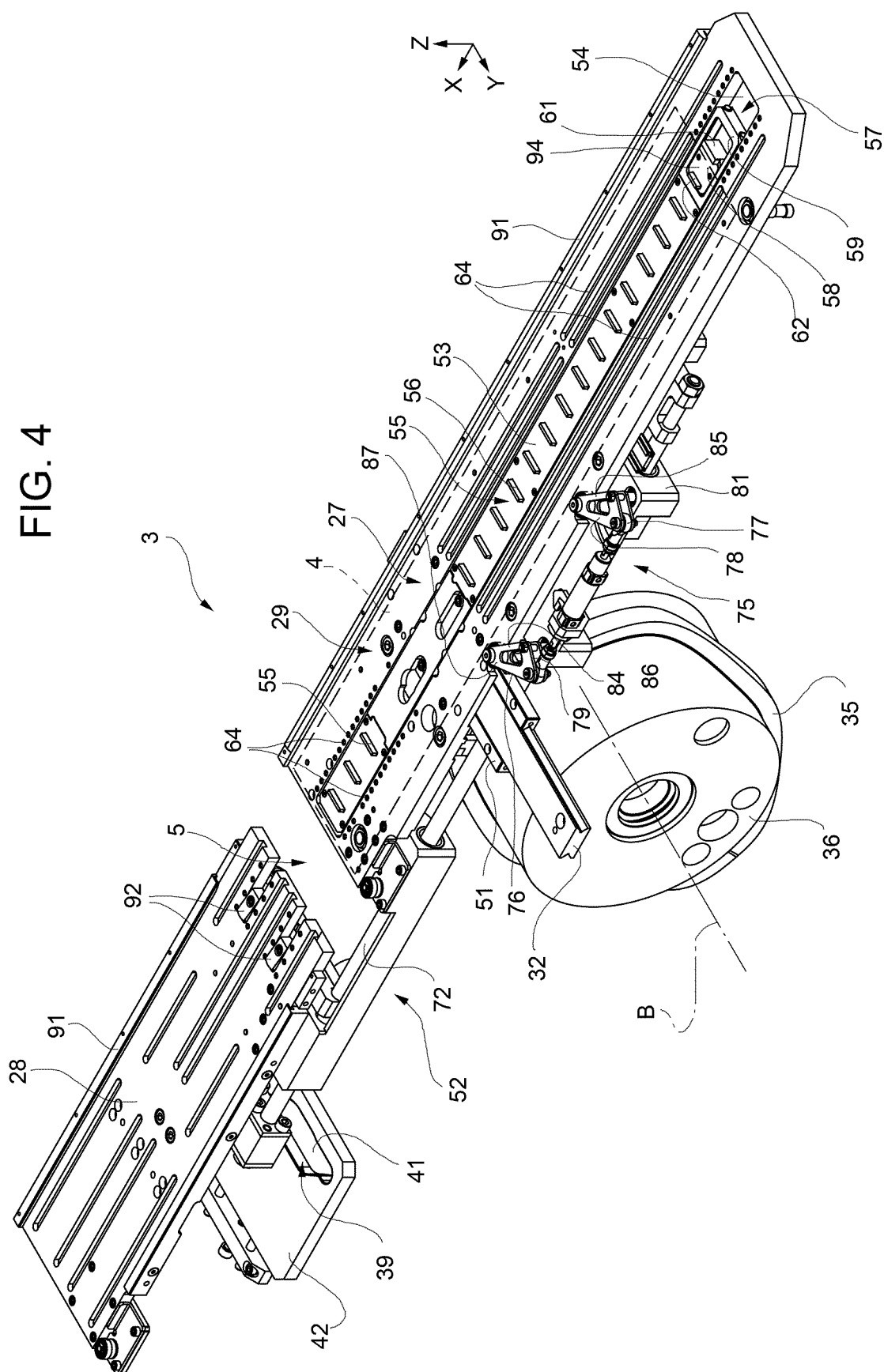


FIG. 4



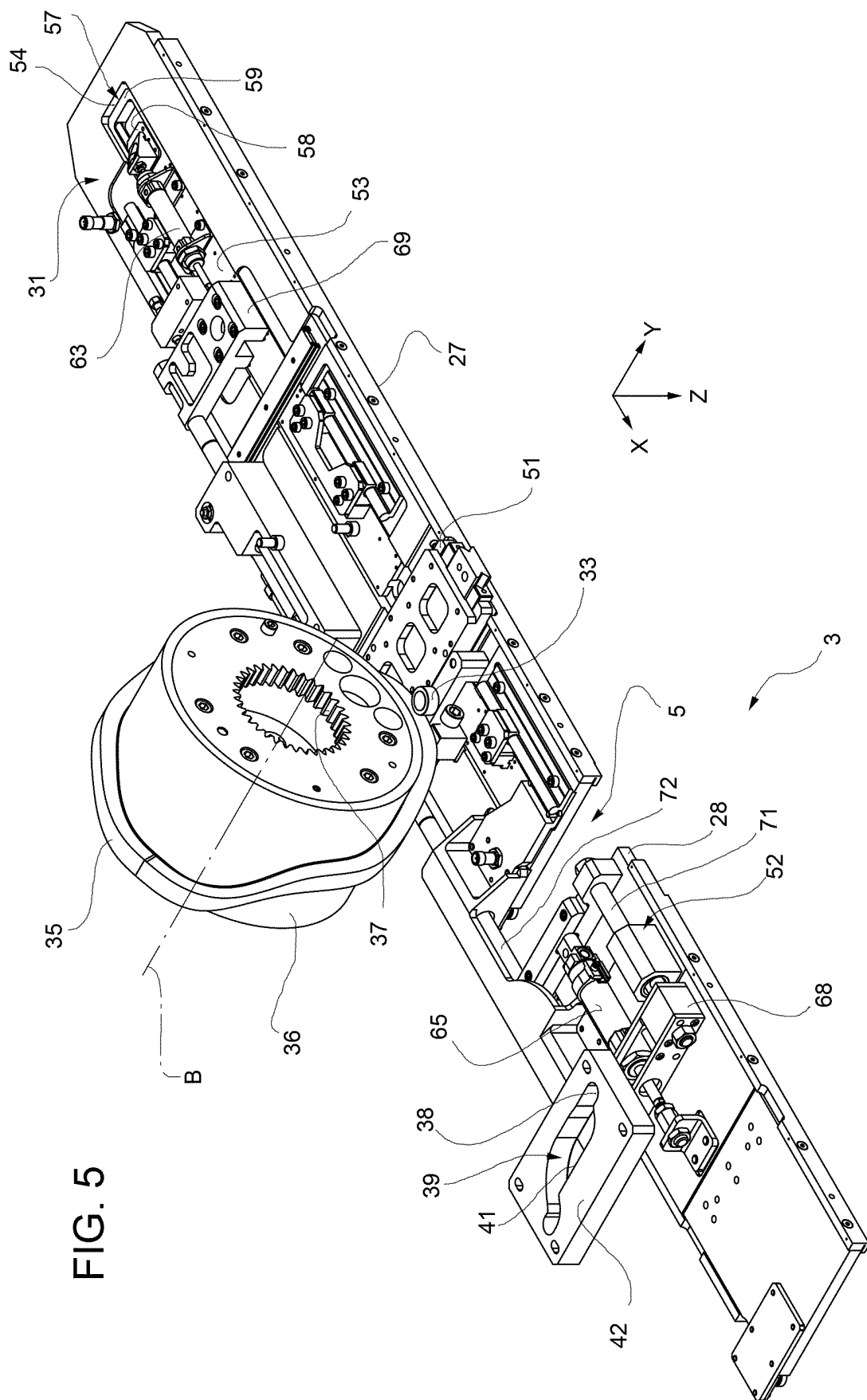


FIG. 5

FIG. 6

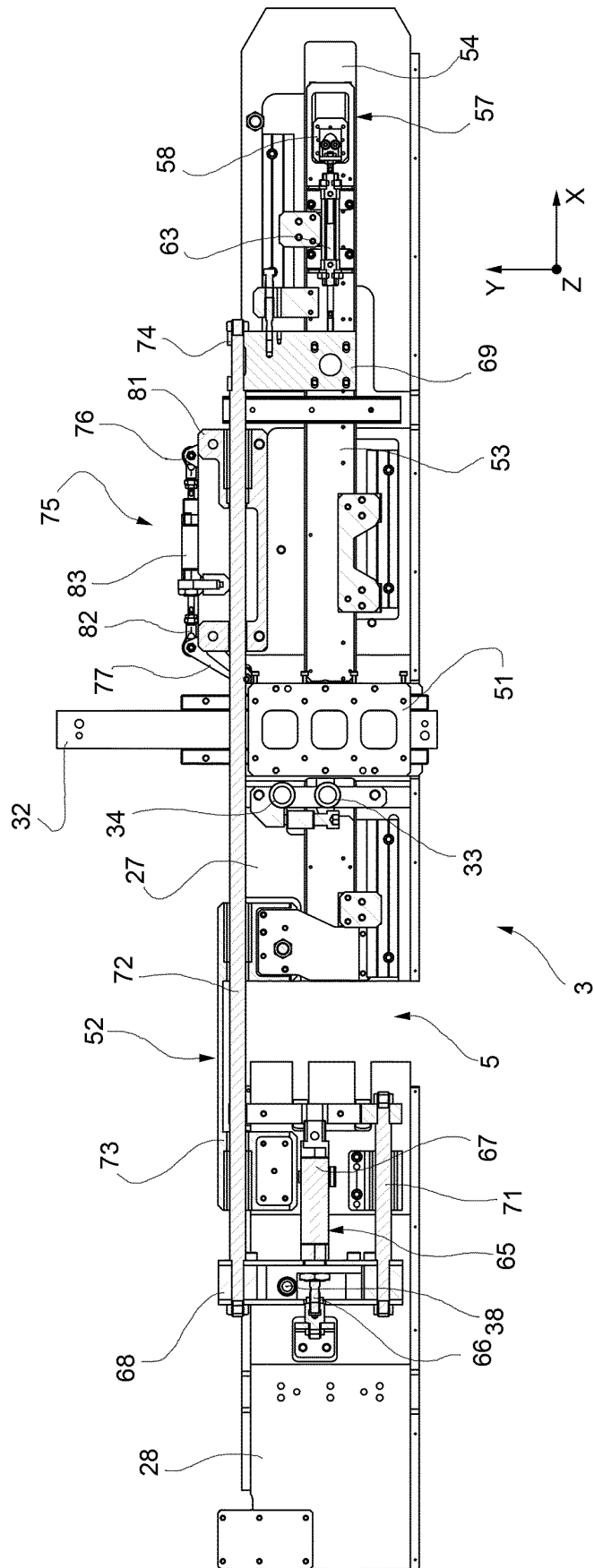


FIG. 7

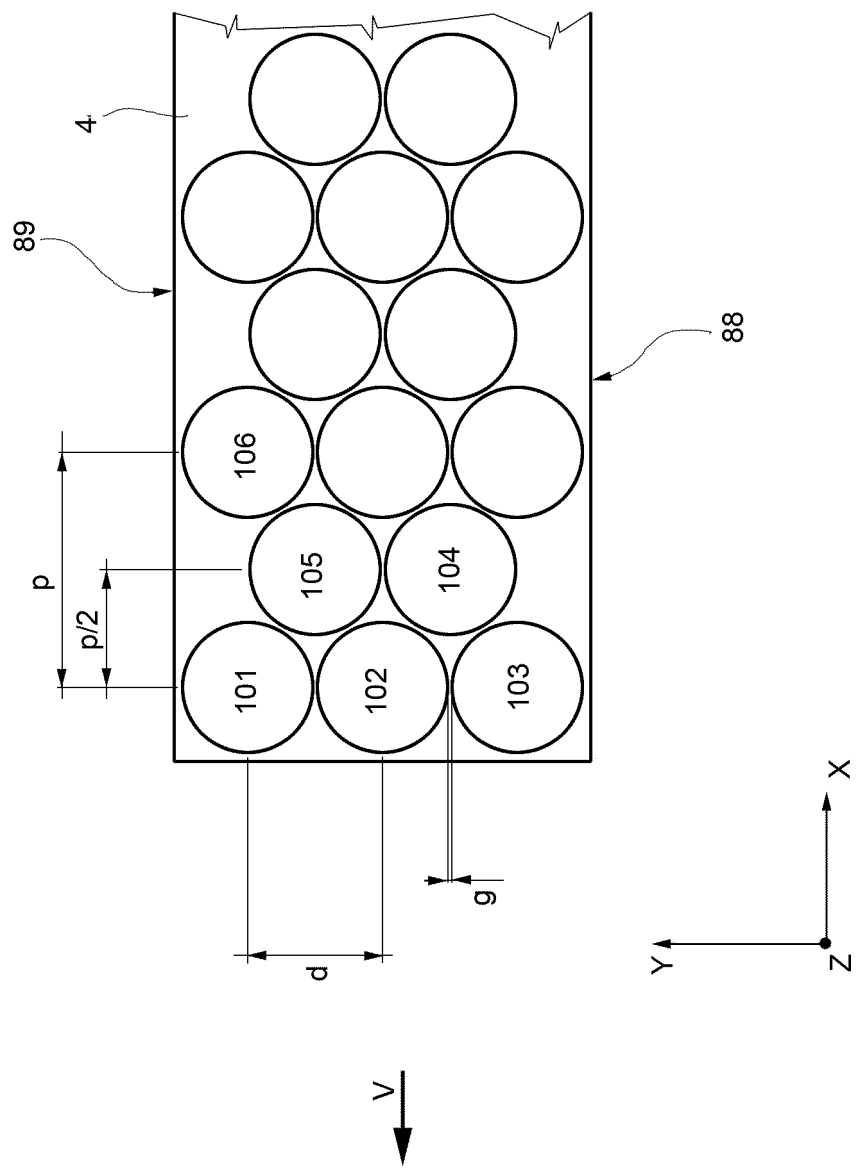


FIG. 8a

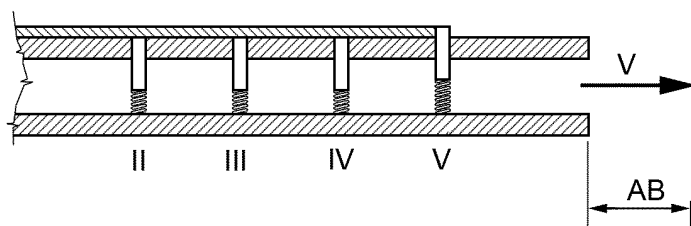


FIG. 8b

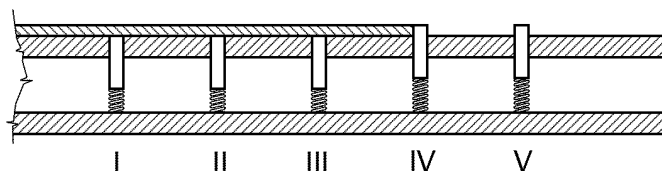


FIG. 8c

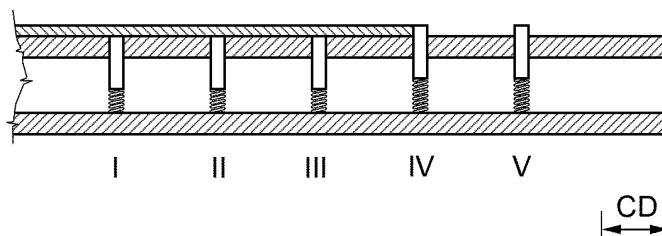


FIG. 8d

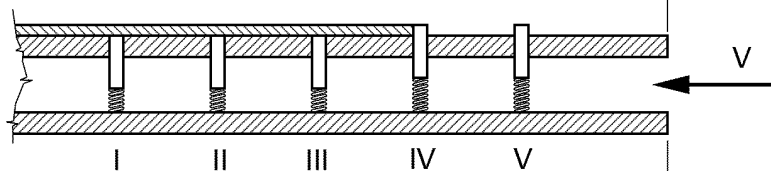


FIG. 8e

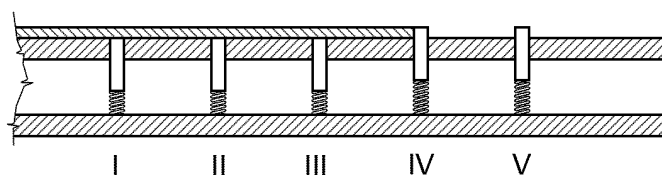
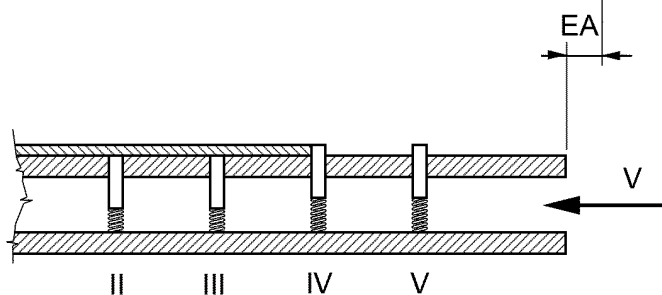


FIG. 8f



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4708043 A [0011]