

(19)



(11)

EP 3 445 586 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

17.04.2024 Bulletin 2024/16

(21) Application number: **17723010.9**

(22) Date of filing: **21.04.2017**

(51) International Patent Classification (IPC):
B41F 9/10^(2006.01)

(52) Cooperative Patent Classification (CPC):
**B41F 9/1009; B41F 9/1027; B41F 9/1036;
B41F 9/1072**

(86) International application number:
PCT/EP2017/025095

(87) International publication number:
WO 2017/182144 (26.10.2017 Gazette 2017/43)

(54) **A DOCTOR BLADE ASSEMBLY WITH SUPPORT IN A ROTOGRAVURE PRINTING UNIT**

RAKELANORDNUNG MIT UNTERSTÜTZUNG IN EINER TIEFDRUCKEINHEIT

ENSEMBLE DE RACLE AVEC SUPPORT DANS UNE UNITÉ D'IMPRESSION PAR ROTOGRAVURE

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **22.04.2016 IT UA20162812**

(43) Date of publication of application:
27.02.2019 Bulletin 2019/09

(73) Proprietor: **BOBST ITALIA S.P.A.
29121 Piacenza (PC) (IT)**

(72) Inventor: **MELOTTI, Renzo
15030 Sala Monferrato (AL) (IT)**

(74) Representative: **Hasler, David
Bobst Mex SA
Intellectual Property
Case postale
1001 Lausanne (CH)**

(56) References cited:
**EP-A1- 1 362 696 EP-A1- 2 657 020
CH-A- 551 868 DE-C- 756 363
US-A- 2 049 846 US-B2- 8 915 184**

EP 3 445 586 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention refers to rotogravure printing machines and in particular a printing unit with a novel support system for the doctor blade assembly.

[0002] Considering a generic rotogravure printing unit, this comprises a printing roller in tangential contact with a second roller, normally a rubber roller. The printing roller has on its outer surface a distribution of cells the pattern of which establishes the motif to be printed and that to this end are filled with ink. These ink filling the cells is transferred to a printing support inserted with a certain pressure between the rollers. However, the inked printing support has to be accurately shaved, so that only the strictly necessary amount of ink is transferred to the printing support, and us a high quality, clear print. To this purpose, a so-called doctor blade is provided, that is essentially a blade member arranged in a longitudinal and tangential fashion with respect to the roller. The blade then, as the printing roller rotates, removes the exceeding amount of ink from its outer surface, while the ink within the cells remain and, during the printing step, is transferred to the support to obtain the desired image and/or types.

[0003] When the printing roller surface is shaved, between such surface and the edge of the blade some ink clogs sometimes may occur, hindering a perfect shaving and causing print defects as a result of the unsatisfactory clearing of the printing roller from the exceeding ink.

[0004] Considering this problem, the blade is provided with a reciprocating drive that is a "to and fro" movement in a direction parallel to the axis of the roller. This motion achieves indeed a brushing effect capable of dislodging the clogs and ensures a higher effectiveness if conducted at high frequency, i.e. with a succession of fast runs having a reduced amplitude. At present, in order to ensure this drive, the whole doctor blade assembly (that is, the blade with its support frame and the relative calibration/adjustment systems) is held by linear bearings, which however due to the high frequency of the motion, considering also the remarkable inertia of the assembly (it can even reach a weight of 200 kg) are subject to a rapid wear with consequent vibrations and plays the necessarily affect the mutual positioning of the various printing elements, eventually causing problems to the same print and quality decay.

[0005] US 6,752,077B discloses a doctor blade assembly where transverse oscillations of the doctor blade are induced by an oscillator and absorbed by a dedicated absorber. The oscillation amplitude is in the sub.-millimeter range, allowing the whole system to be held by rigid arms.

[0006] US 8,915,184B discloses a doctor blade assembly where the transverse oscillations of the doctor blade are guided by a linear guide. The contact with the engraved cylinder is maintained with a helical spring whose preload force can be set manually.

[0007] It is, therefore, an object of the present invention

to solve the above-mentioned problem, providing a movable support system for the blade ensuring improved precision, quality, reliability with respect to the known systems.

5 **[0008]** A particular object of the present invention is also to provide a system of the above-mentioned type, which permits an easy and safe control by an operator from the outside of the machine, namely via safe commands at a distanced position from the potentially hazardous region of the machine.

10 **[0009]** These objects are achieved with the doctor blade assembly with an elastic support in a rotogravure printing unit according to the invention, the essential features of which are defined by the first of the appended claims.

15 **[0010]** The characteristics and advantages of the doctor blade assembly with an elastic support in a rotogravure printing unit according to the invention will become apparent from the following description of an embodiment thereof, provided by way of examples, with reference to the attached drawings wherein:

- figure 1 is an axonometric view of a printing unit, with some elements like the printing roller and its counter-roller that have been omitted for the sake of clarity, in which a device for supporting and adjusting the position of the doctor blade according to the invention is visible;
- 25 - figures 2 and 3 show the device of figure 1 in isolation, with two axonometric views from different angles;
- 30 - figures 4 and 5 are respectively a bottom view and a front view (with some parts represented according to an axial cross section) of the device of the previous figures, again shown in isolation; and
- 35 - figure 6 is a sectional view taken along the plane indicated by the arrows VI of figure 5.

40 **[0011]** With reference to the above figures, a rotogravure printing unit comprises a printing roller and a rubber roller, not shown here, held by a frame 1. The rotation axis of the printing roller is sketched in figure 1 and indicated at X.

45 **[0012]** The present invention specifically concerns a doctor blade assembly comprising a shaft 2, typically with a cylindrical shape, extending along an axis/direction X' parallel with the roller axis X and supporting, as explained hereafter, the actual blade member 31 via a pair of clamping bars 3.

50 **[0013]** According to the invention, the shaft 2 is held at its ends, corresponding to respective axial ends of the printing rollers, by two elastically flexible laminar members 41, 42 lying over respective diametrical planes orthogonal to axis X'. More precisely, the laminar members 41, 42 are attached to the frame 1 at two mutually spaced regions 41a, 41b, 42a, 42b, that for instance and prefer-

ably are approximately aligned with each other (in each member), according to a vertical direction or in any case a direction approaching the vertical. The support of the shaft 2 occurs at an intermediate position between the two attachment regions, so that the same shaft is compliant to a reciprocating motion along its own axis X', by the effect of the deformability of the member when subject to a bending stress. This elastic deformability is obtained from the use of a suitable material such as spring steel along with the laminar nature of the member.

[0014] Each deformable element comprise two attachment points to the fixed frame. The objective of the attachment configuration is to block the movement of the blade along any direction perpendicular the direction of the reciprocating motion (called the *spurious motion* here). There are several possible configuration that can achieve this goal; these configuration are characterized by the absolute angle between the line connecting the first point of connection of the laminar member (for example 41a) to the axis X' and the line connecting the second connecting point of the laminar member (for example 41b) to the axis X'. This angle should be larger than 30 degrees (for example, a value of 45 degrees puts the two attachment points 41a and 41b on the same side compared to the axis X'). To reduce the displacement of the doctor blade along the direction of the laminar member (perpendicular to axis X'), the attachment points are preferably located at opposite sides of axis X', for example with said absolute angle between 170 and 180 degrees (or at least larger than 135 degrees to obtain this reduction). Also, the length of the laminar element (between the connection point and the axis X') must be set large enough compared to the amplitude of the motion. This is because, when the attachments points are not perfectly symmetric around axis X' (i.e. an angle of 180 degrees when using two attachment points), the blade tends to move along a circle segment, whose radius (which is linked to said length) must be large enough so that the circle segment does not depart from the tangent of said circle by more than the tolerance about the spurious motion maximum amplitude. A typical tolerance is a maximum spurious motion of 0.1mm for web width comprised between 60cm and 220cm, and an angular tolerance smaller than 1 arc min. For example, the length is chosen to be of the order of 1m for a 5mm doctor blade motion. Nevertheless, the length cannot be chosen arbitrarily large to ensure enough stiffness.

[0015] One of the attachment regions further provides for a compliant system adapted to permit some adjustment of the position of the axis of the shaft, and thus the correction of possible parallelism errors of the blade with respect to the axis of the printing roller. To this purpose, at least one of the laminar member provides for a device with a control knob 94 that can be actuated from the outside of the frame and operates with the opposing force of a spring 95 on the connection between the laminar member (in this case the laminar member 42) and the frame, to the end of modifying the slant of the same lam-

inar member.

[0016] A motor 5 is anchored to the frame 1 on the side of a first laminar member 41 (externally to the space delimited by the two laminar blades) and via an obviously designed eccentric system obviously transmits a reciprocating drive to an arm 6, in turn extending along the axis X' or parallel therewith. The arm 6, on an opposite side with respect to the linking side to the motor 5, is connected to the laminar member 41 at a region close to the support point of the shaft. Also, the arm has a flexible structure, to absorb the stresses and allow for the parallelism corrections. The shaking thus transmitted to the assembly of the arm and laminar members, permitted by the elastic flexion of the members, actuates the reciprocating motion along the axis X' with an amplitude of some mm - typically between 2 and 8 mm - that permits to provide the blade with the desired "to and fro" brushing movement. The amplitude of the motion (between 2 and 8 mm) is large enough to be able to dislodging the clogs. For example the amplitude can be set to 4 mm.

[0017] Externally to the second laminar element 42, and therefore at an axially opposite side with respect to the motor 5, the movement of the shaft (in a direction away from the same motor) is hindered by an adjustable preload device 7, controlled as explained hereafter, that in an embodiment comprises a helical spring 71 having the function to exert a thrust as a result of its compression between the second laminar member 42 and frame 1.

[0018] Considering again the blade support system by the shaft 2, the already mentioned clamping bars 3, between which the blade 31 is clamped with screw means 32 of a known type, extend between the free ends of stems 81 that project in a substantially tangential arrangement from the shaft 2. The stems 81 are in fact slidable along their own axes Y (indeed, tangential or in any case hitting the side surface of the shaft over a plane normal to the shaft axis) inside respective guides 82 connected to the shaft 2 (as more precisely described shortly), the sliding being hindered/cushioned by respective pneumatic dampers 83. This mechanism serves to provide the blade with the cushioned pressing function that is necessary to "squeeze" the ink over the printing roller.

[0019] The guides 82 are in turn supported by the shaft 2 in such a way to ensure a displacement thereof (and with it the displacement of all the assembly of stems, dampers, bars and blade) to accomplish an adjustment depending on the specific geometry of the working circumstances. This displacement occurs linearly according to a tangential direction with respect to the shaft (indeed coinciding with the axis Y) within seatings 21a formed for this purpose by the shaft 2, or more properly by a sleeve 21 of the shaft. The latter has, in fact, a structure in two pieces, with the mentioned sleeve that coaxially houses in a rotatable fashion, via bearings 23, a core 22. As visible in particular in figures 5 and 6, the core 22 has two geared pinion portions 22a that mesh with respective rack 82a integral with the guides 82 so that from a rotation of the core the above cited adjustable displace-

ment of the guides ensues.

[0020] This adjustment as just described, i.e. the rotation of the core, is actuated manually via a first crank 91 accessible from the outside at a front side 10 of the frame 1. The crank 91 rotatably drives a spindle 92, in turn having a tangential axis with respect to the shaft 2 over a plane orthogonal to the axis X', meshing via a gear transmission with an end of the core 22, in this case, adjacent to the motor 5.

[0021] At the other axial end of the shaft, that is the one adjacent to the second laminar member 42 and supported by this very end, the preload adjustment system is arranged, comprising a crank to be actuated from the outside. This adjustment operates through suitable gearings on the device 7, compressing to a variable extent the above-mentioned spring 71 and thus affecting the preload.

[0022] The above clearly shows that the support according to the invention permits to achieve the required brushing motion of the doctor blade, by simply exploiting an elastic deformation, and then without the wear due to friction that in the known art ensue from the sliding motion of a remarkable mass, such as that of the doctor blade assembly. The consequent reduction of vibrations and plays in general improves the printing performance and ensures an increased overall work reliability, a longer life of the machine and a reduction of the maintenance needs. Moreover, the elastic support system permits to effectively optimise the architecture of the unit finalised to greater safety, with drive/transmission systems that permit an easy control of the unit adjustments through actuation means external to the hazardous area and comfortably available to the operator.

[0023] When mentioning an absolute value of an angle in this invention, we mean an angle with a positive value comprised between 0 and 180 degrees. It is understood that when measuring an angle between two arbitrary intersecting lines, it is always possible to obtain said angle value between 0 and 180 degrees.

Claims

1. A doctor blade assembly suitable for a rotogravure printing unit, the assembly comprising a doctor blade (31), doctor blade support means adapted to be connected to a fixed frame (1) of the unit and to permit a reciprocating motion of the blade along a motion axis (X') parallel to the elongation direction of the blade, and drive means functionally linked with the blade to transmit said reciprocating motion thereto, **characterized in that** the support means comprise a pair of elastically deformable laminar members (41, 42) arranged between respective end regions of said blade (31) and said fixed frame (1), said members (41, 42) extend over respective planes orthogonal to the motion axis (X') and are arranged to allow said reciprocating motion while blocking the movement

of the blade along any direction perpendicular to the motion axis (X').

2. The assembly according to claim 1, wherein the blade support means comprise a shaft (2) centered on the motion axis (X') and from which the blade is spaced in a parallel fashion, wherein the shaft is connected to the laminar members at a point of connection, wherein each laminar member comprise two attachment points to the fixed frame, and wherein an angle between the line connecting the first attachment point to said point of connection and the line from said point of connection to the second attachment point, measured in the plane perpendicular to the motion axis, has an absolute value larger than 30 degrees, preferably larger than 135 degrees, preferably larger than 170 degrees, preferably equal to 180 degrees.
3. The assembly according to claim 2, wherein in each laminar member (41,42), the two attachment regions to the fixed frame and the intermediate point of connection to the shaft (2) are substantially aligned.
4. The assembly according to claim 2 or 3, wherein said drive means comprise a transmission arm (6) connected between a motor (5) and a first (41) of said laminar members, adapted to transmit a shaking force along said motion axis (X') to said first element.
5. The assembly according to claim 4, comprising eccentric means arranged between said motor (5) and said arm (6) adapted to convert the rotational motion of the first into said shaking motion.
6. The assembly according to claim 4 or 5, comprising adjustable preload means (7) associated with a second (42) of said elastic elements.
7. The assembly according to claim 6, wherein said preload means (7) comprise a helical spring (71) urged in compression between said second elastic element (42) and said fixed frame (1), and preload adjustment means adapted to vary the compression force acting on the spring, provided with actuation means (93) adapted to be controlled from an outer region of said fixed frame (1).
8. The assembly according to any of the claims 2 to 7, wherein said shaft (2) comprises a sleeve (21) fixed to said laminar members, and a core (22) adapted to rotate inside said sleeve (21) around said motion axis (X'), the blade support means (31) comprising guide means (82) projecting in a displaceable fashion from said sleeve (21) of said shaft, said guide means being engaged via gears with said core so that the displacement of the guide means is responsive to a rotation of the core, actuation means (91)

being further provided for controlling the rotation of the core, adapted to be controlled from an outer region of said fixed frame (1).

9. The assembly according to claim 8, wherein said blade (31) is supported by a bar (3) sustained by at least two stems (81) that project in a substantially tangential fashion from said shaft (2) sliding on said guide means (82), the sliding being opposed by damper means (83).

Patentansprüche

1. Raketklingenanordnung, die für eine Tiefdruckeinheit geeignet ist, wobei die Anordnung eine Raketklinge (31), Raketklingenstützmittel, die angepasst sind, mit einem festen Rahmen (1) der Einheit verbunden zu sein und eine Hin- und Herbewegung der Klinge entlang einer Bewegungsachse (X') parallel zur Ausdehnungsrichtung der Klinge zu erlauben, und Antriebsmittel umfasst, die funktionell mit der Klinge verbunden sind, um die Hin- und Herbewegung darauf zu übertragen, **dadurch gekennzeichnet, dass** die Stützmittel ein Paar elastisch verformbarer Laminarkomponenten (41, 42) umfassen, das zwischen jeweiligen Endbereichen der Klinge (31) und dem festen Rahmen (1) eingerichtet ist, wobei sich die Komponenten (41, 42) über jeweilige Ebenen orthogonal zur Bewegungsachse (X') erstrecken und eingerichtet sind, um die Hin- und Herbewegung zu erlauben, während die Bewegung der Klinge entlang einer beliebigen Richtung senkrecht zur Bewegungsachse (X') blockiert wird.
2. Anordnung nach Anspruch 1, wobei die Klingensstützmittel eine Welle (2) umfassen, die auf der Bewegungsachse (X') zentriert ist und von der die Klinge parallel beabstandet ist, wobei die Welle an einem Verbindungspunkt mit den Laminarkomponenten verbunden ist, wobei jede Laminarkomponente zwei Befestigungspunkte mit dem festen Rahmen umfasst und wobei ein Winkel zwischen der Linie, die den ersten Befestigungspunkt mit dem Verbindungspunkt verbindet, und der Linie vom Verbindungspunkt zum zweiten Befestigungspunkt, gemessen in der Ebene senkrecht zur Bewegungsachse, einen absoluten Wert größer als 30 Grad, bevorzugt größer als 135 Grad, bevorzugt größer als 170 Grad, bevorzugt größer als 180 Grad aufweist.
3. Anordnung nach Anspruch 2, wobei in jeder Laminarkomponente (41, 42) die zwei Befestigungsbe-
reiche am festen Rahmen und der Zwischenverbindungspunkt an der Welle (2) im Wesentlichen fluchten.
4. Anordnung nach Anspruch 2 oder 3, wobei die An-

triebsmittel einen Getriebearm (6) umfassen, der zwischen einem Motor (5) und einer ersten (41) der Laminarkomponenten verbunden ist, der angepasst ist, eine Schüttelkraft entlang der Bewegungsachse (X') auf das erste Bauelement zu übertragen.

5. Anordnung nach Anspruch 4, umfassend exzentrische Mittel, die zwischen dem Motor (5) und dem Arm (6) eingerichtet sind, die angepasst sind, um die Drehbewegung der ersten in die Schüttelbewegung umzuwandeln.
6. Anordnung nach Anspruch 4 oder 5, umfassend einstellbare Vorspannmittel (7), die mit einem zweiten (42) der elastischen Bauelemente verknüpft sind.
7. Anordnung nach Anspruch 6, wobei die Vorspannmittel (7) eine Schraubenfeder (71), die zwischen dem zweiten elastischen Bauelement (42) und dem festen Rahmen (1) in Kompression gedrängt wird, und Vorspanneinstellungsmittel umfassen, die angepasst sind, die Kompressionskraft, die auf die Feder wirkt, zu variieren, die mit Betätigungsmitteln (93) bereitgestellt sind, die angepasst sind, von einem Außenbereich des festen Rahmens (1) aus gesteuert zu werden.
8. Anordnung nach einem der Ansprüche 2 bis 7, wobei die Welle (2) eine Hülse (21), die an den Laminarkomponenten befestigt ist, und einen Kern (22) umfasst, der angepasst ist, sich innerhalb der Hülse (21) um die Bewegungsachse (X') zu drehen, wobei die Klingensstützmittel (31) Führungsmittel (82) umfassen, die verschiebbar aus der Hülse (21) der Welle hervorstehen, wobei die Führungsmittel über Zahnräder mit dem Kern in Eingriff genommen werden, sodass die Verschiebung der Führungsmittel auf eine Drehung des Kerns anspricht, wobei Betätigungsmittel (91) weiter zum Steuern der Drehung des Kerns bereitgestellt sind, die angepasst sind, von einem Außenbereich des festen Rahmens (1) aus gesteuert zu werden.
9. Anordnung nach Anspruch 8, wobei die Klinge (31) von einem Stab (3) gestützt wird, der von mindestens zwei Halmen (81) getragen wird, die im Wesentlichen tangential auf den Führungsmitteln (82) gleitend aus der Welle (2) hervorstehen, wobei Dämpfungsmittel (83) dem Gleiten entgegenwirken.

Revendications

1. Ensemble racle convenant à une unité d'impression par rotogravure, l'ensemble comprenant une racle (31), des moyens de support de racle conçus pour être reliés à un cadre fixe (1) de l'unité et pour permettre un mouvement de va-et-vient de la racle le

- long d'un axe de mouvement (X') parallèle à la direction d'allongement de la racle, et des moyens d'entraînement fonctionnellement liés à la racle pour transmettre ledit mouvement de va-et-vient à celle-ci, **caractérisé en ce que** les moyens de support comprennent une paire d'éléments laminaires élastiquement déformables (41, 42) agencés entre des régions d'extrémité respectives de ladite racle (31) et dudit cadre fixe (1), lesdits éléments (41, 42) s'étendent sur des plans respectifs perpendiculaires à l'axe de mouvement (X') et sont agencés pour permettre ledit mouvement de va-et-vient tout en bloquant le mouvement de la racle le long de toute direction perpendiculaire à l'axe de mouvement (X').
2. Ensemble selon la revendication 1, dans lequel les moyens de support de racle comprennent un arbre (2) centré sur l'axe de mouvement (X') et duquel la racle est espacée de façon parallèle, dans lequel l'arbre est relié aux éléments laminaires en un point de liaison, dans lequel chaque élément laminaire comprend deux points de fixation au cadre fixe, et dans lequel un angle entre la ligne reliant le premier point de fixation audit point de liaison et la ligne dudit point de liaison au second point de fixation, mesuré dans le plan perpendiculaire à l'axe de mouvement, présente une valeur absolue supérieure à 30 degrés, de préférence supérieure à 135 degrés, de préférence supérieure à 170 degrés, de préférence égale à 180 degrés.
 3. Ensemble selon la revendication 2, dans lequel, dans chaque élément laminaire (41, 42), les deux régions de fixation au cadre fixe et le point de liaison intermédiaire à l'arbre (2) sont sensiblement alignés.
 4. Ensemble selon la revendication 2 ou 3, dans lequel lesdits moyens d'entraînement comprennent un bras de transmission (6) monté entre un moteur (5) et un premier élément (41) desdits éléments laminaires, conçu pour transmettre une force de secousse le long dudit axe de mouvement (X') audit premier élément.
 5. Ensemble selon la revendication 4, comprenant des moyens excentriques agencés entre ledit moteur (5) et ledit bras (6) conçus pour convertir le mouvement de rotation du premier en ledit mouvement de secousse.
 6. Ensemble selon la revendication 4 ou 5, comprenant des moyens de précharge réglables (7) associés à un second élément (42) desdits éléments élastiques.
 7. Ensemble selon la revendication 6, dans lequel lesdits moyens de précharge (7) comprennent un ressort hélicoïdal (71) poussé en compression entre ledit second élément élastique (42) et ledit cadre fixe (1), et des moyens de réglage de précharge conçus pour faire varier la force de compression agissant sur le ressort, dotés de moyens d'actionnement (93) conçus pour être commandés à partir d'une région extérieure dudit cadre fixe (1).
 8. Ensemble selon l'une quelconque des revendications 2 à 7, dans lequel ledit arbre (2) comprend un manchon (21) fixé auxdits éléments laminaires, et un noyau (22) conçu pour tourner à l'intérieur dudit manchon (21) autour dudit axe de mouvement (X'), les moyens de support de racle (31) comprenant des moyens de guidage (82) faisant saillie de manière déplaçable à partir dudit manchon (21) dudit arbre, lesdits moyens de guidage étant en prise par l'intermédiaire d'engrenages avec ledit noyau de sorte que le déplacement des moyens de guidage réponde à une rotation du noyau, des moyens d'actionnement (91) étant en outre présents pour commander la rotation du noyau, conçus pour être commandés à partir d'une région extérieure dudit cadre fixe (1).
 9. Ensemble selon la revendication 8, dans lequel ladite racle (31) est supportée par une barre (3) soutenue par au moins deux tiges (81) qui font saillie de façon sensiblement tangentielle à partir dudit arbre (2) en couissant sur lesdits moyens de guidage (82), le couissement étant contré par des moyens amortisseurs (83).

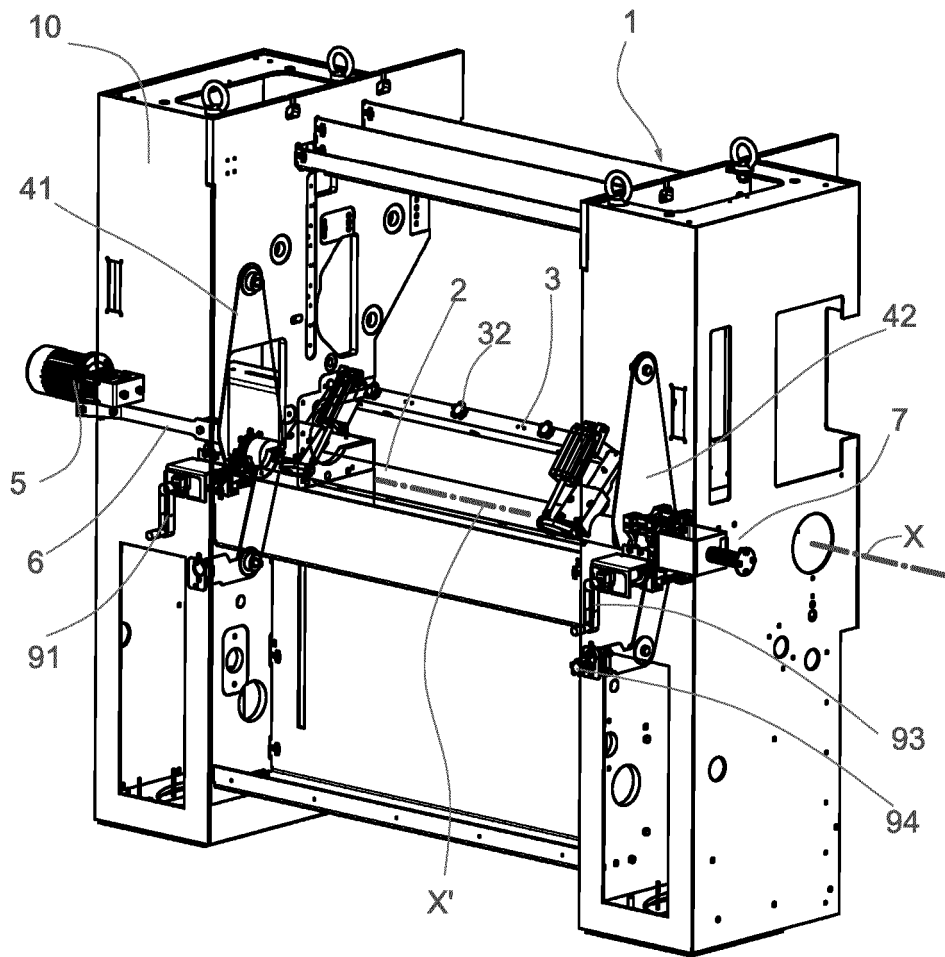


Fig. 1

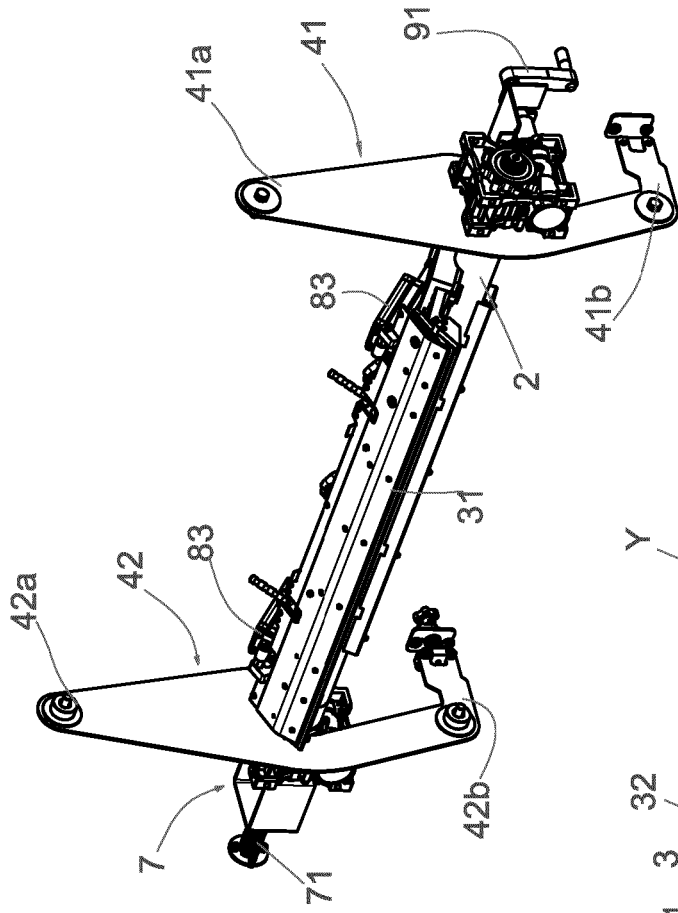


Fig. 2

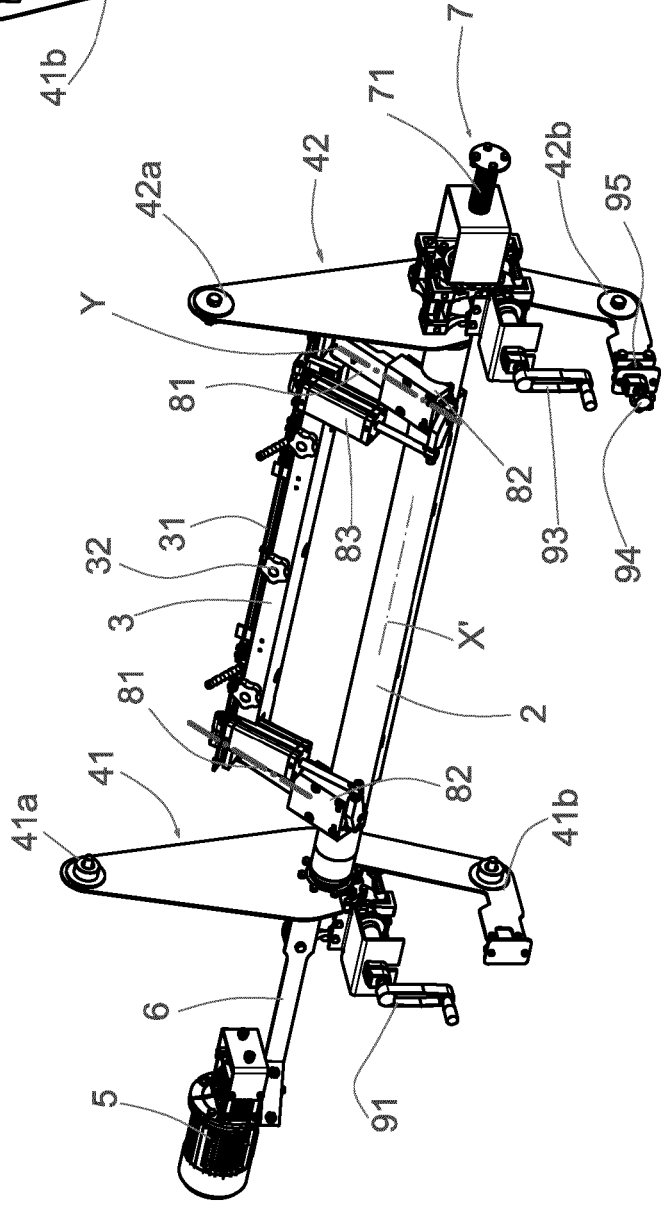


Fig. 3

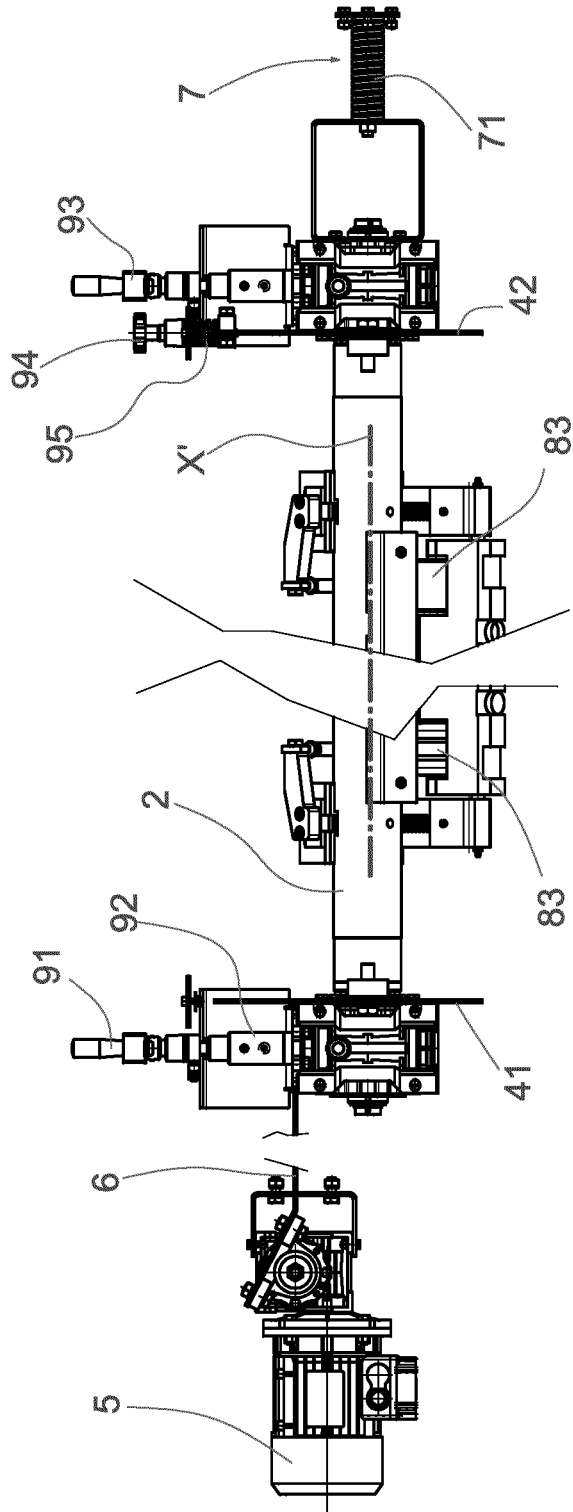


Fig. 4

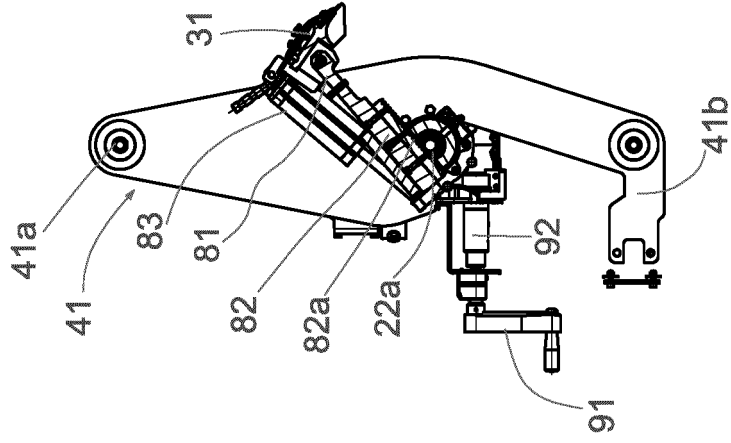


Fig. 6

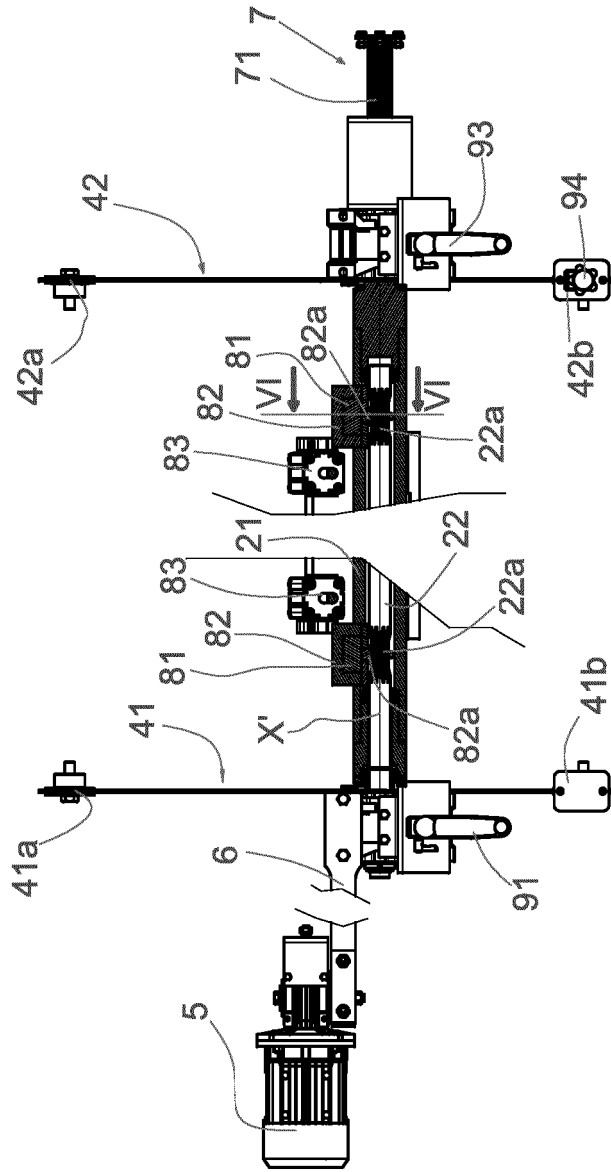


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 6752077 B [0005]
- US 8915184 B [0006]