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(54) **A gripping unit and a method for gripping a paper**

(57) The invention relates to a gripping unit for gripping a paper from a top surface of a stack, comprising a first and second wheel (2,5) having rotation axes that are mainly parallel with respect to each other. The first wheel (5) is arranged to exert a friction force on sections of a paper (20) during removal of the paper. The gripping unit further comprises an actuator (12) on which the first wheel (5) is mounted for moving the first wheel (5) in a moving direction towards the second wheel (2). In addition,

the gripping unit comprises an airflow generator (16) for providing an air flow following a flow path (31) directed substantially along the moving direction of the first wheel (5) towards a side surface (32) of the stack and upon approaching said side surface (32) directing away from the stack in a direction substantially transverse with respect to the top surface of the stack.

EP 2 067 723 A1

Description

[0001] The invention relates to a gripping unit for gripping a paper from a top surface of a stack, comprising a first and second wheel having rotation axes that are mainly parallel with respect to each other, the first wheel being arranged to exert a friction force on sections of a paper during removal of the paper, the gripping unit further comprising an actuator on which the first wheel is mounted for moving the first wheel in a moving direction towards the second wheel.

[0002] Such a gripping unit for gripping a paper is e.g. known in the field of computer-to-plate imaging processes, wherein printing plates are picked up from a multiple plate stack. In the stack, each printing plate is sandwiched between a paper sheet to avoid damages on the surface of the plates and to avoid interaction of the printing plate's surfaces, which are regularly manufactured from aluminium. In the process of handling the printing plates, elements on the stack are sequentially removed, thus in an alternating way a printing plate and a paper sheet. The printing plates are e.g. handled for processing, e.g. by exposing radiation to the printing plate. The paper sheets are removed and deposited in a box.

[0003] To remove a paper which is located on a top surface of the stack, the known gripping unit is positioned above the paper, such that the first and second wheel each exerts a friction force on sections of the paper. Then the actuator of the gripping unit moves the first wheel from the initial position towards the second wheel, so that the paper between the two friction wheels is folding upwardly and subsequently pressed between vertically oriented contact portions of the wheels facing each other. The paper can then be removed from the stack.

[0004] It is noted, however, that during the above-described paper removal process, frictional damage can occur on the top layer of some offset plate types. In particular, a top friction surface layer on the wheels might cause damage to a photosensitive layer of the plate.

[0005] It is an object of the invention to provide a gripping unit according to the preamble, wherein the disadvantage identified above is reduced. In particular, the invention aims at obtaining a gripping unit wherein damage on a photosensitive layer of the plate is counteracted. Thereto, according to an aspect of the invention, the gripping unit further comprises an additional actuator for moving the second wheel towards the paper on the top surface of the stack and wherein the gripping unit also comprises an airflow generator for providing an air flow following a flow path from adjacent a paper surface directed away from the stack in a direction substantially transversely with respect to the top surface of the stack.

[0006] By providing an air flow following a flow path from adjacent a paper surface directed away from the stack in a direction substantially transversely with respect to the top surface of the stack, a paper section can be lifted from the stack by the applied air flow, thereby counteracting adhesion forces between the paper and the sur-

face below the paper, e.g. a printing plate, so that the paper can be gripped without exerting a substantial friction force on the stack. As a consequence, damage on the top surface of the plates is counteracted. By moving the second wheel towards the paper on the top surface of the stack it is counteracted that the paper is blown away by the applied air flow in an uncontrolled manner.

[0007] In using the gripping unit according to the invention, it is not necessary to move the gripping unit towards the centre of the sheet to grip the paper, it might be sufficient to grip a paper near a border region of the paper.

[0008] It is noted that the unpublished European patent application EP 06076146.7 filed by the applicant discloses a gripping unit for gripping a paper from a top surface of a stack, comprising an airflow generator for providing a flow of air between a paper to be gripped and a surface below the paper.

[0009] In an advantageous embodiment according to an aspect of the invention, the flow path is directed substantially along the moving direction of the first wheel towards a side surface of the stack and upon approaching said side surface directing away from the stack in a direction substantially transversely with respect to the top surface of the stack. In designing such a flow path, the airflow generator can advantageously be provided on or near the actuator for moving the first wheel in the moving direction towards the second wheel. Further, as the air flow is first directed to the side surface and then away from the stack, upwardly, the process of lifting the paper from the stack can be optimized. Further, the reliability of the gripping unit can be further improved. Alternatively, the air flow can be designed otherwise, e.g. by providing an air flow directed above and along the paper to be lifted and then in a certain area directed away from the stack, upwardly, thus creating a local underpressure above a certain paper area, so that the paper is subjected to a pull force directed away from the stack, upwardly.

[0010] In this context it is noted that the top surface of the stack can be oriented in a horizontal plane, so that the direction that is transverse with respect to said top surface is upward. However, in principle, the stack can be oriented otherwise, e.g. tilted with respect to the horizontal plane, thereby also changing said direction that is transverse with respect to said top surface.

[0011] By arranging the first wheel to rotate with respect to its axis during and after and/or during the movement towards the second wheel such that a paper section gripped between the first and second wheel is removed from the stack, the effect is obtained that the paper is more easily transferred from the stack as the paper is directed towards and/or pulled between the first and second wheel. It is noted, however, that the second wheel can also be fixed with respect to its axis, e.g. for cost price purposes.

[0012] In an embodiment according to the invention, the rotation of the first wheel is driven by the actuator for moving the first wheel towards the second wheel. There-

by the movement of the first wheel towards the second wheel and the rotation of the first wheel with respect to its axis might be performed by a single motor, thus reducing a motor equipment, costs and space in the gripping unit. Alternatively, the gripping unit is provided with a second actuator mechanism to drive the first wheel in a rotational way with respect to its axis.

[0013] In a further embodiment according to the invention, the first wheel is mounted on a first axle being provided with an additional wheel to improve a grip on the paper. In a simpler implementation, the first wheel is not coupled to an additional wheel, either by absence of the additional wheel or by missing a common axle. However, it is also possible to implement one or a multiple number of additional wheels having axes that mainly coincide with the axis of the first wheel or that are mainly parallel with it. Optionally, the one or multiple number of additional wheels can be moved during the gripping action towards the second wheel and/or rotated such, that a paper section gripped between the first and second wheel is removed from the stack.

[0014] In a similar way, the second wheel can be mounted on a second axle being provided with an additional wheel. Of course, similar variants as described with respect to the additional wheels of the first wheel are possible.

[0015] Other advantageous embodiments according to the invention are described in the following claims.

[0016] The invention relates also to a method for gripping a paper.

[0017] By way of example only, embodiments of the present invention will now be described with reference to the accompanying figures in which

Fig. 1 shows a schematic side view of a gripping unit according to the invention in a first stage of a gripping process;

Fig. 2 shows a schematic side view of a gripping unit according to the invention in a second stage of a gripping process;

Fig. 3a shows a first schematic side view of a gripping unit according to the invention in a third stage of a gripping process;

Fig. 3b shows a second schematic side view of a gripping unit according to the invention in a third stage of a gripping process;

Fig. 4 shows a schematic side view of a gripping unit according to the invention in a fourth stage of a gripping process;

Fig. 5 shows a schematic side view of a gripping unit according to the invention in a fifth stage of a gripping process;

Fig. 6 shows a schematic top view of the gripping unit of Figure 1;

Fig. 7a shows a schematic side view of a further embodiment of the gripping unit according to the invention in a first position; and

Fig. 7b shows a schematic side view of the gripping

unit of Figure 7a in a second position.

[0018] The figures are merely schematic views of preferred embodiments according to the invention. In the figures, the same reference numbers refer to equal or corresponding parts.

[0019] Figure 1 shows a schematic side view of gripping unit according to the invention in a first stage of a gripping process. The gripping unit 1 comprises a first wheel 5 and a second wheel 2 each having a rotation axis that coincides with a rotation axle 7, 4, respectively, of the respective wheel 5, 2. The rotation axes are mainly parallel with respect to each other. The first wheel 5 is arranged to exert a friction force on a paper section being gripped between the wheels 5, 2 as is described below. Therefore, the first wheel 5 is also called a friction wheel.

[0020] The gripping unit 1 further comprising an actuator 12 on which the friction wheel 5 is mounted for moving the friction wheel 5 towards the second wheel 2. In addition, the friction wheel 5 is arranged to rotate with respect to its axis during the movement towards the second wheel 2 such that a paper section 20 is directed towards the space between the friction wheel 5 and the second wheel.

[0021] To that end the rotation of the friction wheel 5 is caused by the actuator 12 for moving the friction wheel 5 towards the second wheel 2. In particular, the friction wheel 5 is driven by a tooth wheel transmission. Obviously, other transmission systems could also be applied, such as a belt transmission. The friction wheel 5 is fixedly provided with a gear wheel 13 cooperating with a gear rack 14 that is fixed with respect to the axle 4 of the second wheel 2.

[0022] Figure 6 shows a schematic top view of the gripping unit 1. On the axle 7 of the friction wheel 5 an additional friction wheel 6 is mounted to form a first pair of friction wheels 5, 6 and to enhance the grip on the paper 20. Similarly, the second wheel 2 forms together with an additional wheel (not shown) a pair of wheels that are both mounted on the axle 4 which carries the second wheel 2. As a consequence, a stable grip on the paper 20 can be obtained.

[0023] Between the friction wheels 5, 6 on the axle 7, a cylinder 15 is aligned. The cylinder 15 is provided with a curved cylindrical surface directed to a space between the friction wheels 5, 6 and the pair of wheels mounted on the second axle 4. The purpose of the curved cylindrical surface will be explained below. Further, in Figure 6, the gear wheels 13 interposed between the cylinder 15 and the friction wheels 5, 6, respectively, are shown. Also the gear racks 14 cooperating with the gear wheels 13 can be identified.

[0024] The axle 4 carrying the second pair of wheels 2 comprises a block on which the gear racks 14 are fixedly mounted, the gear racks 2 extending towards the gear wheels 13 mounted on the axle 7 carrying the friction wheels 5, 6. The gear rack 14 engages with the gear wheel 13 on the axle 7 carrying the first pair of friction

wheels 5, 6.

[0025] The axle 7 of the first pair of friction wheels 5, 6 is rotatably carried by a carrier unit 17 that is connected to the actuator 12. The actuator 12 comprises an electrical motor to drive the movable carrier unit 17. The movable carrier unit 17 can be driven in the moving direction 23 by means of one or more hydraulic and/or pneumatic cylinders. In using a hydraulic or pneumatic cylinder, a fluid or gas, e.g. air, respectively is compressed, thus generating a force for moving the carrier unit 17. Obviously, also other actuator mechanism can be applied, e.g. an electric stepped motor.

[0026] In the first stage of the gripping process, the gripping unit 1 is positioned above a stack 30 comprising printing plates 21 that are sandwiched between individual paper sheets 20. The top surface of the stack is formed by a paper sheet 20 that is to be removed by the paper gripper 1.

[0027] During a second stage of the gripping process, the second wheel 2 is moved towards the paper 20 on the top surface of the stack. The second stage is shown in Figure 2. The movement is accomplished by an additional actuator (not shown) provided on the gripping unit 1 for moving the second wheel 2 with respect to the paper surface, preferably in a direction substantially transversely with respect to the plane wherein the paper 20 extends. In an embodiment according to the invention, the gripping unit 1 moves from a parking position aside the stack 30. Preferably, during a final stage of the gripping unit movement, the second wheel approaches the top sheet 20 via a direction that is transverse with respect to the paper orientation, thereby counteracting friction that the wheel 2 might cause on the paper 20. Advantageously, the second wheel 2 is pushed in a downward direction 25 against the paper 20 to contact the paper 20. In principle, the second wheel can also be positioned just above the paper top surface. It is noted that the additional actuator can perform the movement of the second wheel 2 independently of the position of the friction wheel 5. Alternatively, the additional actuator is arranged for moving both the second wheel 2 and the friction wheel 5 relative to the paper surface. In this respect it is noted however, that the friction wheel 5 does not contact the paper 20 in the second stage of the process in order to avoid damages on the surface of a plate.

[0028] In a third stage of the gripping process, shown in Figure 3a, the friction wheel 5, upon activation of the actuator 12, is moving in a direction 23 towards the second wheel 2, while rotating the friction wheel 5 in a clockwise direction 22. The movement of the friction wheel axis 7 forms substantially a translation. The function of the rotation of the friction wheel 5 will be explained below.

[0029] It is noted that the movement of the first friction wheel 5 caused by the actuator 12 can also be non-planar, e.g. curved. Further, the actuator 12 might be designed such, that the first friction wheel 5 follows the top surface of the stack.

[0030] Figure 3b shows a second view of the gripping

unit in the third stage of the gripping process. The gripping unit 1 further comprises an airflow generator 16 that is fixed to the actuator 12 for moving the friction wheel 5 towards the second wheel 2. The air leaving the airflow generator 16 follows a flow path 31 that is directed substantially along the moving direction 23 of the friction wheel 5 towards a side surface 32 of the stack 30 and upon approaching said side surface 32 directing away from the stack in a direction 33 substantially transversely with respect to the top surface of the stack 30, upwardly. By the application of the airflow, a paper section 20 near the side surface 32 of the stack 30 is lifted upwardly towards a space between the friction wheel 5 and the second wheel 2. The air flow is causing the paper to peel off and to contact the friction wheel 5 as it curls up towards the second wheel 2.

[0031] The rotation of the friction wheel 5 shown in Figure 3a is such, that a contacting paper section is transferred by a friction force exerted by the friction wheel 5 towards the space between the friction wheel 5 and the second wheel 2. The rotation of the friction wheel 5 is forced by the translation of the friction wheel 5 and the gear transmission comprising the gear wheel 13 and the gear rack 14. By the actions of the friction wheel 5, the paper 20 may fold and extends upwardly between the friction wheel 5 and the second wheel 2.

[0032] The gripping unit 1 comprises a cylinder 15 that is coupled to the friction wheel 5 such that a curved cylindrical surface is substantially oriented parallel to the rotation axis 7 of the friction wheel 5 for inducing the flow path from the moving direction 23, 31 of the friction wheel 5 towards away from the stack in the direction 33 substantially transversely with respect to the top surface of the stack 30. By applying the curved cylindrical surface of the cylinder 15, the air flow is forced along the cylindrical surface and the air flow that passes above the top of the stack is conducted and directed further upwardly, in a direction substantially transverse with respect to the paper surface. As a consequence, the air flow is induced upwardly. In this respect it is noted that the upward inducement of the air flow can also be generated otherwise, without a cylinder 15, e.g. by a curved cylindrical surface plate. Further, the upwardly inducement of the air flow can be generated on another physical effect, e.g. by applying an underpressure region between the friction wheel 5 and the second wheel 2 for example by applying a suitably positioned air suction device.

[0033] Preferably, the airflow generator 16 is arranged for generating a turbulent air flow. This can be accomplished by orienting the airflow generator outlet such that a main air flow becomes turbulent upon touching the side surface 32 of the stack 30. By applying a turbulent air flow, the paper 20 can more easily be released and lifted from the stack. The turbulent air flow can also be provided by flowing an air flow from the airflow generator 16 that is turbulent by character, e.g. by providing sharp edges near the airflow generator outlet. Otherwise, the airflow generator 16 can also be arranged for generating a non-

turbulent air flow, e.g. a laminar air flow.

[0034] The actuator 12 is further as an option provided with an air conducting shield 11 to direct the air flow substantially towards the side surface 32 of the stack 30.

[0035] During a fourth stage of the gripping process, shown in Figure 4, the first friction wheel 5 abuts against the second wheel 2. As a result, the friction wheel 5 and the second wheel 2 clamp the paper 20 between them. The rotation of the friction wheel 5 is stopped.

[0036] Then, in a fifth stage of the gripping process, shown in Figure 5, the friction wheel 5 is moving upwardly 24, away from the stack surface. Thereto, the gripping unit 1 comprises a further actuator to move the friction wheel 5 away from the stack surface, thereby removing the paper 20 from the stack 30. The printing plate 21 then forms the top surface of the stack. Preferably, also the second wheel 2 is moving upwardly, so that the additional actuator for moving the second wheel 2 and the further actuator for moving the friction wheel 5 can advantageously be integrated. During the upward movement of the friction wheel 5, the paper 20 is firmly gripped between the second wheel 2 and the friction wheel 5 and the integrated gripping unit moves away from the stack 30.

[0037] In an alternative embodiment according to an aspect of the invention, the friction wheel remains rotating in the fourth and fifth stage e.g. until the paper 20 is at least partially or entirely fed between the friction wheel 5 and the second wheel 2. In a further embodiment according to an aspect of the invention, the friction wheel merely rotates after the friction wheel 5 and the second wheel 2 have abutted against each other.

[0038] The second wheel 2 is not motor driven, but is freely rotatable with respect to its axis 4. Since the second wheel 2 is freely rotatable, wear of the wheel 2 is evenly distributed over the entire circumferential surface of the wheel 2 thereby reducing damage on a top surface of a plate. In a preferred embodiment, the second wheel 2 is allowed to rotate in one direction only to more evenly distribute the wear over its entire circumferential surface. Further, the second wheel 2 is provided with a low friction surface, thereby even further reducing any damage that might occur on sensitive plate surface, e.g. plate surface provided with a latex top layer. In an alternative embodiment, the second wheel 2 is provided with a high friction surface, so that the reliability of the gripping unit is enhanced. Further, the construction of the gripping unit can be designed such that the second wheel is motor driven, thereby contributing to the removing process of the paper. In addition, it is noted that the first wheel 5 can in principle also be provided with a low friction surface and/or can be provided freely rotatable, not motor driven.

[0039] In the embodiments described above, the friction wheel 5 is moved towards the second wheel 2 by means of the actuator 12, so that the friction wheel 5 moves with respect to the actuator 12.

[0040] Figures 7a and 7b show a further embodiment of the gripping unit 1 according to the invention in a first

and second position, respectively. Here, the axis 7 of the friction wheel 5 is fixed with respect to a house 40 that carries the wheel 5. The assembly of the house 40 and the friction wheel 5 is integrally moved towards the second wheel 2 during the third stage of the gripping process. As such, the first position shown in Figure 7a corresponds with the second stage of the process shown in Figure 2, while the second position shown in Figure 7b corresponds with the third stage of the process shown in Figure 3a. Here, the actuator 41 for moving the friction wheel 5 towards the second wheel is directly coupled to the axis 4 of the second wheel 2.

[0041] It is noted that in the above-mentioned embodiments, the airflow generator 16 is fixed to the actuator 12 or house 40. However, the airflow generator 16 can also be arranged otherwise, e.g. on a separate bearing mechanism for generating the air flow as described.

[0042] The invention is not restricted to the embodiments described herein. It will be understood that many variants are possible.

[0043] A friction wheel can be provided with a friction tyre that is arranged such that a relatively large frictional force can be applied to the paper 20 below the wheels. Thereto the friction tyres 18 have elastic properties. In stead of applying the friction tyres, other means could be applied to enhance the friction force to be exerted, e.g. elastic portions on the circumferential surface of one or more of the friction wheels.

[0044] Optionally, the gripping unit according to the invention further comprises a guiding element for removing from the stack an element having a surface above the paper to be gripped. Thereby, actions performed by the gripping unit to remove a paper might advantageously cooperate with operations that are carried out to remove an element having a surface above the paper, such as a printing plate. One could however also implement separate mechanisms for performing the above mentioned acts, so that mutual interaction is avoided.

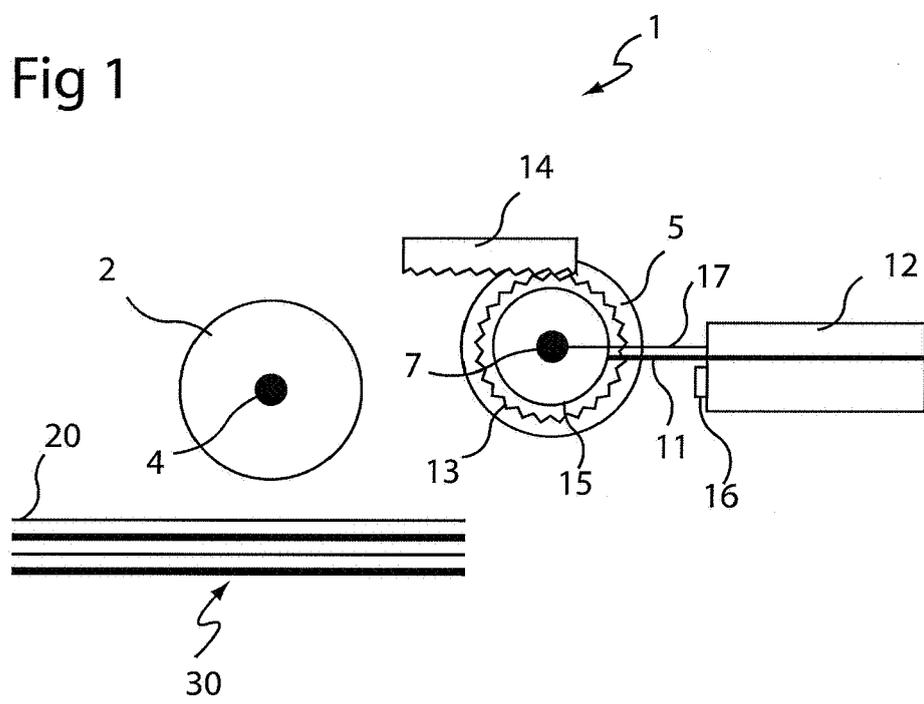
[0045] Further, it is noted that the instead of applying an air flow, other gas types can be used, e.g. a nitrogen flow.

[0046] Other such variants will be obvious for the person skilled in the art and are considered to lie within the scope of the invention as formulated in the following claims.

Claims

1. A gripping unit for gripping a paper from a top surface of a stack, comprising a first and second wheel having rotation axes that are mainly parallel with respect to each other, the first wheel being arranged to exert a friction force on sections of a paper during removal of the paper, the gripping unit further comprising an actuator on which the first wheel is mounted for moving the first wheel in a moving direction towards the second wheel, wherein the gripping unit further com-

- prises an additional actuator for moving the second wheel towards the paper on the top surface of the stack and wherein the gripping unit also comprises an airflow generator for providing an air flow following a flow path from adjacent a paper surface directed away from the stack in a direction substantially transversely with respect to the top surface of the stack.
2. A gripping unit according to claim 1, wherein the flow path is directed substantially along the moving direction of the first wheel towards a side surface of the stack and upon approaching said side surface directing away from the stack in a direction substantially transversely with respect to the top surface of the stack. 5
 3. A gripping unit according to claim 1 or 2, further comprising a curved cylindrical surface substantially oriented parallel to the rotation axis of the first wheel for inducing the flow path from the moving direction of the first wheel towards away from the stack in the direction substantially transversely with respect to the top surface of the stack. 10
 4. A gripping unit according to any of the previous claims, wherein the curved cylindrical surface is formed by a cylinder that is coupled to the first wheel. 15
 5. A gripping unit according to any of the previous claims, wherein the airflow generator is arranged for generating a turbulent air flow. 20
 6. A gripping unit according to any of the previous claims, wherein the first wheel is arranged to rotate with respect to its axis during and after and/or during the movement towards the second wheel such that a paper section gripped between the first and second wheel is removed from the stack. 25
 7. A gripping unit according to any of the previous claims, further comprising a further actuator for moving the first wheel away from the stack surface after a paper section has been gripped between the first and second wheel. 30
 8. A gripping unit according to any of the previous claims, wherein the rotation of the first wheel is driven by the actuator for moving the first wheel towards the second wheel. 35
 9. A gripping unit according to any of the previous claims, wherein the first wheel is driven by a tooth wheel transmission. 40
 10. A gripping unit according to any of the previous claims, wherein the first wheel is fixedly provided with a gear wheel cooperating with a gear rack that is fixed with respect to the axis of the second wheel. 45
 11. A gripping unit according to any of the previous claims, wherein the first wheel is mounted on a first axle being provided with one or more additional wheels. 50
 12. A gripping unit according to any of the previous claims, wherein the second wheel is mounted on a second axle being provided with one or more additional wheels. 55
 13. A gripping unit according to any of the previous claims, further comprising a guiding element for removing from the stack an element having a surface above the paper to be gripped.
 14. A gripping unit according to any of the previous claims, wherein the second friction wheel is allowed to rotate in one direction only.
 15. A method for gripping a paper from a top surface of a stack, comprising the steps of exerting a friction force on a section of the paper being gripped between a first and a second wheel, respectively, the wheels having rotation axes that are mainly parallel with respect to each other, moving the second wheel towards the paper on the top surface of the stack, moving the first wheel towards the second wheel, wherein the method further provides the step of providing an air flow following a flow path from adjacent a paper surface directed away from the stack in a direction substantially transversely with respect to the top surface of the stack.



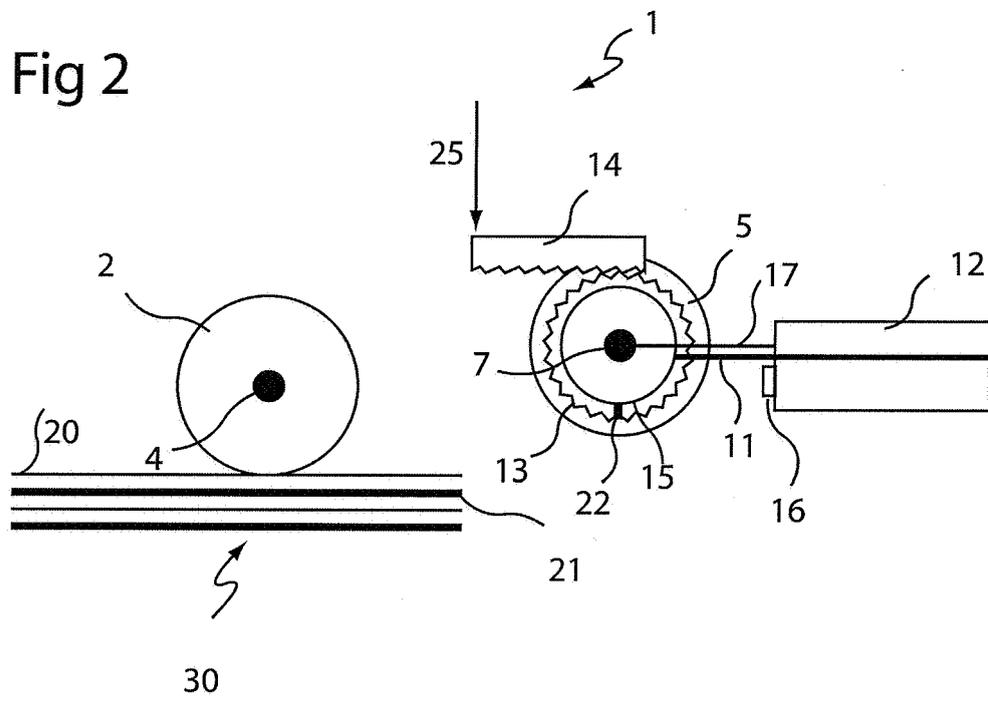


Fig 3A

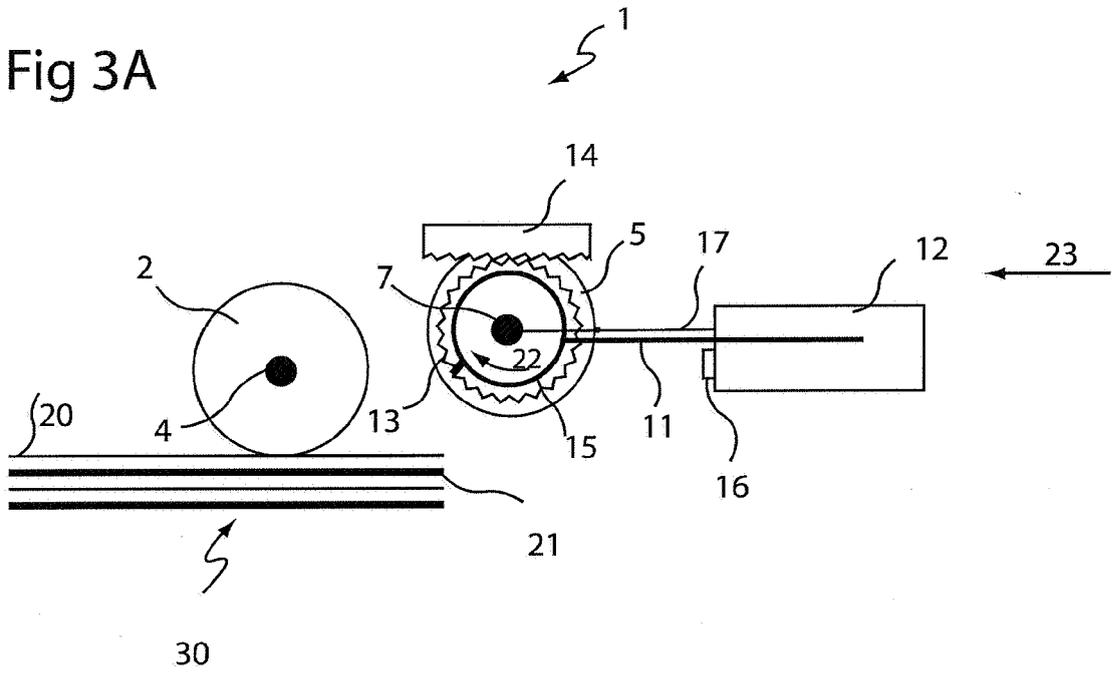


Fig 3B

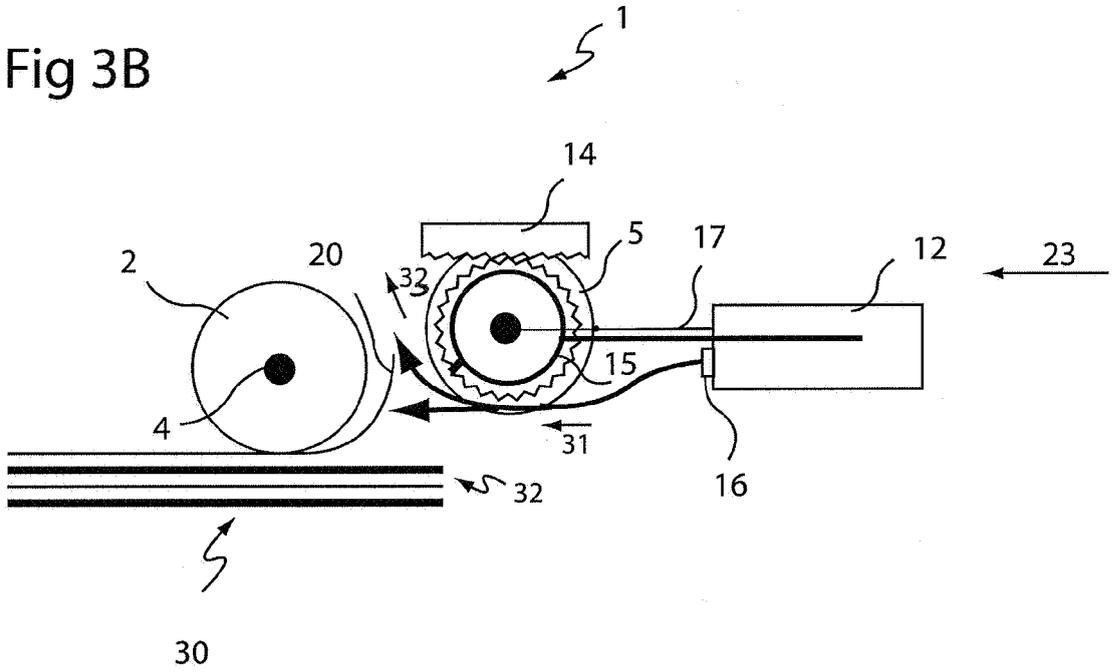


Fig 4

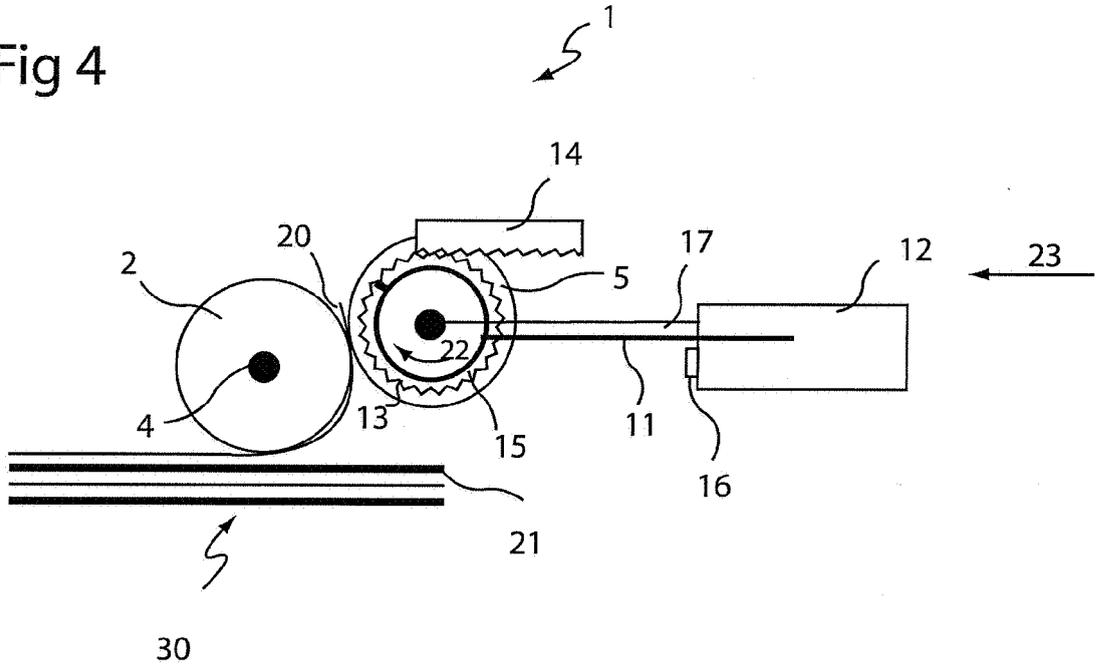
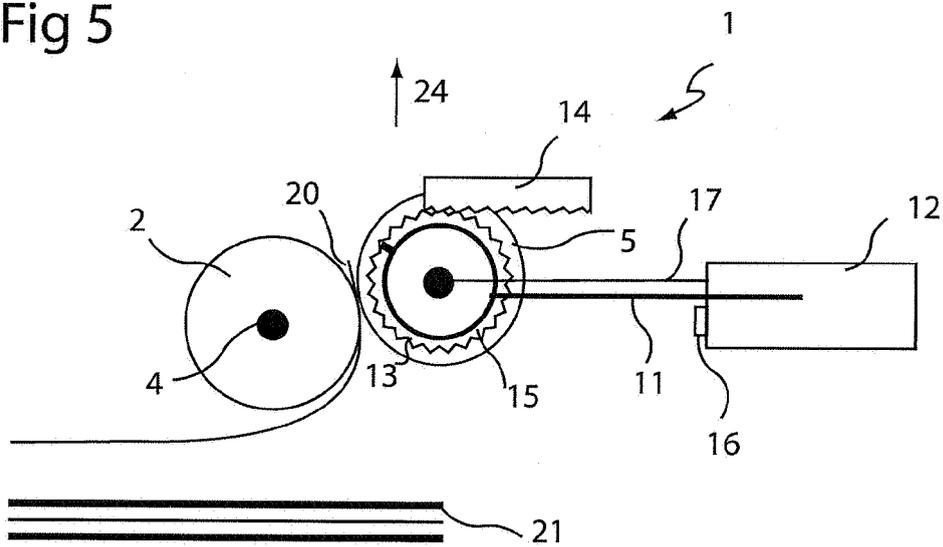


Fig 5



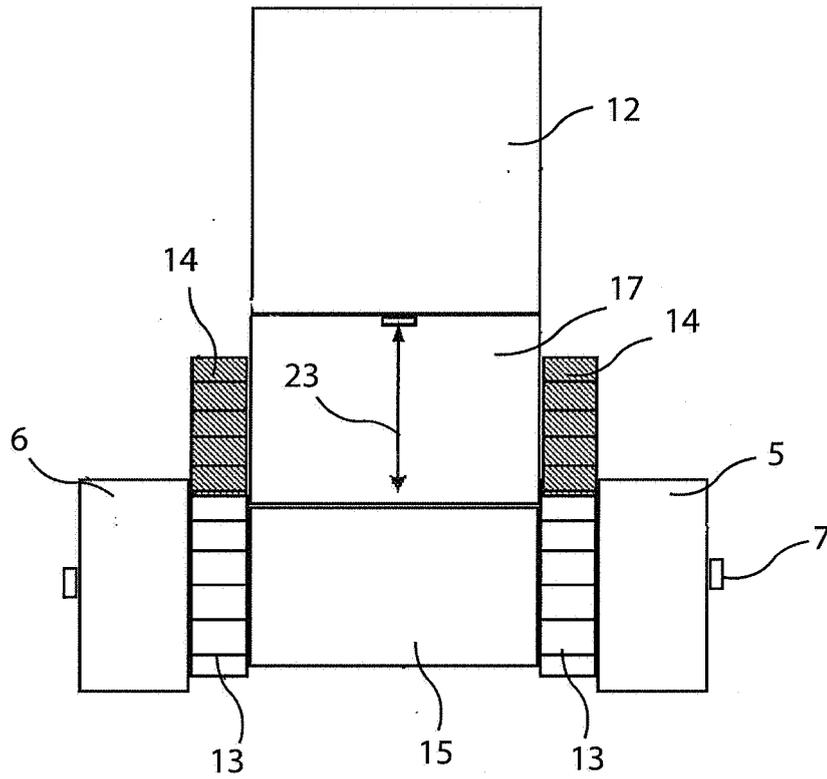


Fig. 6

Fig 7A

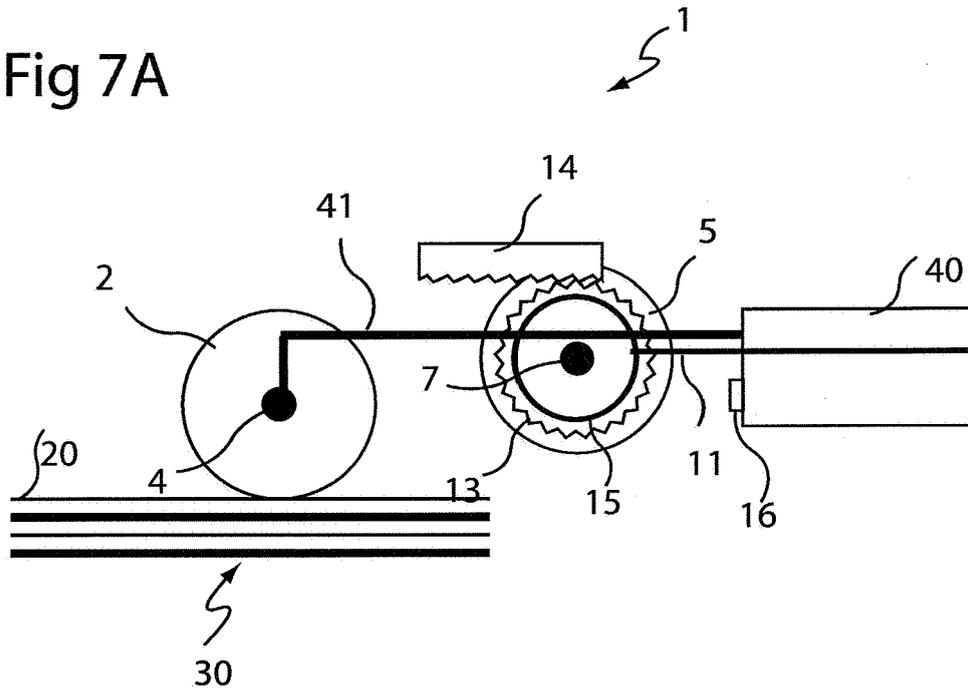
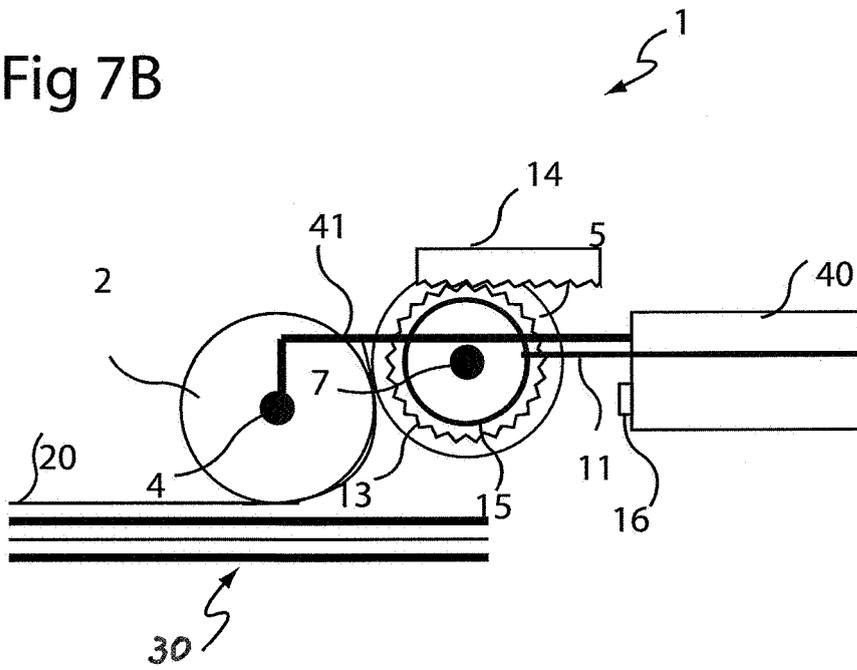


Fig 7B





DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2005/113242 A (ECRM [US]; YEE CHANG J [US]; DOUGHERTY JAMES A [US]; BERRIGAN JOHN W []) 1 December 2005 (2005-12-01) * page 12, line 5 - page 14, line 10; figures 4-8 *	1-15	INV. B65H3/14 B65H3/02 ADD. B65H5/08
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			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 May 2008	Examiner Henningsen, Ole
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