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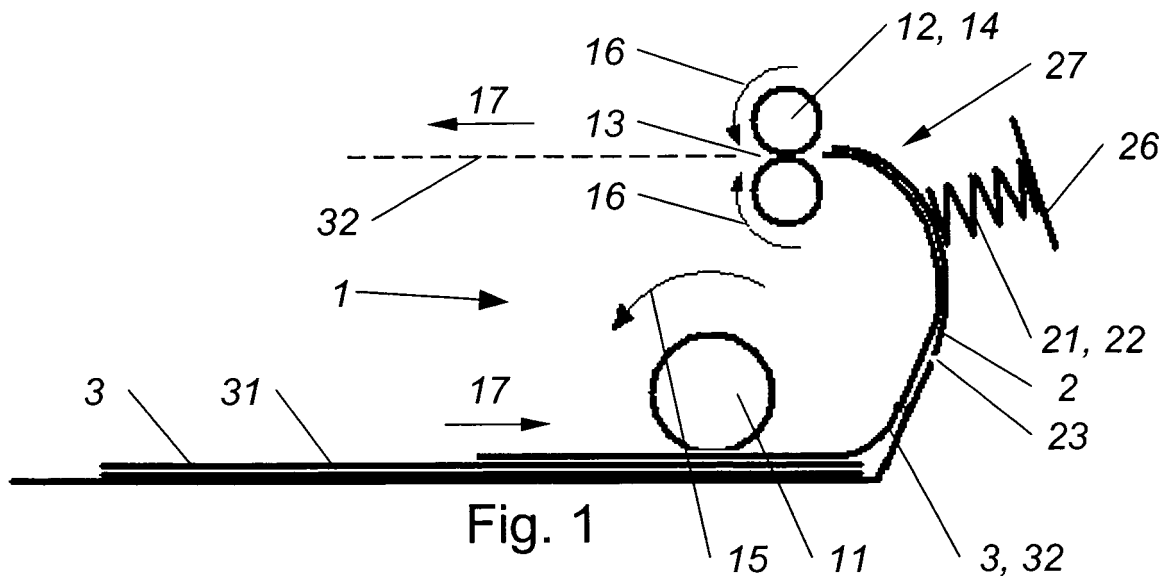
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(54) **Sheet feeder**

(57) Sheet feeder (1) with a receiving roll (11) for bringing a sheet (3) from a sheet stack receptacle (31) into a sheet path (32), a conveyor roll (12) for forwarding

the sheet (3) and a sheet deflector (2) arranged in the sheet path (32) between the receiving roll (11) and the conveyor roll (12), the sheet deflector (2) being arranged so as to be movable toward a prestress element (21).



Description

[0001] The invention relates to a sheet feeder according to the preamble of claim 1.

[0002] Sheet feeders are known in printing devices, for example in printers, fax machines and/or copiers. A sheet which is located in a stack of sheets is in this case received using a receiving roll and conveyed in a sheet path in the direction of conveyance, thus allowing the sheet to be conveyed individually in the direction of a printing unit and further in the direction of a sheet outlet.

[0003] Precise positioning of a printed image to be printed on one side of the sheet requires precise positioning of the sheet relative to the printing unit. In particular, repeatably precise positioning of the sheet relative to the printing unit for a plurality of sheets conveyed in succession is crucial for reproducible precise positioning of the printed image. A drawback of this is that, in the known printing devices, the sheet is in many cases inadequately grasped by the conveyor roll and a paper jam is caused owing to twisting of the sheet or to one sheet colliding with the subsequent sheet.

[0004] The object of the invention is therefore to specify a sheet feeder of the type mentioned at the outset that allows the aforementioned drawbacks to be avoided and with which precise positioning of the sheet relative to the printing unit is ensured and with which a paper jam in the sheet feeder can be avoided.

[0005] According to the invention, this is achieved by the features of claim 1.

[0006] This gives rise to the advantage that after contact of the - viewed in the direction of conveyance of the sheet - first edge with the conveyor roll, at least a second edge, opposing the first edge, of the sheet is conveyed further in the direction of conveyance. The sheet deflector, which is located between the receiving roll and the conveyor roll, prevents in this case crushing of the sheet, wherein the sheet deflector moves and the sheet path between the receiving roll and the conveyor roll is thus temporarily extended. The sheet deflector is in this case moved toward a pre-stress element, as a result of which pre-stress is built up in the pre-stress element. In this way, the sheet deflector is pressed against the sheet, which is located in the sheet path in the region of the sheet deflector, and the first edge of the sheet is pressed against the conveyor roll.

[0007] An advantage of this is that the sheet non-positively contacts the conveyor roll during reversal of the rotation of the conveyor roll and, as a result, the first edge is in secure contact with the conveyor roll. This ensures that the sheet is immediately drawn in by the conveyor roll after reversal of the direction of rotation of the conveyor roll, thus ensuring exact and, in particular, reproducible positioning of one sheet and a plurality of successively conveyed sheets.

[0008] A further advantage of this is that the sheet feeder is simple to control, as the risk of the sheet becoming crushed when the drive roll and the conveyor roll are

driven simultaneously is ruled out by the deflection of the sheet. In this case, the receiving roll and the conveyor roll can be driven, in particular, using a common drive, so an individual drive, in particular an individual motor, for driving the receiving roll can be dispensed with. As a result, the printing device can be manufactured with low weight and with low manufacturing costs.

[0009] A further advantage of this is that the pre-stress element can be configured for controlling the sheet feeder, thus allowing the controller to be further simplified. In this case, the pre-stress element can, when a predetermined level of pre-stress has been reached, initiate reversal of the drive, thus initiating the reversal of the rotation of the conveyor roll and ensuring exact and simple control of the conveyor roll.

[0010] The invention further relates to a method according to the preamble of claim 6.

[0011] A further object of the invention is to specify a method with which the advantages of the sheet feeder described at the outset can be provided simply and cost-effectively.

[0012] According to the invention, this is achieved by the features of claim 8.

[0013] The sub-claims, which at the same time, like claim 1 and claim 8, form part of the description, relate to further advantageous configurations of the invention.

[0014] The invention will be described in greater detail with reference to the appended drawings which show, by way of example, merely preferred embodiments and in which:

Fig. 1 is a schematic side view of a sheet feeder of a first embodiment during the conveyance of a sheet in a first step;

Fig. 2 is a schematic side view of the sheet feeder according to Fig. 1 during the conveyance of the sheet in a second step following the first step; and

Fig. 3 is a schematic side view of the sheet feeder according to Fig. 1 during the conveyance of the sheet in a third step following the second step.

[0015] Fig. 1 to 3 show a sheet feeder 1 of a preferred first embodiment with a receiving roll 11 for bringing a sheet 3 from a sheet stack receptacle 31 into a sheet path 32, with a conveyor roll 12 for forwarding the sheet 3 and with a sheet deflector 2 arranged in the sheet path 32 between the receiving roll 11 and the conveyor roll 12, the sheet deflector 2 being arranged so as to be movable toward a pre-stress element 21. The advantages and effects described at the outset can be ensured using the sheet feeder 1.

[0016] The sheet feeder 1 is used for receiving the sheet 3 from the sheet stack receptacle 31, for conveying the sheet 3 in the direction of and toward a printing unit (which is arranged downstream of the sheet feeder viewed in the direction of conveyance of the sheet 3), the

sheet 3 being brought into the sheet path 32 during receiving using the receiving roll 11.

[0017] The sheet 3 may comprise paper, film, cardboard and/or fabric and alternatively consist, in particular, of one or more of the aforementioned materials.

[0018] The sheet stack receptacle 31 may be configured for the manual supply of sheets or as a sheet storage container. In this case, the printing device may, in particular, comprise a plurality of sheet stack receptacles 31.

[0019] The sheet path 32 is basically the route along which the sheet 3 is transported and conveyed, guided by the printing device. The sheet path 32 begins with the sheet being received by the receiving roll 11 and ends with the sheet being ejected by one of at least one sheet injection opening.

[0020] The sheet deflector 2 is a component which is movable relative to the receiving roll 11 and to the conveyor roll 12, the receiving roll 11 and the conveyor roll 12 and the printing device being fixed in a housing of the printing device.

[0021] The sheet deflector 2 allows the sheet path 32 to be extended between the receiving roll 11 and the conveyor roll 12. The sheet deflector 2 may, in particular, be configured so as to be smooth on a side facing the sheet and be configured for sliding contact with the sheet. For this purpose, the sheet deflector 2 may, for example, be made of a thermoplastic.

[0022] The sheet deflector 2 can be curved at least in certain regions. Advantageously, the sheet deflector 2 can in this case be concave on the side facing the sheet. This ensures all-over contact of the sheet deflector 2 with the sheet 3 which is guided past the sheet deflector 2. The sheet deflector 2 can, in particular, be convex, in particular in the direction of the pre-stress element 21.

[0023] The pre-stress element 21 can advantageously be configured as a spring element 22. As a result, on movement of the sheet deflector 2 toward the pre-stress element 21, the energy applied by the sheet deflector 2 for movement toward the pre-stress element 21 in the direction of a deflection movement 24, i.e. on movement of the sheet deflector 2 from a starting position 27 into a deflected position 28, is stored in the spring element 22 as spring energy. The energy thus stored in the spring element 21 can, on return movement 25 of the sheet deflector 2, i.e. on movement of the sheet deflector 2 from a deflected position 28 back into a starting position 27, be issued to the sheet deflector 2.

[0024] In a further embodiment, the energy applied mechanically by the sheet deflector 2 can also be converted into another form of energy and stored in this way, for example, as electrical, magnetic and/or potential energy. For example, two permanent magnets can be moved toward each other by the sheet deflector 2, wherein these two permanent magnets store magnetic energy in the deflected position 28 between the two permanent magnets, and the two permanent magnets can in the deflected position 28 bring about a restoring force which acts on the sheet deflector 2. In a further embodiment, a

lifting part can, for example, be raised counter to gravity on movement of the sheet deflector 2 into the deflected position 28, wherein potential energy is stored in the lifting part and wherein, in the deflected position 28, the lifting part can also bring about a restoring force which urges the sheet deflector 2 into the starting position 27.

[0025] Particularly preferably, there may be provided a method for drawing in a sheet 3 out of the sheet stack receptacle 31, the sheet 3 being received using the receiving roll 11, conveyed along the sheet path 32 to the conveyor roll 12, the sheet deflector 2 being arranged in the sheet path 32 between the receiving roll 11 and the conveyor roll 12, wherein when the sheet 3 is received by the receiving roll 11 for conveying the sheet 3 in the direction of conveyance along the sheet path 32, the conveyor roll 12 is rotated counter to the direction of conveyance 17 along the sheet path 32 and wherein the sheet deflector 2 is moved by the sheet 3 toward the pre-stress element 21.

[0026] The sheet 3 can in this case advantageously be conveyed from the sheet stack receptacle 31 up to the printing unit in such a way that firstly the sheet 3 from the sheet stack receptacle is received and is thus conveyed and transported in isolation, merely one sheet being received, in the direction of conveyance along the sheet path 32, and the controlling of the receiving roll 11 and the conveyor roll 12, and thus the conveyance of the sheet 3 in the sheet path 32, being carried out preferably using a control device.

[0027] Immediately thereafter, the sheet 3 is guided in the sheet path 32 along the movable sheet deflector 2, a first edge of the sheet 3 being located in front in the direction of conveyance and a second edge of the sheet 3 being located behind in the direction of conveyance. The sheet deflector 2 is in this case in the starting position 27 and the length of the sheet path 32 between the receiving roll 11 and the conveyance roll 12 is minimal.

[0028] Subsequently, in particular once the first edge has been guided completely past the sheet deflector 2, the first edge of the sheet 3 enters into contact with the conveyor roll 12 which is in this case rotated, counter to the direction of conveyance 17, along the sheet path 32. As a result, the first edge of the sheet 3 cannot be conveyed any further and is blocked by the conveyor roll 12. However, the sheet 3 continues to be conveyed by the receiving roll 11, the second edge of the sheet 3 being conveyed, at constant speed in the direction of conveyance 17, along the sheet path 32. As a result, viewed in the direction of conveyance 17, a greater length of the sheet 3 is conveyed between the receiving roll 11 and the conveyor roll 12. In order to prevent the sheet 3 from becoming crushed and/or to ensure that it becomes just slightly crushed, wherein crushing could lead to destruction of the sheet 3 and/or to a paper jam in the sheet path 32, the sheet deflector 2 is then moved toward the pre-stress element 21, as a result of which the length of the sheet path 32 between the receiving roll 11 and the conveyor roll 12 is extended and wherein the sheet deflector

2 carries out the deflection movement 24. This extension of the sheet path 32 can be carried out continuously, in particular in a proportional relationship to the speed of the second edge of the sheet 3.

[0029] In this case, the sheet 3 may, in particular, be arranged in a curved manner in the sheet path 32, the side of the sheet 3 that faces the sheet deflector 2 being particularly preferably curved in a convex manner, i.e. outwardly. Advantageously, provision may in this case be made for the sheet deflector 2 to have a concave side facing the sheet path 32 and for the sheet path 32 to be movable in the direction of the concave side on tensioning of the pre-stress element 21. As a result, the sheet 3 can transmit forces in a two-dimensional manner onto the sheet deflector 2, in particular in the direction of the deflection movement 24, and thus drive the deflection movement 24.

[0030] The force and energy which are required for the deflection movement 24 of the sheet deflector 2, most of which can be stored, in particular, in the pre-stress element, can be brought about by the rotation in opposite directions of the receiving roll 11 and the conveyor roll 12. As a result of the movement of the sheet 3 in the direction of its convex curvature, i.e. outward, the size of the sheet path 32 between the receiving roll 11 and the conveyor roll 12 increases. If forwarding of the sheet 3 is prevented by the conveyor roll 12 and further regions of the sheet are conveyed by the receiving roll 11, the sheet path 32 can thus be adapted to the required length, the sheet deflector 2 being moved and the pre-stress element 21 being tensioned as a result of the increase in size of the sheet path 32. The tensioning energy can subsequently be used to ensure, on reversal of the direction of rotation of the conveyor roll 12, that the sheet 3 is in contact with the conveyor roll 12 and is received thereby.

[0031] Subsequently, the direction of rotation of the conveyor roll 12 can be reversed at a predefinable moment, as a result of which, on the one hand, the conveyor roll 12 releases the forwarding of the first edge of the sheet 3 in the direction of conveyance and, on the other hand, after the grasping of the sheet 3 by the conveyor roll 12, i.e. the non-sliding contact of the sheet 3 and conveyor roll 12, the conveyor roll 12 determines the speed at which the first edge is conveyed. As a result of the fact that the sheet deflector 2 was moved beforehand toward the pre-stress element 21 and into a deflected position 28, wherein energy was stored in the pre-stress element 21, a force acts on the sheet deflector 2 during the reversal of the direction of rotation of the conveyor roll 12. The force acting on the sheet deflector 2 causes, in turn, the first edge of the sheet to be pressed by a force in the direction of conveyance 17. This ensures that on reversal of the direction of rotation of the receiving roll 11 and the conveyor roll 12, the sheet 3 is pressed by the pre-stress element 21 in the direction of the conveyor roll 12. The sheet 3 can thus be grasped by the conveyor roll 12, during and after the reversal of the direction of

rotation of the conveyor roll 12, substantially immediately and particularly reliably, thus ensuring secure conveyance and reproducible positioning of the sheet 3 relative to the printing unit and in the printing device and allowing the risk of a paper jam to be kept low. User-friendly operation of the printing device, with at the same time reproducibly effective positioning of the printed image to be printed on the sheet 3, in particular on one of the two sides of the sheet 3, can thus be ensured. In this way, the sheet can also be imprinted on both sides, with highly precise positioning of the printed image to be reproduced, wherein both sides of the sheet 3 can be imprinted either simultaneously or successively.

[0032] As soon as the sheet 3 has been grasped by the conveyor roll 12, the sheet deflector 2 can be moved back into the starting position 27, wherein this movement can be carried out substantially continuously. During this return movement 25 of the sheet deflector 2, the length of the sheet path 32 between the receiving roll 11 and the conveyor roll 12 can be reduced to the minimum length.

[0033] In a further embodiment, the reversal of the direction of rotation of the conveyor roll 12, from rotation counter to the direction of conveyance 17 into rotation in the direction of conveyance 17, can be controlled as a function of the stored pre-stressing and the stored energy in the pre-stress element 21. The direction of rotation of the conveyor roll 12 can in this case be reversed if a predetermined level of pre-stress in the pre-stress element 21 is exceeded. The predetermined pre-stress can be measured using a sensor and sent to the control device as a signal or using a mechanical arrangement, for example a lever arrangement which at a predetermined level of pre-stress brings about a movement and thus initiates reversal of the direction of rotation of the conveyor roll 12. In this way, the pre-stress element 21 can be configured for controlling the sheet feeder.

[0034] In other embodiments, the reversal of the direction of rotation of the conveyor roll 12, from rotation counter to the direction of conveyance 17 into rotation in the direction of conveyance 17, can be effected using a time controller and at a predetermined first moment.

[0035] This first moment can be selected in such a way that the first edge of the sheet 3 is stopped substantially just briefly. The brief stoppage of the first edge can, on the one hand, be sufficient to ensure precise positioning of the first edge relative to the conveyor roll 12 and relative to the printing unit and, on the other hand, be sufficient to build up in the pre-stress element 21 the minimum energy required for reliable operation of the sheet feeder 1 of the printing device.

[0036] Alternatively, the first moment may be selected in such a way that substantially at this moment the second edge of the sheet 3 is disengaged from the receiving roll, thus ensuring that the sheet 3 is further conveyed in the direction of conveyance 17 independently of the direction of rotation of the receiving roll 11.

[0037] According to a preferred embodiment, provision

may be made for the receiving roll 11 and the conveyor roll 12 to be coupled together and to be driven in diametrical opposition. This allows the controller and the drive means to be simple and cost-effective in their configuration.

[0038] In an advantageous development, provision may be made for the receiving roll 11 and the conveyor roll 12 to be connected to a common drive unit, preferably by means of a transmission mechanism, and for, on rotation of the receiving roll 11 in the direction of conveyance 17 along the sheet path 32, the conveyor roll 12 to rotate counter to the direction of conveyance 17 along the sheet path 32. This ensures that the receiving roll 11 and the conveyor roll 12 are operated using a common drive unit. There may thus be configured a common drive and/or a common transmission mechanism allowing the printing device to be configured easily, using little energy and/or cost-effectively.

[0039] On reversal of the direction of rotation of the drive, both the direction of rotation of the conveyor roll 12 and the direction of rotation of the receiving roll 11 are in this case changed. As changing the direction of rotation of the receiving roll 11 would cause the sheet 3 to be conveyed in the region of the receiving roll 11 counter to the direction of conveyance 17, it must be ensured that during and after the first moment there is no contact between the sheet 3 and the receiving roll 11. For this purpose, the receiving roll 11 can, for example, be raised from the first sheet 3, as can be achieved by appropriate configuration of a bearing of the receiving roll 11, the receiving roll 3 being positionally fixed when the receiving roll 11 is rotated in the direction for conveyance of the sheet 3 in the direction of conveyance 17, and the receiving roll 3 being movably fixed when the receiving roll 11 rotates counter to the direction for conveyance of the sheet 3 in the direction of conveyance 17.

[0040] In a particularly preferred development of the embodiment, provision may be made for the receiving roll 11 to have a free run. This ensures that the receiving roll 11 is operated, when driven counter to the direction of conveyance 17 along the sheet path 32, in a free-running mode. In this way, the receiving roll 11 can be in non-slip contact with the sheet 3 even after a change in direction of the drive of the receiving roll 11, the free run allowing simultaneous rotation of the receiving roll 11 in the direction of conveyance 17 and rotation of the drive of the receiving roll 11 in the opposite direction to the direction of conveyance 17. This free run can, for example, be compared to the free run of the rear wheel of a bicycle.

[0041] Preferably, provision may be made for the conveyor roll 12 to be configured as a double roller 14 forming a feed-through means 13. This ensures secure grasping of the first edge and secure conveyance both on the first side and on the second side of the sheet 3 by the conveyor roll 12.

[0042] Further embodiments according to the invention display merely some of the described features,

wherein any combination of features, especially a combination of various described embodiments, may be provided.

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Claims

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1. Sheet feeder (1) with a receiving roll (11) for bringing a sheet (3) from a sheet stack receptacle (31) into a sheet path (32), a conveyor roll (12) for forwarding the sheet (3) and a sheet deflector (2) arranged in the sheet path (32) between the receiving roll (11) and the conveyor roll (12), **characterised in that** the sheet deflector (2) is arranged so as to be movable toward a pre-stress element (21).

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2. Sheet feeder according to claim 1, **characterised in that** the conveyor roll (12) is configured as a double roller (14) forming a feed-through means (13).

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3. Sheet feeder according to either claim 1 or claim 2, **characterised in that** the pre-stress element (21) comprises a spring element (22).

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4. Sheet feeder according to claim 1, 2 or 3, **characterised in that** the sheet deflector (2) has a concave side facing the sheet path (32) and **in that** the sheet path (32) is movable in the direction of the concave side when the pre-stress element (21) is tensioned.

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5. Sheet feeder according to any claim 1, 2, 3 or 4, **characterised in that** the receiving roll (11) and the conveyor roll (12) are connected to a common drive unit, preferably by means of a transmission mechanism, and **in that** on rotation of the receiving roll (11) in the direction of conveyance (17) along the sheet path (32), the conveyor roll (12) rotates counter to the direction of conveyance (17) along the sheet path (32).

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6. Sheet feeder according to claim 5, **characterised in that** the receiving roll (11) has a free run.

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7. Method for drawing in a sheet (3) out of a sheet stack receptacle (31), the sheet (3) being received using a receiving roll (11), conveyed along a sheet path (32) to a conveyor roll (12), a sheet deflector (2) being arranged in the sheet path (32) between the receiving roll (11) and the conveyor roll (12), **characterised in that** when the sheet (3) is received by the receiving roll (11) for conveying the sheet (3) in the direction of conveyance along the sheet path (32), the conveyor roll (12) is rotated counter to the direction of conveyance (17) along the sheet path (32) and **in that** the sheet deflector (2) is moved by the sheet (3) toward a pre-stress element (21).

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8. Method according to claim 7, **characterised in that**

the receiving roll (11) and the conveyor roll (12) are coupled together and are driven in diametrical opposition.

9. Method according to either claim 7 or claim 8, **characterised in that** on reversal of the direction of rotation of the receiving roll (11) and the conveyor roll (12), the sheet (3) is pressed by the pre-stress element (21) in the direction of the conveyor roll (12). 5
10. Method according to claim 7, 8 or 9, **characterised in that** the receiving roll (11) is operated, when driven counter to the direction of conveyance (17), in a free-running mode along the sheet path (32). 10
11. Method according to any one of claims 7 to 10, **characterised in that** the receiving roll (11) and the conveyor roll (12) are operated using a common drive unit. 15

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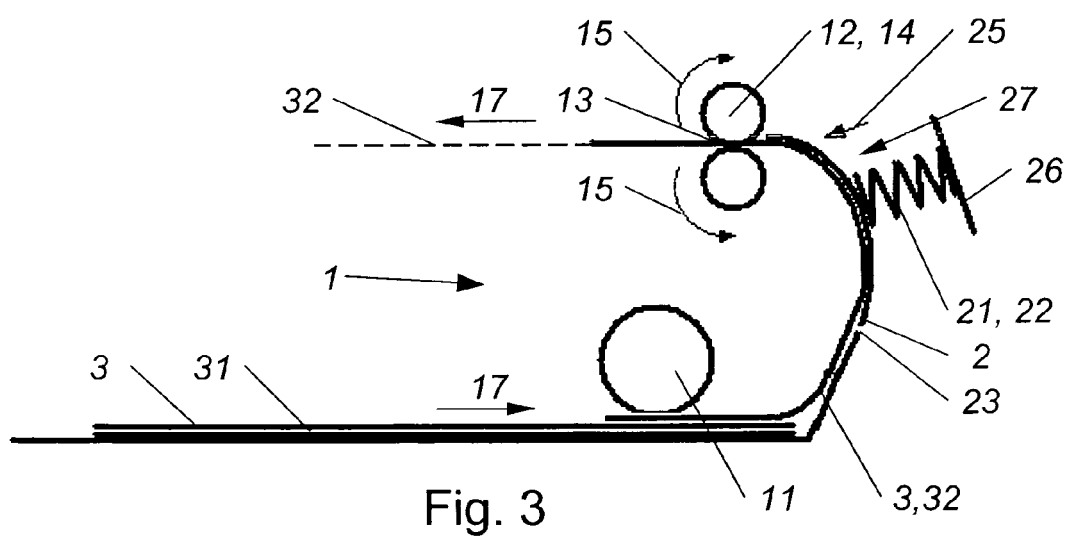
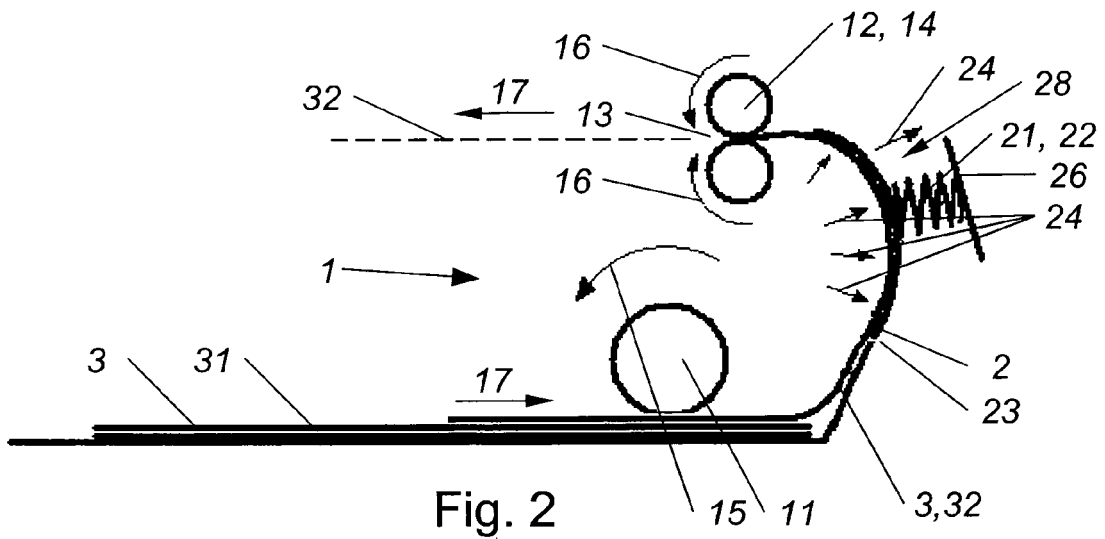
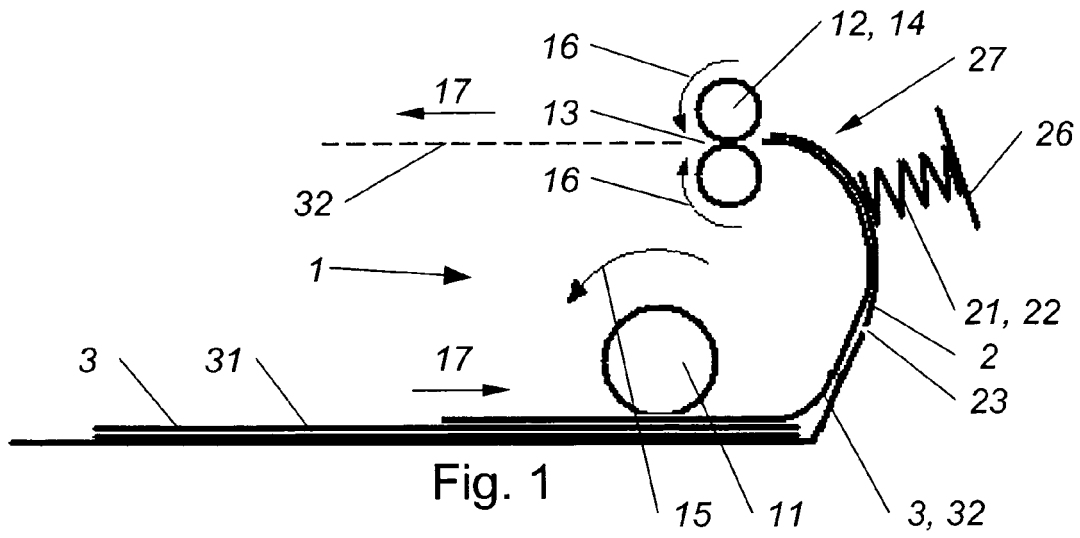
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European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 07 29 1344

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 April 2008	Examiner Henningsen, Ole
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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