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(54) **PLASMA TREATMENT SYSTEM FOR CUT SHEET MEDIA**

PLASMABEHANDLUNGSSYSTEM FÜR GESCHNITTENE BLATTMEDIEN

SYSTÈME DE TRAITEMENT AU PLASMA DESTINÉ À COUPER DES SUPPORTS EN FEUILLES

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(56) References cited:

EP-A1- 1 919 048 EP-A2- 1 293 458
DE-A1- 10 221 746

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Description

FIELD

[0001] The invention relates to a plasma discharging treatment apparatus for applying a corona or plasma to cut sheet media and a method for plasma or corona treatment of cut sheet media sheet.

BACKGROUND

[0002] It is generally known to treat sheets to be printed in a printing system by means of a corona or plasma treatment. Exposure to a corona or plasma adjusts the surface energy of the sheet, allowing a better adhesion of the printed image to the sheet surface. Thereby, a better quality print is achieved.

[0003] A plasma discharging treatment apparatus comprises a pair of electrodes between which the corona or plasma is generated by applying a high voltage potential across the pair of electrodes. A sheet is transported between the pair of electrodes and through the corona or plasma for treatment by means of a conveyor belt driven by driving rollers. The conveyor belt is generally formed of a polyimide. Document EP-A-1 919 048 discloses an apparatus according to the preamble of claim 1 and a method according to the preamble of claim 15.

[0004] A drawback of the above described plasma discharging treatment apparatus is that the belt is affected by the corona or plasma, preventing an accurate control of the speed and position of the conveyor belt and thus of the sheet. Additionally, the conveyor belt over time receives damage from the corona or plasma, resulting in a polluting of the conveyor belt, and as a consequence a polluting of the image printed on the sheet. This is especially disadvantageous for to be duplex printed sheets, wherein ink on the simplex printed side of such a sheet adheres to damaged regions of the conveyor belt, thereby contaminating a subsequent sheet. Finally, in the case of a paper jam, the corona or plasma is likely to burn in or even through the belt, leading to downtime wherein the damaged conveyor belt is replaced.

SUMMARY

[0005] It is an object of the present invention to provide a plasma discharging treatment apparatus with a reliable transport mechanism and reduced pollution of the to be printed sheets.

[0006] In accordance with the present invention, a plasma discharging treatment apparatus according to claim 1, and a method according to claim 15 are provided. Advantageous or preferred features of the invention are recited in the dependent claims.

[0007] It is the insight of the inventors, that reliable transport for cut sheet media through a corona or plasma can be achieved by providing one of the electrodes in the form of a pair of transport rollers with a guide member

placed between them to allow a sheet to travel unhindered from one transport roller to the other.

[0008] The present invention provides a plasma discharging treatment apparatus for applying a corona or plasma to cut sheet media. The apparatus comprises:

- a first electrode and a second electrode for generating a plasma or corona;
- a transport path extending between the first and second electrode, wherein the first electrode is spaced apart from the transport path, and wherein the second electrode defines part of the transport path,

wherein the second electrode comprises at least two rotatable transport rollers for transporting the cut sheet medium along the transport path, wherein the at least two rotatable transport rollers are positioned adjacent the transport path and spaced apart from one another in the direction of the transport path, and

wherein a guide member is positioned between the at least two rollers to define the transport path between the at least two transport rollers.

[0009] A sheet is transported along the transport path for example by means of a pair of driving rollers for pushing the sheet towards and over the transport rollers. The transport path extends between the first and second electrodes, such that during operation the transport path passes through the corona or plasma generated between the first and second electrodes. The first electrode is spaced apart from the transport path, preferably above the transport path, such that the first electrode does not contact the sheet. A sheet on the transport path does come into contact with the transport rollers of the second electrode, since these transport rollers are positioned adjacent the transport path and define part of the transport path. The transport rollers allow for a reliable transport of the sheet, as these rollers, unlike a conveyor belt, may be formed of an inert and rigid material. As such, the transport rollers are substantially unaffected by the corona or plasma, ensuring proper control over the sheet's speed and position. Since there is no damage to the transport rollers, the unwanted deposition of ink from a to be duplex printed sheet on the transport rollers is eliminated, thus preventing pollution of the to be printed sheets.

[0010] The at least two transport rollers are spaced apart from one another in the direction of the transport path to allow the transport rollers to rotate freely with respect to one another. To allow a sheet to pass unhindered from one transport roller to a neighboring or adjacent transport roller, a guide member is positioned between the at least two rollers. The guide member defines the transport path between the at least two transport rollers. Preferably the top surfaces of the guide member and the transport rollers are at substantially equal level, such that a substantially straight transport path is formed. The guide member prevents at least the leading edge of the sheet from bending downwards in between the transport

rollers, enabling reliable sheet transport through the corona or plasma. The transport rollers and guide member according to the present invention are more resistant to the effects of the plasma or corona than the conveyor belt applied in the prior art. In this way, a plasma discharging treatment apparatus with a reliable transport mechanism and reduced pollution of the printed sheets is provided.

[0011] In an embodiment, the guide member is positioned near and/or between the at least two transport rollers, such that bending and/or curling of a leading edge of a cut sheet medium passing from one of the at least two transport rollers over the guide member to the other of the at least two transport rollers under the effect of gravity is substantially prevented. The stiffness of the cut sheet medium is insufficient to keep a free leading edge of the sheet straight. Without support the leading edge of the sheet will bend downward into the region between the at least two transport rollers, causing the sheet to deviate or even drop off from the transport path. As such, after leaving a first one of the at least two transport rollers the leading edge slides on the guide member, which then supports the leading edge. The space between the top side of the first one of the at least two transport rollers and a top surface of the guide member is preferably sufficiently small to allow the sheet to pass from the transport roller onto the guide member without bending or curling due to the stiffness of the sheet. For similar reasons, the guide member is positioned near the top side of a second one of the at least two transport rollers. By preventing the cut sheet medium, or the sheet, from bending away from the transport path, a reliable transport mechanism is provided. Note that a small amount of bending or curling of the leading edge of the sheet, for example over an angle of a few degrees, may be allowed within the context of the present invention. The guide member according to the present invention eliminates the risk of paper jams or curling up of paper due to the leading edge of the sheet significantly bending and/or curling away from the transport path.

[0012] In another embodiment, the guide member is pivotable around a pivoting axis substantially parallel to rotation axes of the at least two transport rollers. The transport rollers and the guide member are arranged to rotate and respectively pivot substantially around an axis perpendicular to the direction of the transport path, for example a horizontal axis. The pivoting axis and the rotation axes extend preferably substantially parallel to the plane of the cut sheet medium on the transport path. The guide member is arranged for being supported on the circumferential surface of at least one of the transport rollers. Since the guide member is pivotable, rotation of a transport roller is not hindered by contact with the guide member. By being in contact with or close proximity to a transport roller, the guide member is able to pick up a sheet from or deposit a sheet on a transport roller without the sheet substantially bending away from the transport path.

[0013] In an embodiment, the guide member is supported on the at least two transport rollers, such that a substantially straight transport path is formed between the at least two transport rollers, preferably between the top sides of the at least two transport rollers. The guide member may comprise a guiding surface over which the sheet may be transported between the at least two transport rollers. Preferably, the guiding surface, such as a top surface, of the guide member is at substantially equal level with the top sides of the at least two transport rollers for forming a substantially straight and horizontal transport path.

[0014] In a further embodiment, the at least two transport rollers and the guide member define a substantially straight transport path. The transport path is preferably a planar transport path. To prevent bending, the sheet, specifically the leading edge of the sheet, is substantially supported over its entire surface when being transported along the transport path. By aligning the top surface of the guide member and the top sides of the transport rollers in a straight line and/or single plane, the leading edge of the sheet is kept straight and unable to bend.

[0015] In an embodiment, the at least two transport rollers comprise a plasma resistant surface layer. The outer surface of each of the transport rollers is thus unaffected by exposure to plasma or corona, preventing pollution of the transport roller and thus of any sheet that comes into contact with said transport roller. In a preferred embodiment, the plasma resistant layer is a ceramic surface layer, such as an alumina layer or coating deposited on the transport roller. The plasma or corona resistant layer effectively prevents damage to the transport roller, providing a durable and clean apparatus.

[0016] In another embodiment, the plasma resistant surface layer has been treated to be smooth. A smooth outer surface of the transport rollers prevents pollution or dirt from adhering to the outer surface of the transport roller. Preferably, the plasma resistant surface layer has been smoothened by means of polishing, grinding, and/or sanding. The smooth layer prevents pollution and reduces friction between the transport rollers and the guide member.

[0017] In an embodiment, the guide member comprises a plurality of guide fingers provided on a pivoting axis and spaced apart from one another in a direction parallel to the pivoting axis, e.g. parallel to the rotation axes of the at least two transport rollers. Said pivoting axis and rotation axes preferably extend substantially horizontally to provide a level and substantially horizontal transport path.

[0018] In an embodiment the first electrode or the second electrode is connected to a high voltage source for generating the plasma or corona. Preferably, one of the first and second electrode is connected to the high voltage source, while the other of the first and second electrode is connected to ground. In a preferred embodiment the first electrode comprises a high voltage electrode, while the transport rollers of the second electrode are

connected to ground. The first electrode is preferably provided with a cooling system. For example, the first electrode may be or comprise a high voltage electrode comprising a hollow tube body provided on its inside with a passive cooling system, such as cooling fins. Such a high voltage electrode is known from EP2866318, which is incorporated herein by reference. The first electrode in the present invention may be provided with any of the characteristics of the electrode described in EP2866318, such as its hollow tubular body, and/or its cooling system. Cooling of the high voltage electrode reduces the amount of heat which needs to be eliminated in the transport rollers of the second electrode. Thereby, the diameters of the transport rollers can be reduced.

[0019] In another embodiment, the apparatus according to the present invention further comprises at least two driving rollers positioned upstream of the at least two transport rollers for driving the cut sheet media over the rollers. Additionally at least two further driving rollers may be provided downstream of the at least two transport rollers for pulling the cut sheet media through the plasma or corona. The (further) driving rollers may comprise push rollers, pull rollers, and/or pinch rollers.

[0020] In an embodiment, the plasma discharging treatment apparatus according to the present invention further comprises an input strip and an output strip disposed parallel to the rotation axes of the at least two transport rollers and respectively upstream and downstream of the at least two transport rollers. The strips provide a support surface on which the leading edge of the sheet is supported when it is transported between a transport roller and a driving roller or a further driving roller. Thus, bending of the leading edge between a transport roller and a driving roller or a further driving roller is prevented.

[0021] In a further embodiment, the first and second electrode are positioned on either sides of the transport path, such that a cut sheet medium transported over the transport path passes through the plasma or corona generated by the first and second electrode.

[0022] In another aspect, the present invention provides a printing system comprising a plasma discharging treatment apparatus according to the present invention. Preferably, the plasma discharging treatment apparatus is provided along a transport path of the printing system upstream of an image forming unit of the printing system. In a preferred embodiment the printing system comprises a duplex transport path arranged for transporting to be duplex printed sheets from the image forming unit to the plasma discharging treatment apparatus. Thus, simplex and duplex printed sheets can be treated by plasma prior to printing.

[0023] In another aspect, the present invention provides a method for the plasma or corona treatment of cut sheet media. The method comprises the steps of:

- generating a corona or plasma between a first and second electrode, such that a transport path extends

through the generated corona or plasma, wherein the second electrode comprises at least two rotatable transport rollers for transporting the cut sheet medium along the transport path, wherein the at least two rotatable transport rollers are positioned adjacent the transport path and spaced apart from one another in the direction of the transport path;

- transporting a cut sheet medium along the transport path to and over a first one of the at least two transport rollers;
- transporting the cut sheet medium along the transport path from the first one of the at least two transport rollers, then over a guide member positioned between the at least two rollers, and finally to, and preferably over, a second one of the at least two transport rollers.

[0024] By transporting the leading edge of the sheet over the guide member, the leading edge of the sheet is prevented from bending away from the transport path as it passes from one transport roller to the other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] For a more complete understanding of the invention and the advantages thereof, exemplary embodiments of the invention are explained in more detail in the following description with reference to the accompanying figures, in which like reference characters designate like parts in which:

Fig. 1 is a schematic side view of a plasma discharging treatment apparatus for applying a corona or plasma to cut sheet media according to the present invention; and

Fig. 2 is a schematic perspective view of a guide member of a plasma discharging treatment apparatus for applying a corona or plasma to cut sheet media according to the present invention.

[0026] The accompanying drawings are included to provide a further understanding of the present invention and are incorporated in and constitute a part of this specification. The drawings illustrate particular embodiments of the invention and together with the description serve to explain the principles of the invention. Other embodiments of the invention and many of the attendant advantages of the invention will be readily appreciated as they become better understood with reference to the following detailed description.

[0027] It will be appreciated that common and/or well understood elements that may be useful or necessary in a commercially feasible embodiment are not necessarily depicted in order to facilitate a more abstracted view of the embodiments. The elements of the drawings are not necessarily illustrated to scale relative to each other. It will further be appreciated that certain actions and/or

steps in an embodiment of a method may be described or depicted in a particular order of occurrences while those skilled in the art will understand that such specificity with respect to sequence is not actually required. It will also be understood that the terms and expressions used in the present specification have the ordinary meaning as is accorded to such terms and expressions with respect to their corresponding respective areas of inquiry and study, except where specific meanings have otherwise been set forth herein.

DETAILED DESCRIPTION OF THE DRAWINGS

[0028] With reference to Fig. 1 a side view is illustrated of a plasma discharging treatment apparatus 1 for applying a corona or plasma to cut sheet media S. The cut sheet medium S (or the sheet S for easy reference) is transported along a transport path P, from left to right in Fig. 1. The transport path P extends over an input roller 30, via an input strip 20, over transport roller 4, guide member 10, and transport roller 4', via output strip 21, and over output roller 31. Above the pair of transport rollers 4, 4' in Fig. 1 a first electrode 2 formed by a pair of high voltage electrodes 2a, 2a' is positioned at a distance above the transport path P. A plasma or corona (the general term "plasma" is used to indicate both) may be generated between the transport rollers 4, 4' and the first electrode 2 by applying a voltage difference between the first electrode 2 and the transport rollers 4, 4', which form a second electrode 3. The sheet S is transported through the plasma or corona for treatment to improve its surface energy to obtain a better print quality.

[0029] The first electrode 2 comprises preferably a pair of high voltage electrodes 2a, 2a' comprising a hollow tubular body 2b, 2b' with a cooling system 2d, 2d'. The cooling system is preferably a passive cooling system 2d, 2d'. Through the inner chamber 2c, 2c' in the body 2b, 2b' a cooling medium, such as a fluid or gas, is able to flow for cooling the first electrode 2. Cooling elements, such as cooling fins 2d, 2d', may be provided on the inner surface of the hollow tubular body 2b, 2b' to facilitate better cooling by increasing the contact area between the cooling medium and the high voltage electrodes 2a, 2a' of the first electrode 2. Cooling may be further enhanced by pumping fluid or gas through the hollow tubular body 2b, 2b'. Such an electrode 2 is known from European patent application EP2866318, which is incorporated herein by reference.

[0030] One advantage of the application of a high voltage electrode 2a, 2a' with a hollow tubular body 2b, 2b' as described in EP2866318, is the enhanced cooling of the first electrode 2. The improved cooling of the high voltage electrodes 2a, 2a' of the first electrode 2 results in a reduced heating of the second electrode 3, such that less heat needs to be eliminated at the second electrode 3. This allows for reduction in the size of the second electrode 3. Specifically, in the embodiment shown in Fig. 1, the enhanced cooling of the first electrode 2 allows the

transport rollers 4, 4' of the second electrode 3 to be provided with relatively small diameters. Smaller diameters for the transport rollers 4, 4' reduces bending of the leading edge L of the sheet S when being transported from one transport roller 4 to the other 4'.

[0031] In Fig. 1 the first electrode 2 comprises a plurality, specifically a pair, of high voltage electrodes 2a, 2a' positioned apart from one another in the transport direction of the sheet along the transport path P. Each of the high voltage electrodes 2a, 2a' in Fig. 1 is configured with a hollow tubular body 2b, 2b' provided with a cooling system 2d, 2d' in its inner chamber 2c, 2c'. One high voltage electrode 2a is positioned directly upstream of the guide member 10, while another high voltage electrode 2a' is positioned directly downstream of the guide member 10, such that, during operation, the guide member 10 is positioned substantially outside the plasma generated between the first and second electrodes 2, 3. Each high voltage electrode 2a, 2a' is preferably positioned centrally to and/or above a rotation axis 5, 5' of a respective transport roller 4, 4' of the second electrode 3.

[0032] A free end L of a sheet S tends to bend, but not until said free L end has reached a certain length. Due to the sheet's S stiffness a maximum free length of the leading edge L may be unsupported before the leading edge L starts bending downwards under the effect of gravity. For stiffer sheets S, this maximum free length is increased with respect to more flexible sheets S. In the present invention, the diameters of the transport rollers 4, 4' correspond substantially to this maximum free length to reduce bending of the leading edge L. As such, the leading edge L is kept straight while extending freely from the one transport roller 4, and becomes supported by a second transport roller 4' or guide member 10, before the length of the freely extending leading edge L exceeds this maximum free length to prevent bending of the leading edge L before being supported by the second transport roller 4' or the guide member 10. The smaller diameters of the transport rollers 4, 4' are the direct result of the improved cooling of the high voltage electrode 2.

[0033] The plasma or corona is generated between the first and second electrodes 2, 3 by applying a voltage difference between the two, for example via a high voltage source connected to both the first and second electrode 2,3. Alternatively, a high voltage source may be connected to the first electrode 2, while the transported rollers 4, 4' of the second electrode 3 may be connected to ground, or vice versa. Furthermore, a high voltage electrode 2a may be connected to a high voltage source, while another high voltage electrode 2a' upstream or downstream of this first electrode 2a may be connected to ground, such that a plasma generated between them 2a, 2a' may be blown towards the transport path P. Preferably, the high voltage source comprises a controller which allows an operator to adjust the corona or plasma for optimizing the treatment of the sheet S.

[0034] During operation, the transport rollers 4, 4' rotate exposing a region of their outer surface to the plasma

for a short period of time. This region then rotates out of the plasma and cools down before re-entering the plasma during a subsequent cycle or turn. By exposing regions of the outer surface of the transport roller 4, 4' only briefly to the plasma and allowing them to cool, a "burn-in" of the plasma into the outer surface of the transport roller 4, 4' is prevented. Damage to the transport roller is thus eliminated. Also, the rotation allows dirt on the transport roller 4, 4' to fall off due to gravity. To improve the cooling of the outer surface of the transport roller 4, 4', a cooling system may be provided inside or near the transport roller 4, 4'.

[0035] In the embodiment in Fig. 1a, the transport rollers 4, 4' are positioned adjacent the transport path P and are positioned at a distance from one another along the transport direction of the sheet S. The transport rollers 4, 4' are rotatable around rotation axes 5, 5'. In Fig. 1 the rotation axes 5, 5' extend parallel to the plane of the sheet S and perpendicular to the transport path P. The transport rollers 4, 4' are positioned, such that their top sides in Fig. 1 define the transport path P, which extends in a straight line tangential to the surface of the rollers 4, 4' at their respective top sides. The transport rollers 4, 4' may be arranged for free rotation around their rotation axes 5, 5' or be provided with means for driving the rollers 4, 4', such as an electromotor.

[0036] In Fig. 1, the guide member 10 is provided on a pivoting axis 11 between the at least two transport rollers 4, 4'. The pivoting axis 11 runs substantially parallel to the rotation axes 5, 5' of the transport rollers 4, 4'. The top surface (indicated by 13 and 14 in Fig. 2) of the guide member 10 extends substantially between the top sides of the transport rollers 4, 4' to define the transport path P between the rollers 4, 4'. As can be seen in Fig. 1, the transport path P extends in a substantially straight and/or planar manner from the top side of one transport roller 4, over the top surface 13, 14 of the guide member 10, to the top side of the other transport roller 4'. The guide member 10 is arranged for contacting a transport roller 4, 4' near its top side. A sheet S can then pass from the transport roller 4, 4' onto the guide member 10, or vice versa, before the leading edge L starts bending. The guide member 10 thus supports the leading edge S of the sheet S in between the top sides of the transport rollers 4, 4'. Bending of the leading edge L of the sheet S due to gravity is thereby effectively prevented, providing reliable sheet transport. It will be appreciated that the guide member 10 is pivotable around axis 11, such that the transport rollers 4, 4' may rotate substantially unhindered by friction between the guide member 10 and an outer surface of the rollers 4, 4'.

[0037] As seen from above, the guide member 10 is positioned in between the pair of high voltage electrodes 2a, 2a'. Each high voltage electrode 2a, 2a' generates a plasma field directed substantially downwards towards the respective transport roller 4, 4' of the second electrode 3. The guide member 10 is thereby positioned effectively outside the plasma. This prevents damage to the

guide member 10, ensuring sheets passing over it do not become contaminated. Thus, print quality is increased. Note that the plasma may extend over the guide member 10 due to diffusion, but the intensity of this diffused plasma is significantly reduced with respect to the plasma applied between the electrodes 2, 3. In the present invention, the guide member 10 is formed of a material able to withstand exposure to this diffused plasma. Preferably, the guide member 10 is formed of polytetrafluoroethylene ("Teflon").

[0038] The spacing between the bottom side of the first electrode 2 and the top side of the second electrode 3 is around 1 mm. The spacing is kept small to create a narrow passage for the sheet, which allows the sheet to be pushed through the passage with wrinkling or curling up.

[0039] In Fig. 1, an input strip 20 and an output strip 21 are provided on the opposite side of a respective transport roller 4, 4' as the guide member 10. A transport roller 4, 4' is positioned between a strip 20, 21 and the guide member 10. The strips 20, 21 serve a similar purpose as the guide member 10 and may, in a further embodiment, be provided similar to the guide member 10. The input strip 20 facilitates reliable transport of a sheet S from an input roller 30 to a transport roller 4 (the left one in Fig. 1), while the output strip 21 facilitates reliable transport of a sheet S from a transport roller 4' (the right one in Fig. 1) to an output roller 31. The top surface of the strip 20, 21 defines the transport path P between the respective input or output roller 30, 31 and the respective transport roller 4, 4'. Thereby, the strips 20, 21 prevent bending of the leading edge L, when it passes between one of the rollers 30, 31 and one of the transport rollers 4, 4'.

[0040] The input strip 20 and the output strip 21 in Fig. 1 comprise a longitudinal substantially L-shaped profile positioned, such that the top surface of one leg of the L-shaped profile defines the transport path P. When passing between a roller 30, 31 and a transport roller 4, 4' the sheet is supported by the top surface of the leg. Similar to the guide member 10, an end of each strip 20, 21 is positioned near or in close proximity to the top side of the respective roller 4, 4'. Preferably, a top surface of the input strip 20 and/or output strip 21 is aligned or at equal level with the top side of the transport rollers 4, 4' and/or a top surface of the guide member 10. For forming a substantially straight transport path P, the top surface of the transport rollers 4, 4', guide member 10, input strip 20, and/or output strip 21 may be aligned with respect to one another.

[0041] The input roller 30 and the output roller 31 in Fig. 1 are depicted as single rollers 30, 31, but may alternatively be provided as a pair of pinch rollers for driving the sheet S along the transport path P.

[0042] A further advantage of the apparatus 1 in Fig. 1 is the reduction of pollution of the printed sheets S. When a sheet S is intended for duplex printing, it is printed on a first side, flipped such that the first side faces downwards, and transported back to the apparatus 1 for pre-treatment. In Fig. 1, the simplex printed first side of the

sheet S is facing down, such that the ink printed on the sheet S is able to contact the transport rollers 4, 4'. The outer surface of the transport roller 4, 4' is preferably ink repellent, such that ink will not be transferred from the sheet S to the roller 4, 4'. During operation, the outer surface of the roller 4, 4' is exposed to the corona and plasma. Should the outer surface of a transport roller 4, 4' become damaged, ink might adhere to the damaged regions on the outer surface of the roller 4, 4'. This ink may then be transferred to a subsequent sheet S, contaminating the sheet S and leading to pollution of the image which will be printed on the subsequent sheet S. This reduces the print quality of the subsequent sheet S.

[0043] To prevent damage to the outer surface of a transport roller 4, 4', the transport rollers 4, 4' are provided with a plasma resistant surface layer 6. The surface 6 runs circumferentially around the roller 4, 4' forming the outer surface of the transport roller 4, 4'. The plasma resistant surface layer 6 is preferably formed of a material able to withstand the effects of the corona or plasma. Ceramics, such as alumina (aluminum-oxide or Al_2O_3) may be applied as surface layers 6, because of their inert character. Furthermore, the adherence of ink to the transport roller 4, 4' may be reduced by providing a smooth outer surface on the rollers 4, 4'. The plasma resistant surface layer 6 may thereto be polished, ground, and/or sanded to obtain a surface layer 6 with a very low roughness coefficient. Alternatively, a smooth and plasma-resistant coating may be applied to a drum for forming a transport roller 4, 4' with a plasma-inert outer surface. Thus, damage to the outer surface of the rollers 4, 4' is prevented, along with the pollution of said rollers 4, 4'. As such, print quality is increased.

[0044] Finally, with reference to Fig. 2, a guide member 10 is shown in perspective view. It will be appreciated that the different elements in Fig. 2 are not drawn to scale. The guide member 10 in Fig. 2 has been enlarged with respect to the transport rollers 4, 4' for better clarity.

[0045] The guide member 10 in Fig. 2 comprises a plurality of guide fingers 12. Each guide finger 12 is provided on the pivoting axis 11, such that all guide fingers 12 are arranged to pivot synchronously. Alternatively, independent pivoting for each of the guide fingers 12 may be applied within the scope of the present invention. A guide finger 12 may be substantially longitudinal, such that it extends between the left and right transport roller 4, 4' in Fig. 2. The top surface of the guide finger 12 comprises an upstream surface part 13 and a downstream surface part 14, provided at a small angle with respect to the one another. The downstream surface 14 is preferably substantially parallel to the direction of the transport path P, while the upstream surface part 13 extends at a small angle with respect to the transport path P. As seen in the transport direction, the upstream surface part 13 extends at an incline to the transport direction for picking up the leading edge L coming of the transport roller 4. The end of the guide finger 12 at the side of roller 4 may be V-shaped. Such a sharp end ensures that the upstream

surface part 13 closely adjoins and follows the surface of the transport roller 4. This prevents curling or jamming of a sheet S at the upstream end of the guide member 10. Thereby, a sheet S slides unhindered from the transport roller 4 onto the guide member 10. The end of the guide finger 12 at the side of roller 4' comprises a blunt end, formed by a substantially downward extension at said end of the guide finger 12. Due to the stiffness of the sheet S, its leading edge L will slide from this blunt end of the guide finger 12 onto the roller 4' without the risk curling or bending. Since curling and bending are eliminated, there is no risk of paper jams by a sheet S becoming trapped between a roller 4, 4' and the guide member 10.

[0046] Fig. 2 further illustrates the longitudinal configuration of the input and output strips 20, 21 which extend parallel to the pivoting axis 11 between their respective transport roller 4, 4' and input/output roller 30, 31. Whereas a length of the transport rollers 4, 4' in Fig. 2 extends over a width of the sheet S in the direction of the pivoting axis 11, the input and output rollers 30, 31 are each provided as a plurality of driving rollers or wheels 30, 31 positioned in a guide member 32, 33. The guide member 32, 33 in Fig. 2 is a longitudinal plate 32, 33, provided with openings through which the rollers or wheels 30, 31 extend. The wheels 30, 31 are preferably drive wheels 30, 31 which respectively push and pull the sheet S through the plasma.

[0047] The plasma discharging treatment apparatus 1 according to the present invention may be applied in a printing system, wherein the apparatus 1 is positioned upstream of the image forming unit comprising a print head. Preferably, a duplex transport pass extends downstream of the image forming unit to an input side of the apparatus 1 in order to prepare to be duplex printed sheets by plasma treatment.

[0048] In the method for the plasma or corona treatment of cut sheet media sheet according to the present invention, a sheet S is first inserted into the apparatus 1 on the left side of Fig. 1 and 2. A corona or plasma is generated between the first and second electrodes 2, 3. The transport path P extends through the generated corona or plasma. Via the input roller 30 and the input strip 20, the sheet S is transported onto and over the transport roller 4, where exposure of the sheet S to the plasma commences. The leading edge L of the sheet S is then picked up from the transport roller 4 by the guide member 10. The leading edge of the sheet L travels over the top surface 13, 14 of the guide member 10, whereupon it is deposited onto the transport roller 4'. There, the leading edge L is again exposed to a plasma or corona. From the transport roller 4' the leading edge L is transported over the output strip 21 onto the output roller 31. In the method according to the present invention, the leading edge L of the sheet S preferably undergoes plasma treatment at a plasma generated between a first high voltage electrode 2a and a first transport roller 4 followed by plasma treatment at a plasma generated between a second

high voltage electrode 2a' and a second transport roller 4'.

[0049] Although specific embodiments of the invention are illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are examples only and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0050] It will also be appreciated that in this document the terms "comprise", "comprising", "include", "including", "contain", "containing", "have", "having", and any variations thereof, are intended to be understood in an inclusive (i.e. non-exclusive) sense, such that the process, method, device, apparatus or system described herein is not limited to those features or parts or elements or steps recited but may include other elements, features, parts or steps not expressly listed or inherent to such process, method, article, or apparatus. Furthermore, the terms "a" and "an" used herein are intended to be understood as meaning one or more unless explicitly stated otherwise. Moreover, the terms "first", "second", "third", etc. are used merely as labels, and are not intended to impose numerical requirements on or to establish a certain ranking of importance of their objects. Where the term "plasma" is used, it may also refer to "corona" and vice versa. Where an element is said to "define the transport path P" this may be interpreted as said element "defining a respective part of the transport path P".

Claims

1. A plasma discharging treatment apparatus (1) for applying a corona or plasma to cut sheet media (S), comprising:

- a first electrode (2) and a second electrode (3) for generating a plasma or corona;
- a transport path (P) extending between the first electrode (2) and the second electrode (3), wherein the first electrode (2) is spaced apart from the transport path (P), and wherein the second electrode (3) defines part of the transport path (P),

characterized in that the second electrode (3) comprises at least two rotatable transport rollers (4, 4')

for transporting a cut sheet medium (S) along the transport path (P), wherein the at least two rotatable transport rollers (4, 4') are positioned adjacent the transport path (P) and spaced apart from one another in the direction of the transport path (P), and wherein a guide member (10) is positioned between the at least two transport rollers (4, 4') to define the transport path (P) between the at least two transport rollers (4, 4').

2. A plasma discharging treatment apparatus (1) according to claim 1, wherein the guide member (10) is positioned near and/or between the at least two transport rollers (4, 4'), such that bending and/or curling of a leading edge (L) of the cut sheet medium (S) passing from one of the at least two transport rollers (4, 4') over the guide member (10) to the other of the at least two transport rollers (4, 4') under the effect of gravity is substantially prevented.
3. A plasma discharging treatment apparatus (1) according to claim 1 or 2, wherein the guide member (10) is pivotable around a pivoting axis (11) substantially parallel to rotation axes (5, 5') of the at least two transport rollers (4, 4').
4. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the at least two transport rollers (4, 4') and the guide member (10) define a substantially straight transport path (P).
5. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the at least two transport rollers (4, 4') each comprise a plasma resistant surface layer (6).
6. A plasma discharging treatment apparatus (1) according to claim 5, wherein the plasma resistant surface layer (6) has been treated to be smooth.
7. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the guide member (10) comprises a plurality of guide fingers (12) provided on the pivoting axis (11) and spaced apart from one another in a direction parallel to the pivoting axis (11).
8. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the diameters of the at least two transport rollers (4, 4') are relatively small to prevent a leading edge (L) of a cut sheet medium (S) from bending away from the media transport path (P).
9. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the first electrode (2) or the second electrode (3) is con-

nected to a high voltage source.

10. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the first electrode (2) comprises a high voltage electrode (2a, 2a') comprising a hollow tube body (2b, 2b') provided on its inside with a passive cooling system (2c, 2c').
11. A plasma discharging treatment apparatus (1) according to any of the previous claims, further comprising at least two driving rollers (30) positioned upstream of the at least two transport rollers (4, 4') for driving a cut sheet medium (S) over the transport rollers (4, 4').
12. A plasma discharging treatment apparatus (1) according to any of the previous claims, further comprising an input strip (20) and an output strip (21) disposed parallel to the rotation axes (5, 5') of the at least two transport rollers (4, 4') and respectively upstream and downstream of the at least two transport rollers (4, 4').
13. A plasma discharging treatment apparatus (1) according to any of the previous claims, wherein the first electrode (2) and the second electrode (3) are positioned on either sides of the transport path (P).
14. Printing system comprising a plasma discharging treatment apparatus (1) according to any of the previous claims.
15. Method for the plasma or corona treatment of cut sheet media, comprising the steps of:
 - generating a corona or plasma between a first electrode (2) and a second electrode (3), such that a transport path (P) extends through the generated corona or plasma, **characterized in that** the second electrode (3) comprises at least two rotatable transport rollers (4, 4') for transporting a cut sheet medium (S) along the transport path (P), wherein the at least two transport rollers (4, 4') are positioned adjacent the transport path (P) and spaced apart from one another in the direction of the transport path (P);
 - transporting the cut sheet medium (S) along the transport path (P) to and over a first one (4) of the at least two transport rollers (4, 4');
 - transporting the cut sheet medium (S) along the transport path (P) from the first one (4) of the at least two transport rollers (4, 4') over a guide member (10) positioned between the at least two transport rollers (4, 4') to a second one (4') of the at least two transport rollers (4, 4').

Patentansprüche

1. Plasmaentladungs-Behandlungsvorrichtung (1) zum Aufbringen einer Corona oder eines Plasmas zum Schneiden von Blattmedien (S), umfassend: - eine erste Elektrode (2) und eine zweite Elektrode (3) zum Erzeugen eines Plasmas oder einer Corona; einen Transportpfad (P), der sich zwischen der ersten Elektrode (2) und der zweiten Elektrode (3) erstreckt, wobei die erste Elektrode (2) von dem Transportpfad (P) beabstandet ist und wobei die zweite Elektrode (3) einen Teil definiert des Transportpfads (P), wobei die zweite Elektrode (3) mindestens zwei drehbare Transportrollen (4, 4') zum Transportieren eines einzelblattmediums (S) entlang des Transportpfads (P) umfasst, wobei die mindestens zwei drehbare Transportrollen (4, 4') sind benachbart zu dem Transportpfad (P) positioniert und in Richtung des Transportpfads (P) voneinander beabstandet, und wobei ein Führungselement (10) zwischen den mindestens zwei positioniert ist Transportrollen (4, 4') zur Festlegung des Transportweges (P) zwischen den mindestens zwei Transportrollen (4, 4').
2. Plasmaentladungs-Behandlungsvorrichtung (1) nach Anspruch 1, bei der das Führungselement (10) in der Nähe und / oder zwischen den mindestens zwei Transportwalzen (4, 4') angeordnet ist, so dass eine Biegung und / oder eine Krümmung erfolgt Rand (L) des Einzelblattmediums (S), der von einer der mindestens zwei Transportrollen (4, 4') über das Führungselement (10) zu der anderen der mindestens zwei Transportrollen (4, 4') verläuft) unter dem Einfluß der Schwerkraft wird im wesentlichen verhindert.
3. Plasmaentladungs-Behandlungsvorrichtung (1) nach Anspruch 1 oder 2, bei der das Führungselement (10) um eine Schwenkachse (11) schwenkbar ist, die im Wesentlichen parallel zu den Drehachsen (5, 5') der mindestens zwei Transportwalzen ist (4, 4').
4. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei die mindestens zwei Transportwalzen (4, 4') und das Führungselement (10) einen im Wesentlichen geraden Transportweg (P) definieren.
5. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei die mindestens zwei Transportwalzen (4, 4') jeweils eine plasmabeständige Oberflächenschicht (6) umfassen.
6. Plasmaentladungs-Behandlungsvorrichtung (1) nach Anspruch 5, wobei die plasmabeständige Oberflächenschicht (6) glatt behandelt wurde.

7. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei das Führungselement (10) eine Vielzahl von Führungsfingern (12) aufweist, die auf der Schwenkachse (11) vorgesehen sind und in einer Richtung voneinander beabstandet sind parallel zur Schwenkachse (11). 5
8. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, bei der die Durchmesser der mindestens zwei Transportwalzen (4, 4') relativ klein sind, um eine Vorderkante (L) eines Einzelblattmediums (S) zu verhindern sich nicht vom Medientransportpfad (P) ablenken. 10
9. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, bei der die erste Elektrode (2) oder die zweite Elektrode (3) mit einer Hochspannungsquelle verbunden ist. 15
10. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei die erste Elektrode (2) eine Hochspannungselektrode (2a, 2a') umfasst, die einen hohlen Rohrkörper (2b, 2b') umfasst, der an seiner Innenseite mit versehen ist ein passives Kühlsystem (2c, 2c'). 20
11. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, ferner umfassend mindestens zwei Antriebsrollen (30), die stromaufwärts von den mindestens zwei Transportrollen (4, 4') angeordnet sind, um ein Einzelblattmedium (S) anzutreiben. über den Transportrollen (4, 4'). 25
12. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, ferner umfassend einen Eingangstreifen (20) und einen Ausgangstreifen (21), die parallel zu den Drehachsen (5, 5') der mindestens zwei Transportwalzen angeordnet sind (4, 4') bzw. Vor und nach den mindestens zwei Transportrollen (4, 4'). 30
13. Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche, bei der die erste Elektrode (2) und die zweite Elektrode (3) auf beiden Seiten des Transportpfads (P) positioniert sind. 35
14. Drucksystem mit einer Plasmaentladungs-Behandlungsvorrichtung (1) nach einem der vorhergehenden Ansprüche. 40
15. Verfahren zur Plasma- oder Coronabehandlung von Einzelblattmedien, umfassend die Schritte: Erzeugen einer Corona oder eines Plasmas zwischen einer ersten Elektrode (2) und einer zweiten Elektrode (3), derart, dass sich ein Transportpfad (P) durch die 45

erzeugte Corona erstreckt oder Plasma, wobei die zweite Elektrode (3) mindestens zwei drehbare Transportrollen (4, 4') zum Transportieren eines Einzelblattmediums (S) entlang des Transportpfads (P) umfasst, wobei die mindestens zwei Transportrollen (4, 4') benachbart zu dem Transportpfad (P) positioniert und in Richtung des Transportpfads (P) voneinander beabstandet sind; - Transportieren des Einzelblattmediums (S) entlang der Transportbahn (P) zu und über eine erste (4) der mindestens zwei Transportwalzen (4, 4'); Transportieren des Einzelblattmediums (S) entlang der Transportbahn (P) von der ersten (4) der mindestens zwei Transportwalzen (4, 4') über ein Führungselement (10), das zwischen den mindestens zwei Transportwalzen angeordnet ist (4, 4') an eine zweite (4') der mindestens zwei Transportrollen (4, 4') an.

20 Revendications

1. Appareil de traitement par décharge de plasma (1) pour appliquer une couronne ou un plasma sur un support en feuille découpé (S), comprenant: - une première électrode (2) et une seconde électrode (3) pour générer un plasma ou une couronne; un chemin de transport (P) s'étendant entre la première électrode (2) et la deuxième électrode (3), la première électrode (2) étant espacée du chemin de transport (P) et dans lequel la deuxième électrode (3) définit une partie du trajet de transport (P), dans lequel la seconde électrode (3) comprend au moins deux rouleaux de transport rotatifs (4, 4') pour transporter un support en feuille découpé (S) le long du trajet de transport (P), dans lequel les au moins deux des rouleaux de transport rotatifs (4, 4') sont positionnés de manière adjacente au trajet de transport (P) et espacés les uns des autres dans la direction du trajet de transport (P), et dans lequel un élément de guidage (10) est positionné entre les au moins deux des rouleaux de transport (4, 4') pour définir le chemin de transport (P) entre les au moins deux rouleaux de transport (4, 4'). 35
2. Appareil de traitement à décharge de plasma (1) selon la revendication 1, dans lequel l'élément de guidage (10) est positionné à proximité et / ou entre les au moins deux rouleaux de transport (4, 4'), de telle sorte que la flexion et / ou le recourbement d'un rouleau le bord (L) du support en feuille découpé (S) passant de l'un au moins des deux rouleaux de transport (4, 4') au-dessus de l'élément de guidage (10) à l'autre des au moins deux rouleaux de transport (4, 4') sous l'effet de la gravité est sensiblement empêché. 40
3. Appareil de traitement par décharge de plasma (1) selon la revendication 1 ou 2, dans lequel l'élément 45

de guidage (10) peut pivoter autour d'un axe de pivotement (11) sensiblement parallèle aux axes de rotation (5, 5') d'au moins deux rouleaux de transport. (4, 4').

4. Appareil de traitement à décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel les au moins deux rouleaux de transport (4, 4') et l'élément de guidage (10) définissent un chemin de transport sensiblement droit (P). 10
5. Appareil de traitement par décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel les au moins deux rouleaux de transport (4, 4') comprennent chacun une couche de surface résistante au plasma (6). 15
6. Appareil de traitement à décharge de plasma (1) selon la revendication 5, dans lequel la couche de surface résistante au plasma (6) a été traitée pour être lisse. 20
7. Appareil de traitement par décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel l'élément de guidage (10) comprend une pluralité de doigts de guidage (12) prévus sur l'axe de pivotement (11) et espacés les uns des autres dans une direction parallèle à l'axe de pivotement (11). 25 30
8. Appareil de traitement par décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel les diamètres d'au moins deux rouleaux de transport (4, 4') sont relativement petits pour empêcher un bord d'attaque (L) d'un support en feuille coupée (S) de s'éloigner de la voie de transport de support (P). 35
9. Appareil de traitement de décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel la première électrode (2) ou la seconde électrode (3) est connectée à une source haute tension. 40
10. Appareil de traitement de décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel la première électrode (2) comprend une électrode haute tension (2a, 2a') comprenant un corps de tube creux (2b, 2b') pourvu intérieurement de un système de refroidissement passif (2c, 2c'). 45 50
11. Appareil de traitement par décharge de plasma (1) selon l'une quelconque des revendications précédentes, comprenant en outre au moins deux rouleaux d'entraînement (30) positionnés en amont des au moins deux rouleaux de transport (4, 4') pour entraîner un support de feuille coupée (S) sur les rou-

leaux de transport (4, 4').

12. Appareil de traitement à décharge de plasma (1) selon l'une quelconque des revendications précédentes, comprenant en outre une bande d'entrée (20) et une bande de sortie (21) disposées parallèlement aux axes de rotation (5, 5') d'au moins deux rouleaux de transport (4, 4') et respectivement en amont et en aval d'au moins deux rouleaux de transport (4, 4').
13. Appareil de traitement de décharge de plasma (1) selon l'une quelconque des revendications précédentes, dans lequel la première électrode (2) et la seconde électrode (3) sont positionnées de part et d'autre du trajet de transport (P).
14. Système d'impression comprenant un appareil de traitement de décharge de plasma (1) selon l'une quelconque des revendications précédentes.
15. Procédé de traitement par plasma ou corona de feuilles de papier découpées, comprenant les étapes consistant à: générer un corona ou un plasma entre une première électrode (2) et une seconde électrode (3), de telle sorte qu'un chemin de transport (P) traverse la couronne générée ou plasma, dans lequel la seconde électrode (3) comprend au moins deux rouleaux de transport rotatifs (4, 4') pour transporter un support en feuille découpé (S) le long du trajet de transport (P), dans lequel les au moins deux rouleaux de transport (4, 4') sont positionnés de manière adjacente à la voie de transport (P) et espacés les uns des autres dans la direction de la voie de transport (P); - transporter le support en feuille découpé (S) le long du trajet de transport (P) jusqu'à et au-dessus d'un premier (4) des au moins deux rouleaux de transport (4, 4'); transport du support en feuille découpé (S) le long du trajet de transport (P) depuis le premier (4) des au moins deux rouleaux de transport (4, 4') sur un élément de guidage (10) positionné entre les au moins deux rouleaux de transport (4, 4') à un deuxième (4') des au moins deux rouleaux de transport (4, 4').

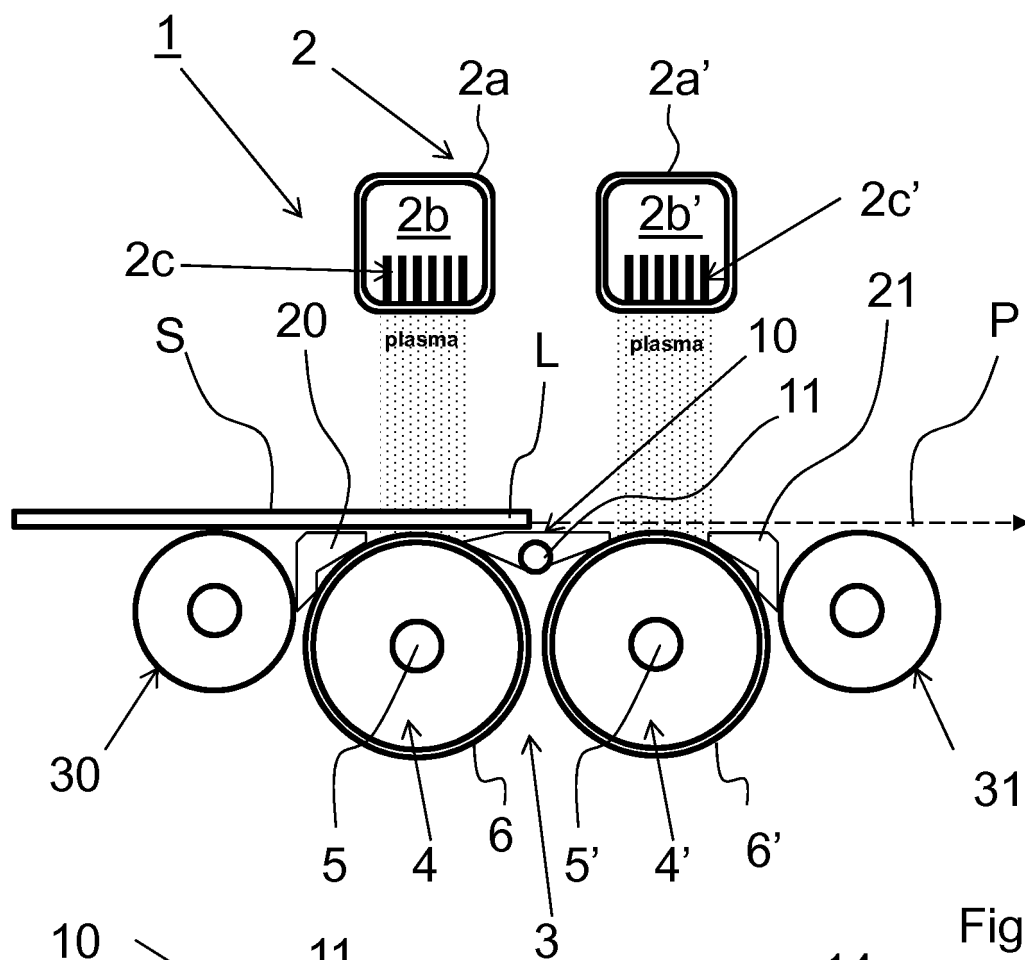


Fig. 1

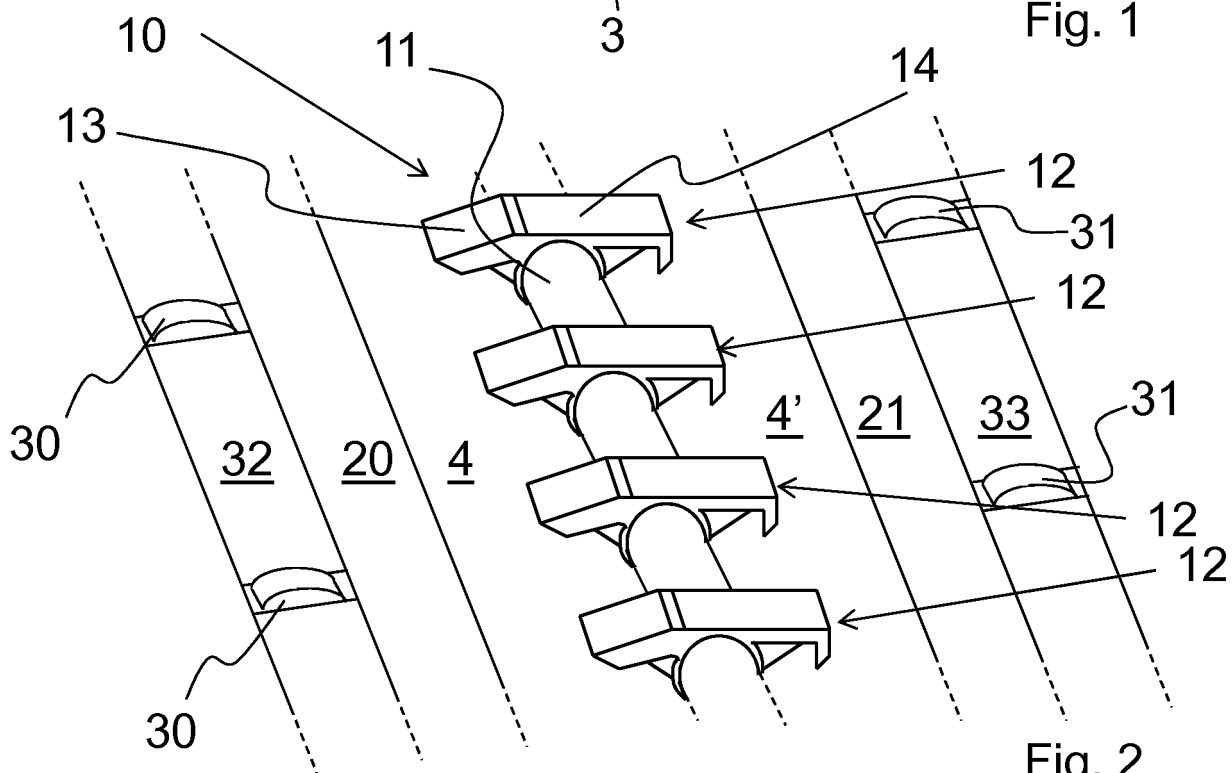


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1919048 A [0003]
- EP 2866318 A [0018] [0029] [0030]