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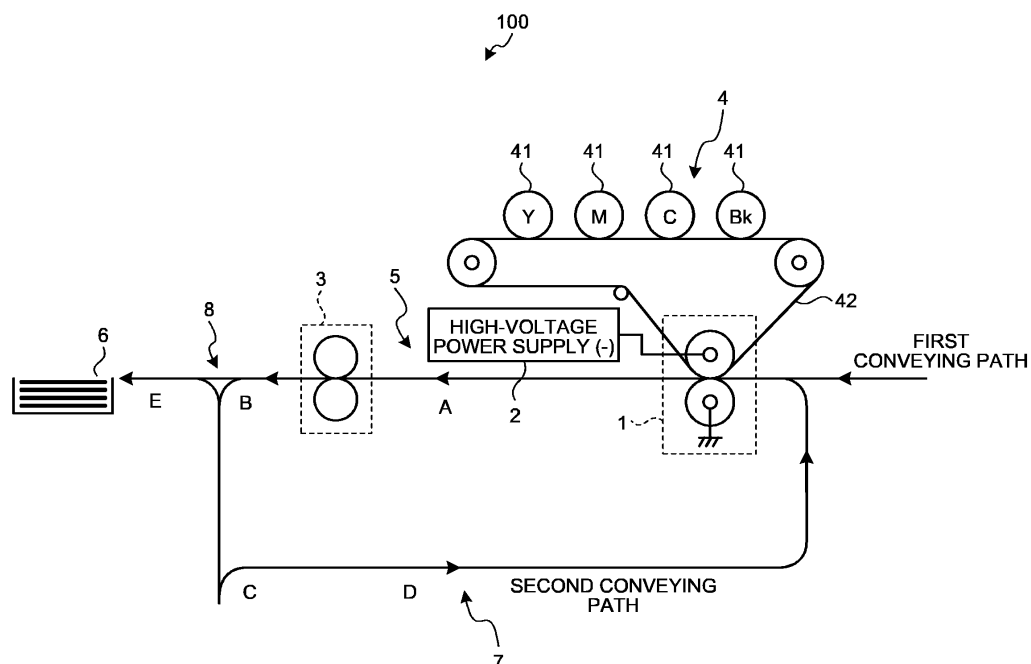
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(54) **IMAGE FORMING APPARATUS AND MEDIUM CONVEYANCE CONTROL METHOD**

(57) An image forming apparatus (100) includes an image bearer (42), a transfer unit (1), a voltage applying unit (202), a stacking unit (6), a turnover conveying unit (8), and a control unit (203). The transfer unit (1) is configured to transfer toner images on the image bearer (42) to print media (P). The voltage applying unit (202) is configured to apply voltage to the transfer unit (1). The stacking unit (6) is configured to stack the transferred printed

print media (P). The turnover conveying unit (8) is configured to turn over a printed print medium (P). The control unit (203) is configured to perform control to apply voltage again to a printed print medium (P) conveyed to the transfer unit (1) via the turnover conveying unit (8), without transferring a toner image onto the printed print medium (P).

FIG.1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an image forming apparatus and a medium conveyance control method.

2. Description of the Related Art

[0002] Conventionally, in an image forming apparatus of an electrophotographic system, a method of transferring toner to a print medium by using high voltage is commonly adopted. Further, an image forming apparatus that includes a neutralizing brush arranged on a conveying path and neutralizes a charged surface in order to prevent reduction of post-processing performance due to occurrence of static electricity or electrical adsorption at the time of ejection and loading (at the time of stacking) of a printed medium has been known.

[0003] Furthermore, Japanese Unexamined Patent Application Publication No. 2015-67433 discloses an image forming apparatus that transfers, in an overlapping manner, a printed print medium that is not turned over and a printed print medium that is turned over, and then ejects the printed print media in order to prevent resin films from sticking to each other due to static electricity.

[0004] However, according to the conventional technique, the printed print medium that is turned over after printing and the printed print medium that is not turned over after printing are transferred in an overlapping manner and thereafter ejected, so that print surfaces of the printed print media that are stacked after paper ejection are alternately turned over. Therefore, a user needs to make the stacked printed print media have the same orientation every two media.

[0005] The present invention has been conceived in view of the foregoing situation, and an object of the present invention is to prevent print media from sticking to one another due to static electricity in a state in which print surfaces of the print media face the same direction while the print media are stacked after being ejected.

SUMMARY OF THE INVENTION

[0006] According to an embodiment, an image forming apparatus includes an image bearer, a transfer unit, a voltage applying unit, a stacking unit, a turnover conveying unit, and a control unit. The transfer unit is configured to transfer toner images on the image bearer to print media. The voltage applying unit is configured to apply voltage to the transfer unit. The stacking unit is configured to stack the transferred printed print media. The turnover conveying unit is configured to turn over a printed print medium. The control unit is configured to perform control to apply voltage again to a printed print medium conveyed

to the transfer unit via the turnover conveying unit, without transferring a toner image onto the printed print medium.

[0007] According to an aspect of the present invention, at the time of paper ejection and loading (at the time of stacking), it is possible to prevent print media from sticking to one another due to static electricity in a state in which print surfaces of the print media face the same direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

FIG. 1 is a diagram schematically illustrating a configuration of a main part of an image forming apparatus according to a first embodiment;

FIG. 2 is a block diagram schematically illustrating a hardware configuration of the image forming apparatus;

FIG. 3 is a diagram simply illustrating a main part of a secondary transfer unit in the image forming apparatus;

FIG. 4 is a diagram illustrating an example of how print media stick to one another due to charging;

FIG. 5 is a functional block diagram illustrating an example of functions related to a medium conveyance control process performed by the image forming apparatus;

FIG. 6 is a flowchart illustrating the flow of the medium conveyance control process performed by the image forming apparatus;

FIG. 7 is a diagram illustrating an example of how printed media are stacked;

FIG. 8 is a flowchart illustrating the flow of sheet processing operation performed by an image forming apparatus according to a second embodiment;

FIG. 9 is a diagram illustrating an example of how printed media are stacked;

FIG. 10 is a flowchart illustrating a modification of the flow of the sheet processing operation performed by the image forming apparatus according to the second embodiment; and

FIG. 11 is a diagram illustrating an example of how printed media are stacked.

[0009] The accompanying drawings are intended to depict exemplary embodiments of the present invention and should not be interpreted to limit the scope thereof. Identical or similar reference numerals designate identical or similar components throughout the various drawings.

DESCRIPTION OF THE EMBODIMENTS

[0010] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present invention.

[0011] As used herein, the singular forms "a", "an" and

"the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0012] In describing preferred embodiments illustrated in the drawings, specific terminology may be employed for the sake of clarity. However, the disclosure of this patent specification is not intended to be limited to the specific terminology so selected, and it is to be understood that each specific element includes all technical equivalents that have the same function, operate in a similar manner, and achieve a similar result.

[0013] An embodiment of the present invention will be described in detail below with reference to the drawings.

[0014] Embodiments of an image forming apparatus and a medium conveyance control method will be described in detail below with reference to the accompanying drawings.

First Embodiment

[0015] FIG. 1 is a diagram schematically illustrating a configuration of a main part of an image forming apparatus 100 according to a first embodiment. In FIG. 1, the image forming apparatus 100 is an image forming apparatus that is generally referred to as a multifunction peripheral (MFP) having at least two of a copier function, a printer function, a scanner function, and a facsimile function.

[0016] Meanwhile, in the present embodiment, an apparatus in which a toner image developed on a photoconductor is transferred to an intermediate transfer belt, and thereafter secondarily transferred from the intermediate transfer belt to paper or a film will be described; however, the present invention achieves the same effects even in an apparatus that does not include an intermediate transfer member and that directly transfers a toner image from a photoconductor to paper or a resin film.

[0017] As illustrated in FIG. 1, the image forming apparatus 100 includes a secondary transfer unit 1 that is a transfer unit, a high-voltage power supply 2, a fixing unit 3, an image forming unit 4, a first conveying unit 5, a stacking unit 6, a second conveying unit 7, and a turn-over conveying unit 8.

[0018] The image forming unit 4 includes tandem-type image formation units (yellow (Y), magenta (M), cyan (C), and black (Bk)) 41, an intermediate transfer belt 42 as an image bearer, and the like. Through an image formation process performed by the image forming unit 41, an image written by an optical writing device is formed on a toner image on the intermediate transfer belt 42.

[0019] Specifically, the image formation units (Y, M, C, Bk) 41 include four photoconductor drums (Y, M, C, K) in a rotatable manner, and further include image formation elements including a charging roller, a developing unit, a primary transfer roller, a cleaner unit, and a neutralizing unit around each of the photoconductor drums.

[0020] In each of the photoconductor drums, the image formation elements function and an image on the photo-

conductor drum is transferred onto the intermediate transfer belt 42 by each of the primary transfer rollers. The intermediate transfer belt 42 is arranged so as to be extended by a driving roller and a driven roller in a nip between each of the photoconductor drums and each of the primary transfer rollers.

[0021] The secondary transfer unit 1 includes a pair of repulsive rollers R1 and a secondary transfer roller R2. The secondary transfer unit 1 transfers toner images (yellow (Y), magenta (M), cyan (C), and black (Bk)) on the intermediate transfer belt 42 onto a supplied print medium P (see FIG. 3). More specifically, the secondary transfer unit 1 secondarily transfers the toner images, which have been primarily transferred on the intermediate transfer belt 42, onto the print medium P located on a secondary transfer belt 11 along with movement of the intermediate transfer belt 42.

[0022] The print medium P subjected to the secondary transfer is conveyed to the fixing unit 3 by drive of the first conveying unit 5, and the toner images are fixed, as a color image, on the print medium P. Thereafter, the print medium P is ejected to the stacking unit 6 located outside the apparatus. Meanwhile, in the case of duplex printing, the print medium P is turned over by the second conveying unit 7, and the turned-over print medium P is conveyed to the secondary transfer unit 1.

[0023] Meanwhile, it is sufficient that the stacking unit 6 stacks two or more media that have been passed through transfer and fixing, and it is possible to achieve the effects of the present invention for two or more overlapping media.

[0024] The high-voltage power supply 2 applies homopolar voltage of, for example, hundreds to thousands volts to the repulsive rollers R1 of the secondary transfer unit 1. The secondary transfer unit 1 transfers the toner images (yellow (Y), magenta (M), cyan (C), and black (Bk)), which are formed on the intermediate transfer belt 42 through image formation, to the print medium P with the aid of pressure due to contact and with the aid of an electrical repelling force due to the homopolar voltage that is applied from the high-voltage power supply 2 to the repulsive rollers R.

[0025] The fixing unit 3 is a fixing unit of, for example, a thermal fixing system, and applies heat and pressure to the print medium P on which the toner images are transferred. Accordingly, the toner is melted and the images are fixed to the print medium P.

[0026] The first conveying unit 5 includes various sensors, a motor, a roller member that is rotated by the motor, and the like. The first conveying unit 5 constitutes a first conveying path that extends from the secondary transfer unit 1 to the stacking unit 6, and conveys the printed print medium P, onto which the toner images on the image bearer are transferred by the secondary transfer unit 1 and the toner images are fixed by the fixing unit 3.

[0027] The stacking unit 6 includes various sensors, a motor, a roller member that is rotated by the motor, and the like. The stacking unit 6 ejects and stacks the printed

print medium P.

[0028] The second conveying unit 7 includes various sensors, a motor, a roller member that is rotated by the motor, and the like. The second conveying unit 7 constitutes a second conveying path that extends from the middle of the first conveying path to the secondary transfer unit 1, turns over the printed print medium P toward a conveying direction, and conveys the printed print medium P again to the stacking unit 6.

[0029] The turnover conveying unit 8 includes various sensors, a motor, a roller member that is rotated by the motor, and the like. The turnover conveying unit 8 is arranged on the first conveying path, and constitutes a turnover conveying path for turning over the printed print medium P, which has been conveyed through the first conveying path, and conveying the printed print medium P toward the stacking unit 6. Meanwhile, it is sufficient that the turnover conveying unit 8 turns over the print medium through the turnover conveying path, and therefore, it is possible to turn over a print medium between B and C or at B illustrated in FIG. 1 and thereafter convey the print medium to E, or it is possible to turn over a print medium at C and thereafter convey the print medium to D.

[0030] A hardware configuration of the image forming apparatus 100 will be described below. FIG. 2 is a block diagram schematically illustrating the hardware configuration of the image forming apparatus 100. As illustrated in FIG. 2, the image forming apparatus 100 includes a control unit 101, such as a central processing unit (CPU), that controls the entire apparatus, a main storage unit 102, such as a read only memory (ROM) or a random access memory (RAM), for storing various kinds of data and various programs, an auxiliary storage unit 103, such as a hard disk drive or a compact disc (CD) drive device, for storing various kinds of data and various programs, and a bus 104 that connects the above-described units, and may be implemented by a hardware configuration using a normal computer.

[0031] Further, the high-voltage power supply 2, the fixing unit 3, and the image forming unit 4 are connected to the control unit 101 via the bus 104. Furthermore, various motors that are included in the first conveying unit 5, the stacking unit 6, the second conveying unit 7, and the turnover conveying unit 8 are connected to the control unit 101 via the bus 104.

[0032] A program executed by the image forming apparatus 100 of the present embodiment is provided by being recorded in a computer readable recording medium, such as a CD-ROM, a flexible disk (FD), a CD-recordable (CD-R), or a digital versatile disk (DVD), in a computer-installable or a computer-executable file format.

[0033] Further, the program executed by the image forming apparatus 100 of the present embodiment may be stored in a computer connected to a network, such as the Internet, and may be provided by download via the network. Furthermore, the program executed by the image forming apparatus 100 of the present embodiment

may be provided or distributed via a network, such as the Internet.

[0034] Moreover, the program executed by the image forming apparatus 100 of the present embodiment may be provided by being incorporated in a ROM or the like in advance.

[0035] Here, FIG. 3 is a diagram simply illustrating a main part of the secondary transfer unit 1 of the image forming apparatus 100. In the present embodiment, the toner is negatively chargeable. As illustrated in FIG. 3, toner T on the intermediate transfer belt 42 in the image formation is transferred to the print medium P with the aid of pressure due to contact and with the aid of an electric repelling force due to negative voltage that is applied from the high-voltage power supply G to the repulsive rollers R. In this case, voltage of hundreds to thousands volts is applied from the high-voltage power supply G to the repulsive rollers R and therefore small gap discharge occurs at a transfer nip, so that a front surface of the print medium P is negatively charged and a back surface of the print medium P is positively charged. Static electricity due to the charge causes a "jam" in which the print medium P is wound around the conveying roller or the like, a stacking failure in post-processing, and a paper handling failure (for example, separation and alignment). Therefore, in general, neutralization is performed by applying separation voltage to the print medium P immediately after the secondary transfer, or neutralization is performed by bringing a neutralizing brush into contact with the surface of the print medium P after the fixing process.

[0036] Meanwhile, performing neutralization by applying separation voltage immediately after the secondary transfer or rubbing the surface by a neutralizing brush after the fixing process is widely known. If a conductive paper medium with relatively small internal resistance is adopted as the print medium P, the amount of discharge is small and electric charge easily moves, so that it is possible to neutralize the electric charge on the surface of the print medium by applying separation voltage or by using a neutralizing brush.

[0037] In contrast, if a high-resistant print medium with high resistance characteristic that is close to the dielectric body is adopted as the print medium P, the amount of charge is large and a range in which the electric charge is movable is limited to an internal narrow range, so that even if a neutralizing brush is used, it is difficult to cause the high-resistant print medium to transition from a polarized state to a non-polarized state. Here, the high resistance indicates a resistance value whose value falls in a range as described below. For example, high resistance indicates resistance of 4×10^{13} to $5 \times 10^{16} \Omega/\text{cm}$ while volume resistance of plain paper is 6×10^8 to $9 \times 10^{12} \Omega/\text{cm}$.

[0038] Meanwhile, the high-resistant print medium is a medium that contains a resin component and therefore has high-resistant characteristic close to a dielectric body, for example. Examples of the high-resistant print medium include coating paper, coated paper, tack paper,

a synthetic resin film, and laminated paper.

[0039] Here, FIG. 4 is a diagram illustrating how print media stick to one another due to charging. When print media in polarized states as described above are ejected and stacked as illustrated in FIG. 4, for example, a non-print surface with negative polarity (-) of a first print medium and a print surface with positive polarity (+) of a second print medium located above electrically attract to each other, so that the print media electrically stick to each other, which is a problem.

[0040] To cope with the problem as described above, it may be possible to apply ion with polarity opposite to the electric charge in the vicinity of the surface of the print medium P by using an ionizer to neutralize the electric charge and reduce sticking. However, even if the method as described above is adopted, it is difficult to radiate ion enough to fully neutralize the electric charge, although it is possible to achieve larger effects than the neutralizing brush.

[0041] Therefore, in the present embodiment, voltage is applied again to the turned-over printed print medium P by using the secondary transfer unit 1, so that it is possible to cause the opposing surfaces of the overlapping print media P to have the same polarity, and it is possible to cause electrical repulsion to occur to reduce sticking. This will be described in detail below.

Functional configuration and medium conveyance control process by program

[0042] Functions that implement a medium conveyance control process that is a characteristic process of the present embodiment among various kinds of arithmetic processing that is performed by the CPU of the image forming apparatus 100 in accordance with a program will be described below.

[0043] FIG. 5 is a functional block diagram illustrating an example of the functions related to the medium conveyance control process performed by the image forming apparatus 100.

[0044] The CPU of the image forming apparatus 100 realizes each of functions of a counting unit 201, a voltage applying unit 202, and a control unit 203 as illustrated in FIG. 5 by executing a program stored in the auxiliary storage unit 103. Meanwhile, it is explained that the counting unit 201, the voltage applying unit 202, and the control unit 203 are implemented by software, but a part or all of the units may be implemented by hardware, such as an integrated circuit (IC).

[0045] The counting unit 201 counts the number of the print media P in a continuous job.

[0046] The voltage applying unit 202 applies, with use of the secondary transfer unit 1, reverse-polarity voltage with polarity opposite to the polarity of the voltage applied by the secondary transfer unit 1, to the printed print medium P that is conveyed to the secondary transfer unit 1 by the second conveying unit 7.

[0047] The control unit 203 controls operation of the

second conveying unit 7, the voltage applying unit 202, and the turnover conveying unit 8 every two print media P on the basis of the number of the print media P counted by the counting unit 201.

[0048] FIG. 6 is a flowchart illustrating the flow of the medium conveyance control process performed by the image forming apparatus 100. The CPU of the image forming apparatus 100 prevents the print media P from sticking to one another by causing the counting unit 201, the voltage applying unit 202, and the control unit 203 based on the program to perform the process in the flowchart.

[0049] Meanwhile, the flowchart illustrated in FIG. 6 indicates operation from printing to paper ejection for each medium during a continuous job performed for a plurality of media.

[0050] First, the counting unit 201 counts the number of printed media in the continuous job (Step S1). For example, the number of printed media is counted as a first medium in the first job.

[0051] Subsequently, if the control unit 203 controls the first conveying unit 5 and determines that the continuous job for the plurality of media is performed for an odd-numbered medium (No at Step S2), the control unit 203 conveys the print medium P through a conveying path of A→B→E illustrated in FIG. 1, and ejects and stacks the print medium P onto the stacking unit 6 illustrated in FIG. 1 (Step S7).

[0052] In contrast, if the control unit 203 determines that the continuous job for the plurality of media is performed for an even-numbered medium (Yes at Step S2), the control unit 203 causes the first conveying unit 5 and the second conveying unit 7 to convey the print medium P through a conveying path of A→B→C illustrated in FIG. 1, turn over the print medium P at C illustrated in FIG. 1, and convey the print medium P to the secondary transfer unit 1 via D illustrated in FIG. 1 (Step S3). Accordingly, if the continuous job for the plurality of media is performed for an even-numbered medium, and when the print medium P is conveyed to the secondary transfer unit 1, the print medium P is turned over from the fed state.

[0053] Subsequently, the control unit 203 causes the voltage applying unit 202 to apply voltage to achieve the same transfer bias as the transfer bias that is applied at the time of printing (the same electrical current if constant electrical current is controlled), without performing printing in the secondary transfer unit 1 (Step S4). Meanwhile, at Step S4, it may be possible to change bias voltage in accordance with an area of an image in order to increase effects. In general, toner in a digital machine is negatively charged, so that if the amount of attachment of toner or the area of the image increases, negatively charged potential on the surface of the print medium P increases by about 20 percent (based on the absolute value) at maximum. Therefore, it is possible to increase the effects by increasing the bias voltage by about 20 percent (based on the absolute value) at maximum in accordance with the amount of attachment of toner or the area of the im-

age. Furthermore, repulsion of surface potential of opposing surfaces of the overlapping print media P increases when the polarity is opposite and the absolute values are the same; therefore, if the amount of attachment of toner or the area of the image is decreased, it is possible to increase the effects by reducing the absolute value of the bias voltage to be applied, in accordance with the amount of attachment of toner or the area of the image rather than continuously applying bias with a large absolute value.

[0054] At this time, the print medium P is turned over from the fed state, and the front surface and the back surface are oppositely charged.

[0055] Subsequently, after the print medium P secondly passes through the secondary transfer unit 1, the control unit 203 causes the first conveying unit 5 and the turnover conveying unit 8 to turn over the print medium P at B illustrated in FIG. 1 (Step S5), and ejects and stacks the print medium P onto the stacking unit 6 illustrated in FIG. 1 (Step S6).

[0056] Here, FIG. 7 is a diagram illustrating an example of how printed media are stacked. The example illustrated in FIG. 7 indicates a state of static electricity when the printed print media P are stacked in the continuous job for four media. As illustrated in FIG. 7, print surfaces (front surfaces) of odd-numbered print media P have negative polarity (-) and non-print surfaces (back surfaces) have positive polarity (+). In contrast, print surfaces (front surfaces) of even-numbered print media P have positive polarity (+) and non-print surfaces (back surfaces) have negative polarity (-). Therefore, when the odd-numbered print medium P and the even-numbered print medium P are stacked, they are stacked such that surfaces with the same polarity face each other.

[0057] In addition, after paper ejection, the printed print media P are stacked while images are not turned over, so that in a stacked state after paper ejection, it is possible to prevent the print media P from sticking to one another due to static electricity while image surfaces face the same direction.

[0058] In other words, in the example in FIG. 7, the print surface of the first print medium P has negative polarity (-) and the non-print surface of the second print medium P that is stacked on the first print medium P has negative polarity (-). Accordingly, the first print medium P and the second print medium P electrically repel each other and are prevented from sticking to each other. Similarly, the print surface of the second print medium P has positive polarity (+) and the non-print surface of the third print medium P that is stacked on the second print medium P has positive polarity (+). Accordingly, the second print medium P and the third print medium P electrically repel each other and are prevented from sticking to each other. Therefore, it is possible to resolve a stacking failure and handling difficulty in post-processing.

[0059] As described above, according to the present embodiment, at the time of paper ejection and loading (at the time of stacking), it is possible to prevent print

media from sticking to one another due to static electricity in a state in which print surfaces of the print media face the same direction.

[0060] Furthermore, the voltage applying unit 202 applies, with use of the transfer unit, certain voltage at the same level as and with polarity opposite to the voltage that is applied by the transfer unit, to the front and back sides of the printed print medium, so that it is possible to secure stability with respect to a temporal change of the transfer unit and variation from lot to lot, and it is possible to provide an image forming apparatus with a small size and at less cost.

[0061] Meanwhile, in the present embodiment, the first printed print medium is ejected and stacked onto the stacking unit 6 by being conveyed through the conveying path of A→B→E illustrated in FIG. 1, and the second printed print medium is ejected and stacked onto the stacking unit 6 by being turned over by the turnover conveying unit 8 after secondly passing through the secondary transfer unit 1; however, embodiments are not limited to this example. For example, the first printed print medium may be turned over by the turnover conveying unit 8 and then ejected and stacked onto the stacking unit 6 (in other words, without passing through the second conveying unit 7). Further, the second printed print medium may be turned over through the second conveying unit 7 and then ejected and stacked onto the stacking unit 6 after being applied with only the transfer bias by the transfer unit 1 without being subjected to printing (voltage is applied but toner is not attached).

Second Embodiment

[0062] A second embodiment will be described below.

[0063] The second embodiment is different from the first embodiment in terms of operation in the medium conveyance control process. In the description of the second embodiment below, explanation of the same components as those of the first embodiment will be omitted and differences from the first embodiment will be described.

[0064] The control unit 203 of the present embodiment controls operation of the second conveying unit 7 for all of the printed print media P, and controls operation of the voltage applying unit 202 and the turnover conveying unit 8 every two print media P on the basis of the number of the print media P counted by the counting unit 201.

[0065] FIG. 8 is a flowchart illustrating the flow of sheet processing operation performed by the image forming apparatus 100 according to the second embodiment. The CPU 7 performs the process in the flowchart by using each of units 25 to 28 based on a sheet processing program, thereby preventing sticking of each of the print media.

[0066] Meanwhile, the flowchart illustrated in FIG. 8 indicates operation from printing to paper ejection for each medium during a continuous job performed for a plurality of media.

[0067] First, the counting unit 201 counts the number of printed media in the continuous job (Step S11). For example, the number of printed media in the first job is counted as a first medium.

[0068] Subsequently, if the control unit 203 determines that the continuous job for the plurality of media is performed for an odd-numbered medium (No at Step S12), the control unit 203 causes the first conveying unit 5 and the second conveying unit 7 to convey the print medium P through the conveying path of A→B→C illustrated in FIG. 1, turn over the print medium P at C illustrated in FIG. 1, and convey the print medium P to the secondary transfer unit 1 via D illustrated in FIG. 1 (Step S16). Accordingly, if the continuous job for the plurality of media is performed for an even-numbered medium, and when the print medium P is conveyed to the secondary transfer unit 1, the print medium P is turned over from the fed state. Subsequently, after the print medium P secondly passes through the secondary transfer unit 1, the control unit 203 causes the conveying unit 5 and the turnover conveying unit 8 not to turn over the print medium P at B illustrated in FIG. 1, and ejects and stacks the print medium P at E illustrated in FIG. 1 (Step S17). In other words, odd-numbered print media P that are turned over and then conveyed are not subjected to printing and not applied with voltage by the secondary transfer unit 1.

[0069] In contrast, if the control unit 203 determines that the continuous job for the plurality of media is performed for an even-numbered medium (Yes at Step S12), the control unit 203 causes the first conveying unit 5 and the second conveying unit 7 to convey the print medium P through the conveying path of A→B→C illustrated in FIG. 1, turn over the print medium P at C illustrated in FIG. 1, and convey the print medium P to the secondary transfer unit 1 via D illustrated in FIG. 1 (Step S13). Accordingly, if the continuous job for the plurality of media is for an even-numbered medium, and when the print medium P is conveyed to the secondary transfer unit 1, the print medium P is turned over from the fed state.

[0070] Subsequently, the control unit 203 causes the voltage applying unit 202 to apply voltage to achieve the same transfer bias as the transfer bias that is applied at the time of printing (the same electrical current if constant electrical current is controlled), without performing printing in the secondary transfer unit 1 (Step S14). Meanwhile, at Step S14, it may be possible to change bias voltage in accordance with an area of an image in order to increase effects.

[0071] At this time, the print medium P is turned over from the fed state, and the front surface and the back surface are oppositely charged.

[0072] Subsequently, after the print medium P secondly passes through the secondary transfer unit 1, the control unit 203 causes the first conveying unit 5 and the turnover conveying unit 8 not to turn over the print medium P at B illustrated in FIG. 1 FIG. 1, and ejects and stacks the print medium P onto the stacking unit 6 illustrated in FIG. 1 (Step S15).

[0073] Here, FIG. 9 is a diagram illustrating an example of how printed media are stacked. The example illustrated in FIG. 9 indicates a state of static electricity when the printed print media P are stacked in the continuous job for four media. As illustrated in FIG. 9, print surfaces (front surfaces) of odd-numbered print media P have negative polarity (-) and non-print surfaces (back surfaces) have positive polarity (+). In contrast, print surfaces (front surfaces) of even-numbered print media P have positive polarity (+) and non-print surfaces (back surfaces) have negative polarity (-). Therefore, when the odd-numbered print medium P and the even-numbered print medium P are stacked, they are stacked such that surfaces with the same polarity face each other.

[0074] In other words, in the example in FIG. 9, the non-print surface of the first print medium P has positive polarity (+) and the print surface of the second print medium P that is stacked on the first print medium P has positive polarity (+). Accordingly, the first print medium P and the second print medium P electrically repel each other and are prevented from sticking to each other. Similarly, the non-print surface of the second print medium P has negative polarity (-) and the print surface of the third print medium P that is stacked on the second print medium P has negative polarity (-). Accordingly, the second print medium P and the third print medium P electrically repel each other and are prevented from sticking to each other. Therefore, it is possible to resolve a stacking failure and handling difficulty in the post-processing.

[0075] As described above, according to the present embodiment, at the time of paper ejection and loading (at the time of stacking), it is possible to prevent print media from sticking to one another due to static electricity in a state in which print surfaces of the print media face the same direction.

[0076] Meanwhile, in the present embodiment, at Step S16, the print medium P is conveyed through the conveying path of A→B→C illustrated in FIG. 1, turned over at C illustrated in FIG. 1, and conveyed to the secondary transfer unit 1 via D illustrated in FIG. 1; however, embodiments are not limited to this example. Here, FIG. 10 is a flowchart illustrating a modification of the flow of the sheet processing operation performed by the image forming apparatus 100 according to the second embodiment. As illustrated in FIG. 10, if the control unit 203 determines that the continuous job for the plurality of media is performed for an odd-numbered medium (No at Step S12), the control unit 203 may cause the first conveying unit 5 and the turnover conveying unit 8 to turn over the print medium P at B illustrated in FIG. 1 (Step S16'), and ejects and stacks the print medium P onto the stacking unit 6 (Step S17).

[0077] Here, FIG. 11 is a diagram illustrating an example of how printed media are stacked. The example illustrated in FIG. 11 corresponds to the modification illustrated in FIG. 10, and indicates a state of static electricity when the printed print media P are stacked in the continuous job for four media. As illustrated in FIG. 11, even

in the modification in FIG. 10, the first print medium P and the second print medium P electrically repel each other and are prevented from sticking to each other. Similarly, the non-print surface of the second print medium P has negative polarity (-) and the print surface of the third print medium P that is stacked on the second print medium P has negative polarity (-). Accordingly, the second print medium P and the third print medium P electrically repel each other and are prevented from sticking to each other. Therefore, it is possible to resolve a stacking failure and handling difficulty in the post-processing.

[0078] Furthermore, the voltage applying unit 202 applies, with use of the transfer unit, certain voltage at the same level as and with polarity opposite to the voltage that is applied by the transfer unit, to the front and back sides of the printed print medium that is transferred to the transfer unit by the turnover conveying unit 8, so that it is possible to secure stability with respect to temporal change of the transfer unit and variation from lot to lot, and it is possible to provide an image forming apparatus with a small size and at less cost.

[0079] Meanwhile, the embodiments above have been explained using examples in which the image forming apparatus of the present invention is adopted to an MFP that is an image forming apparatus having at least two of a copier function, a printer function, a scanner function, and a facsimile function, but may be adopted to any of image forming apparatuses, such as a copier, a printer, a scanner, and a facsimile machine.

[0080] The above-described embodiments are illustrative and do not limit the present invention. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, at least one element of different illustrative and exemplary embodiments herein may be combined with each other or substituted for each other within the scope of this disclosure and appended claims. Further, features of components of the embodiments, such as the number, the position, and the shape are not limited the embodiments and thus may be preferably set. It is therefore to be understood that within the scope of the appended claims, the disclosure of the present invention may be practiced otherwise than as specifically described herein.

[0081] The method steps, processes, or operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance or clearly identified through the context. It is also to be understood that additional or alternative steps may be employed.

[0082] Further, any of the above-described apparatus, devices or units can be implemented as a hardware apparatus, such as a special-purpose circuit or device, or as a hardware/software combination, such as a processor executing a software program.

[0083] Further, as described above, any one of the above-described and other methods of the present invention may be embodied in the form of a computer pro-

gram stored in any kind of storage medium. Examples of storage mediums include, but are not limited to, flexible disk, hard disk, optical discs, magneto-optical discs, magnetic tapes, nonvolatile memory, semiconductor memory, read-only-memory (ROM), etc.

[0084] Alternatively, any one of the above-described and other methods of the present invention may be implemented by an application specific integrated circuit (ASIC), a digital signal processor (DSP) or a field programmable gate array (FPGA), prepared by interconnecting an appropriate network of conventional component circuits or by a combination thereof with one or more conventional general purpose microprocessors or signal processors programmed accordingly.

[0085] Each of the functions of the described embodiments may be implemented by one or more processing circuits or circuitry. Processing circuitry includes a programmed processor, as a processor includes circuitry. A processing circuit also includes devices such as an application specific integrated circuit (ASIC), digital signal processor (DSP), field programmable gate array (FPGA) and conventional circuit components arranged to perform the recited functions.

Claims

1. An image forming apparatus comprising:

an image bearer;
a transfer unit configured to transfer toner images on the image bearer to print media;
a voltage applying unit configured to apply voltage to the transfer unit;
a stacking unit configured to stack the transferred printed print media;
a turnover conveying unit configured to turn over a printed print medium; and
a control unit configured to perform control to apply voltage again to a printed print medium conveyed to the transfer unit via the turnover conveying unit, without transferring a toner image onto the printed print medium.

2. The image forming apparatus according to claim 1, further comprising:

a counting unit configured to count a number of print media;
a first conveying unit configured to convey a printed print medium to the stacking unit through a first conveying path without turning over the printed print medium; and
a second conveying unit configured to convey a print medium that is turned over, to the transfer unit through an turnover conveying path and a second conveying path, wherein the turnover conveying unit is configured to turn

over, through the turnover conveying path, a printed print medium conveyed through the first conveying path, and the control unit is configured to

perform, at least every two printed print media, control to convey a printed print medium to the transfer unit through the second conveying path, and apply voltage again to the printed print medium conveyed to the transfer unit, without transferring the toner image, and transfer the printed print medium applied with the voltage again without transfer of the toner image, to the stacking unit through the first conveying path.

3. The image forming apparatus according to claim 2, wherein the control unit is configured to

convey a first printed print medium to the stacking unit without turning over the first printed print medium through the first conveying path, the first printed print medium being one of an odd-numbered printed print medium and an even-numbered printed print medium, and apply voltage again to a second printed print medium conveyed to the transfer unit through the turnover conveying path and the second conveying path, without transferring a toner image, subsequently turn over the second printed print medium through the first conveying path and the turnover conveying path, and convey the second printed print medium to the stacking unit, the second printed print medium being the other of the odd-numbered printed print medium and the even-numbered printed print medium.

4. The image forming apparatus according to claim 2, wherein the control unit is configured to

turn over a first printed print medium through the first conveying path and the turnover conveying path without through the second conveying path, and subsequently transfer the first printed print medium to the stacking unit, the first printed print medium being one of an odd-numbered printed print medium and an even-numbered printed print medium, apply voltage again to a second printed print medium conveyed to the transfer unit through the turnover conveying path and the second conveying path, without transferring a toner image, and subsequently transfer the second printed print medium to the stacking unit without turning over the second printed print medium through

the first conveying path, the second printed print medium being the other of the odd-numbered printed print medium and the even-numbered printed print medium.

5. The image forming apparatus according to claim 2, wherein the control unit is configured to

convey a first printed print medium transferred to the transfer unit through the turnover conveying path and the second conveying path, to the stacking unit without transferring a toner image to the first printed print medium, without applying voltage to the first printed print medium again, and without turning over the first printed print medium through the first conveying path, the first printed print medium being one of an odd-numbered printed print medium and an even-numbered printed print medium, and apply voltage to a second printed print medium conveyed to the transfer unit through the turnover conveying path and the second conveying path, without transferring a toner image, and subsequently convey the second printed print medium to the stacking unit without turning over the second printed print medium through the first conveying path, the second printed print medium being the other of the odd-numbered printed print medium and the even-numbered printed print medium.

6. The image forming apparatus according to any one of claims 1 to 5, wherein the print media comprise a high-resistant medium with a resistance value of 4×10^{13} to $5 \times 10^{16} \Omega/\text{cm}$.
7. The image forming apparatus according to claim 6, wherein the print media comprise one of coating paper, coated paper, tack paper, a synthetic resin film, and laminated paper.
8. A medium conveyance control method implemented by an image forming apparatus including:

an image bearer;
a transfer unit configured to transfer toner images on the image bearer to print media;
a voltage applying unit configured to apply voltage to the transfer unit;
a stacking unit configured to stack the transferred printed print media; and
a turnover conveying unit configured to turn over a printed print medium, the medium conveyance control method comprising:
performing control to apply voltage again to a printed print medium conveyed to the transfer unit via the turnover conveying unit, without

transferring a toner image onto the printed print medium.

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FIG.1

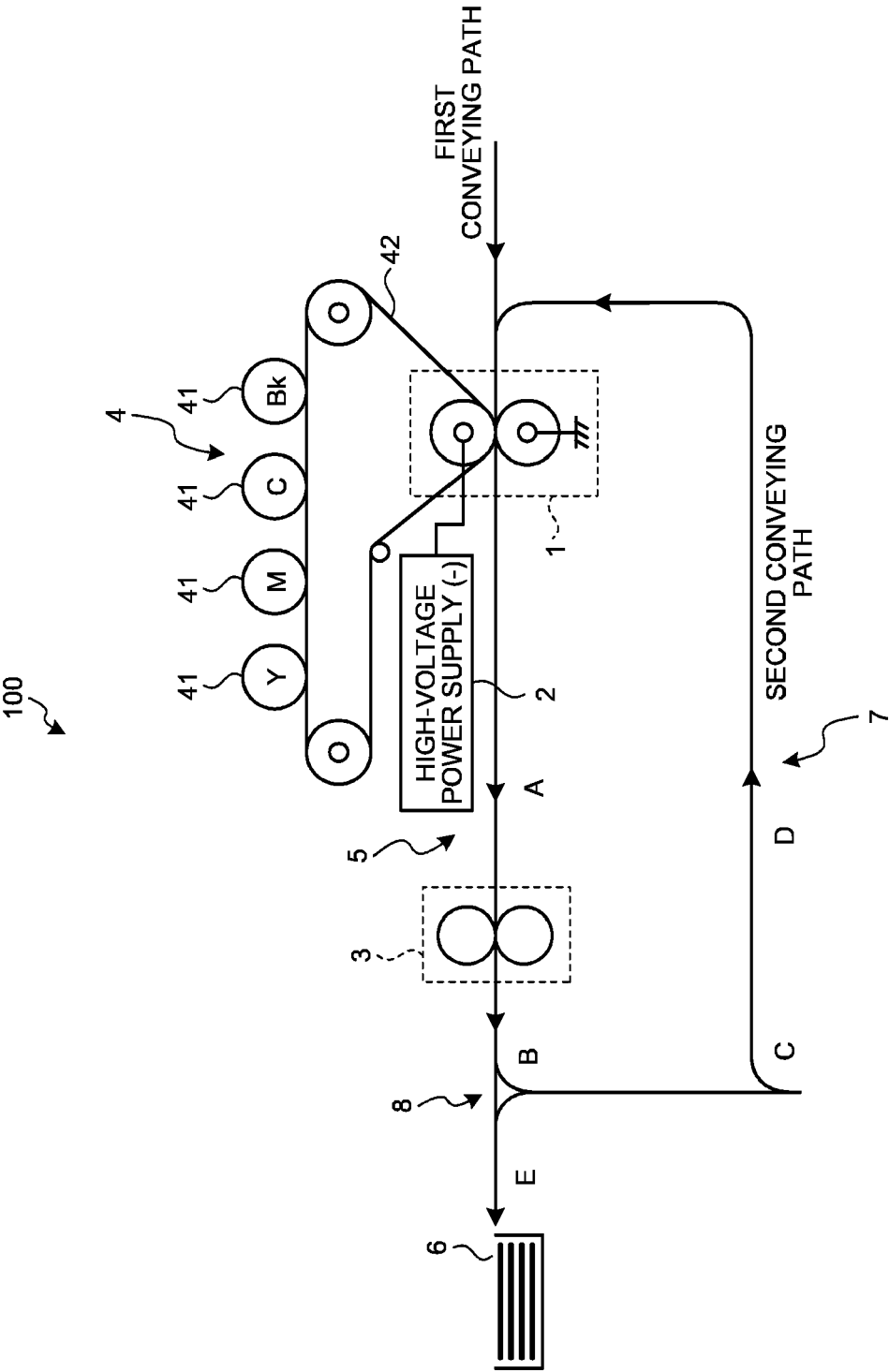


FIG.2

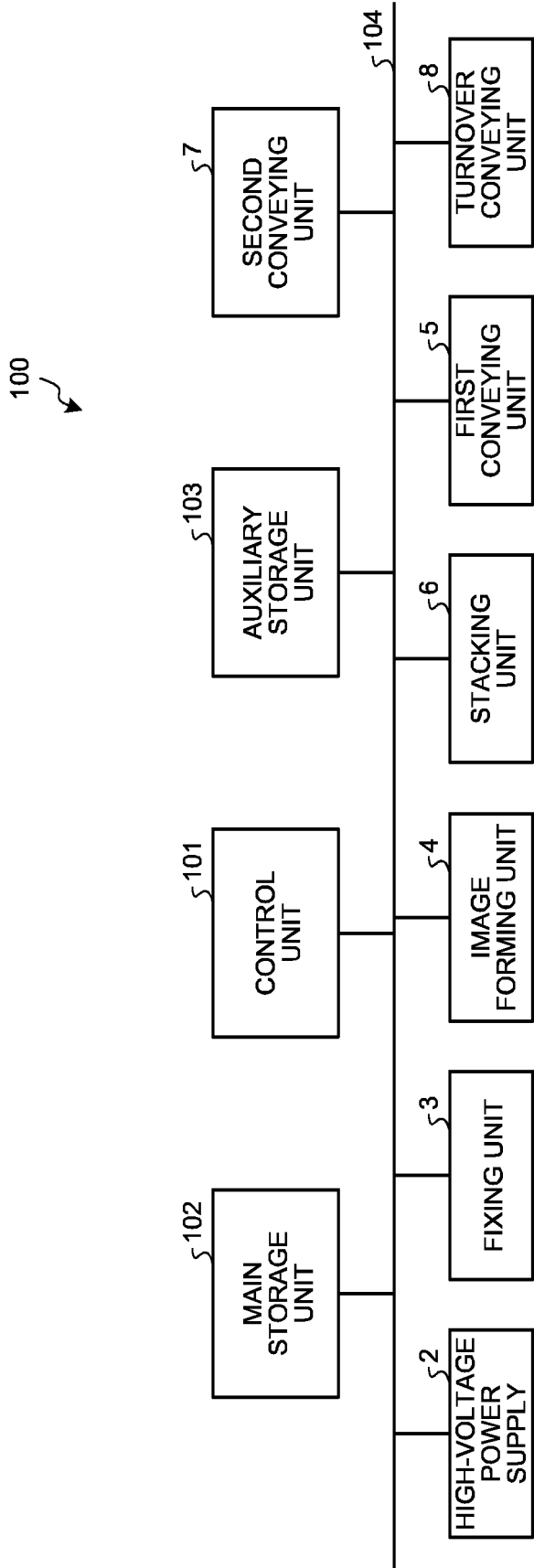


FIG.3

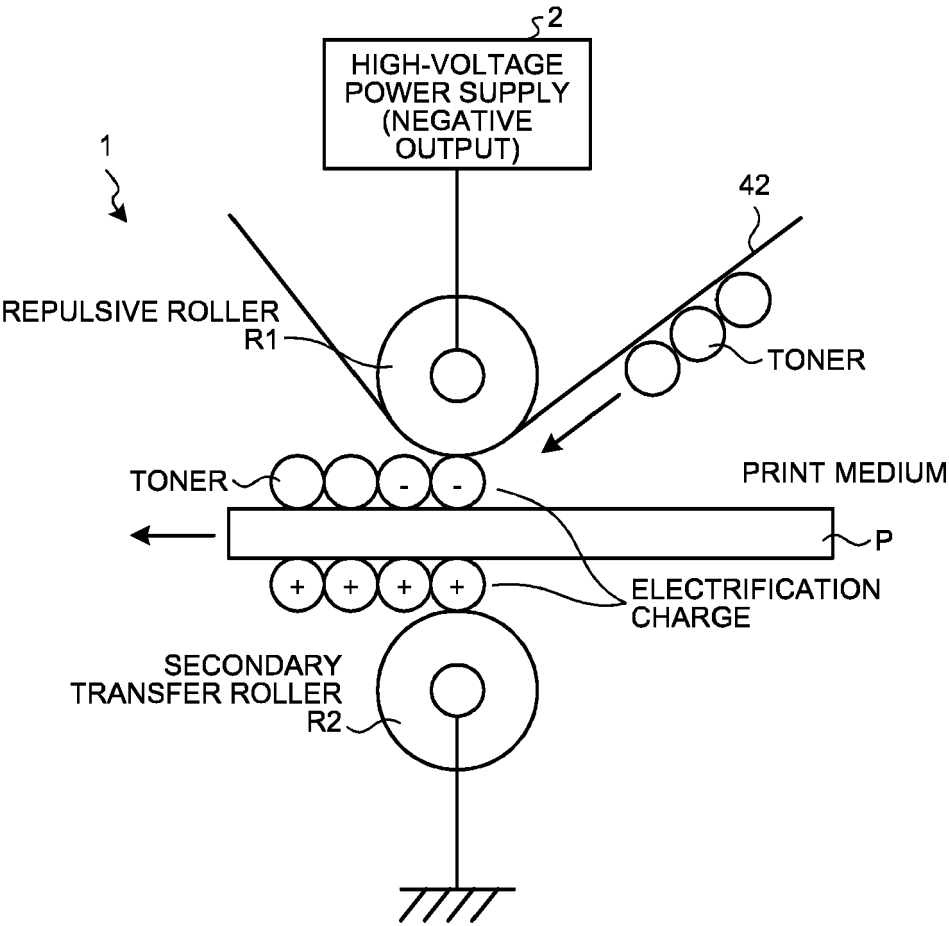


FIG.4

FOURTH MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
THIRD MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
SECOND MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
FIRST MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+

FIG.5

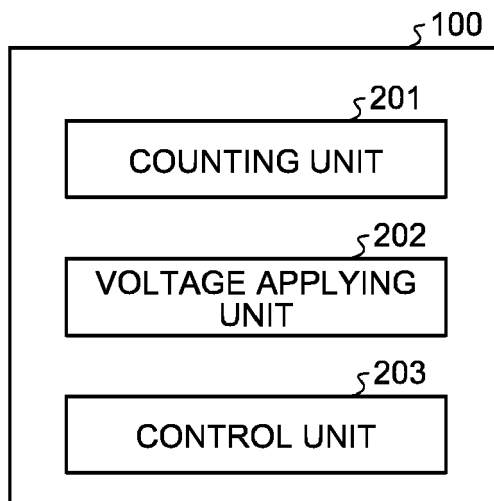


FIG.6

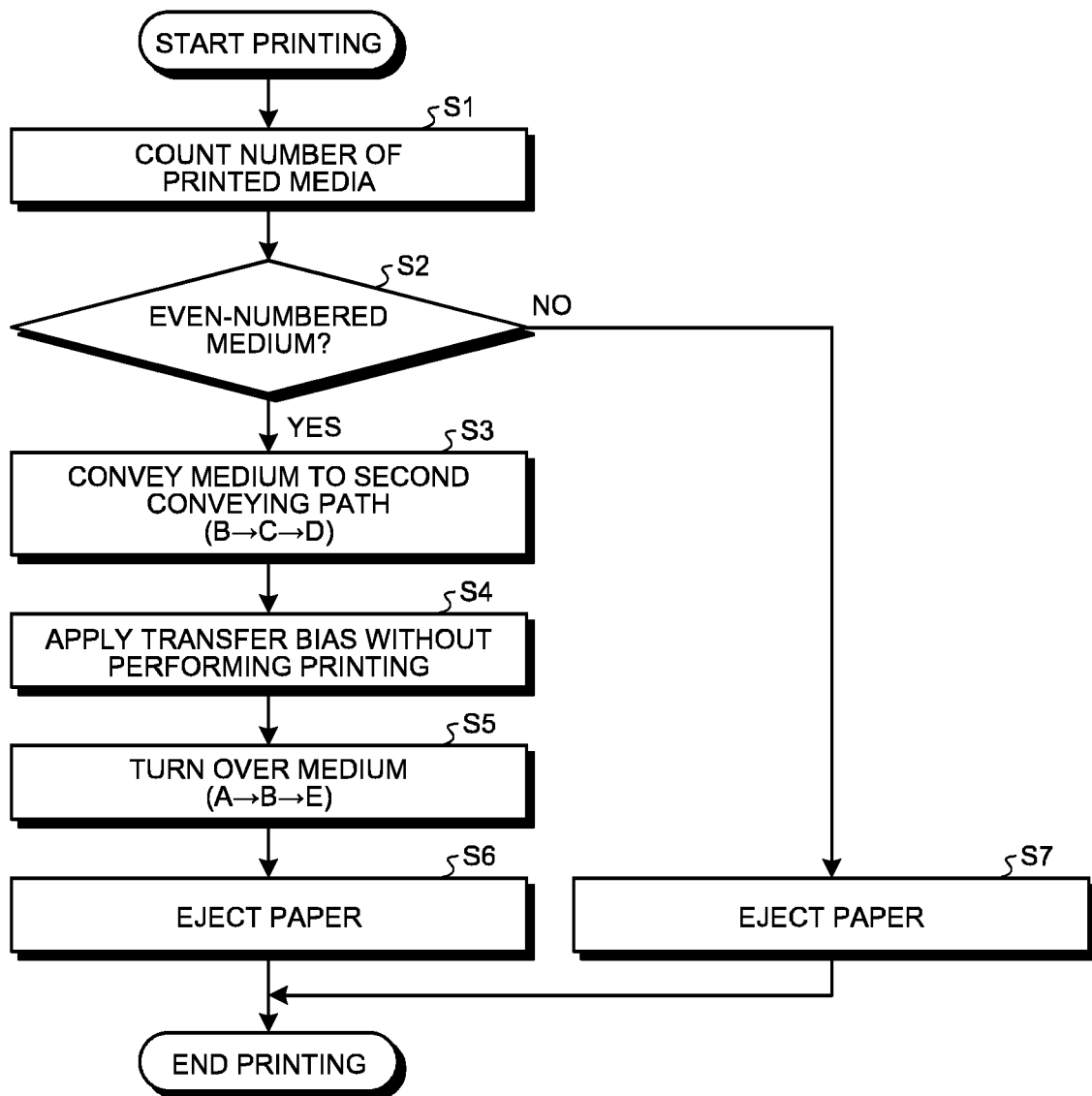


FIG.7

FOURTH MEDIUM	+	+	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-	-	-
THIRD MEDIUM	-	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+	+
SECOND MEDIUM	+	+	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-	-	-
FIRST MEDIUM	-	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+	+

FIG.8

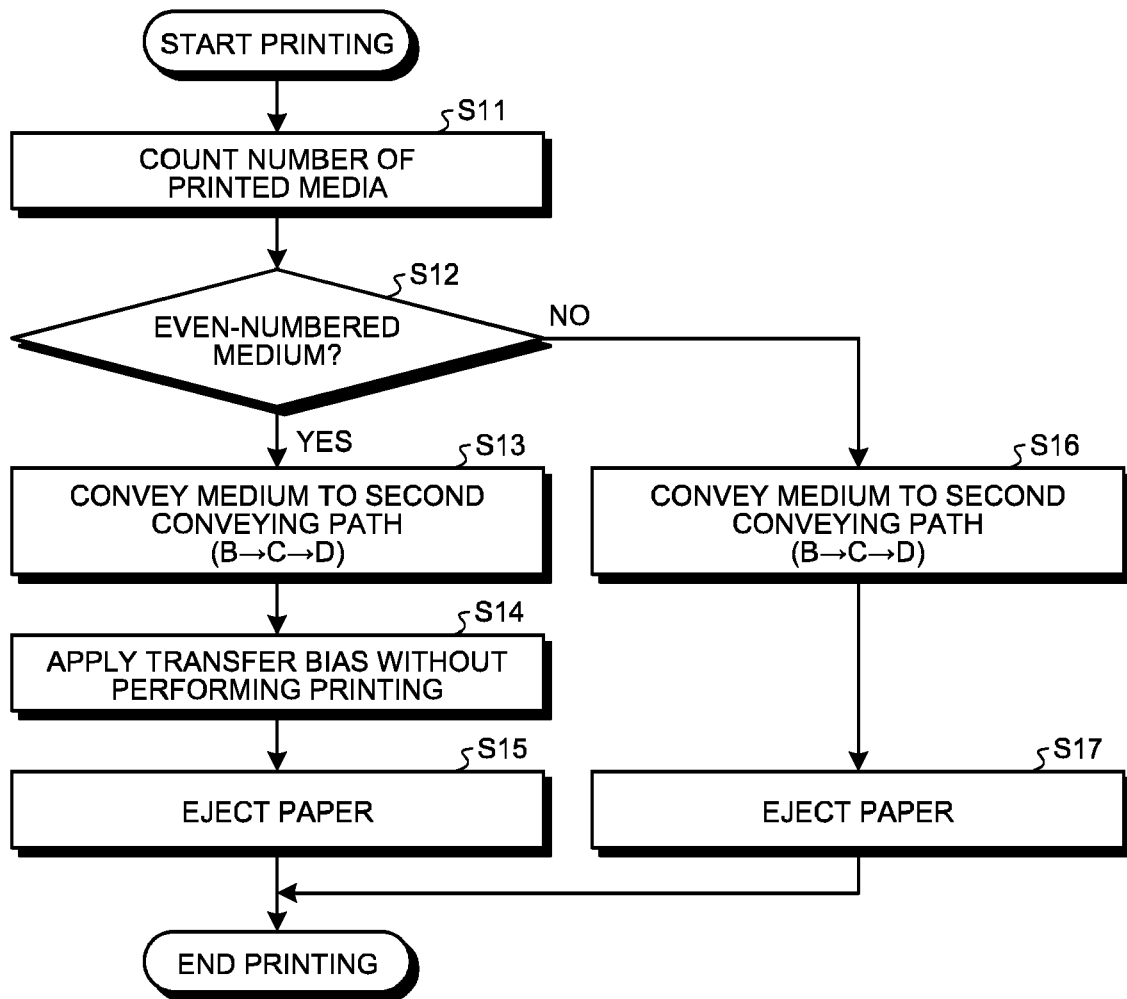


FIG.9

FOURTH MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
THIRD MEDIUM	+	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-	-
SECOND MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
FIRST MEDIUM	+	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-	-

FIG.10

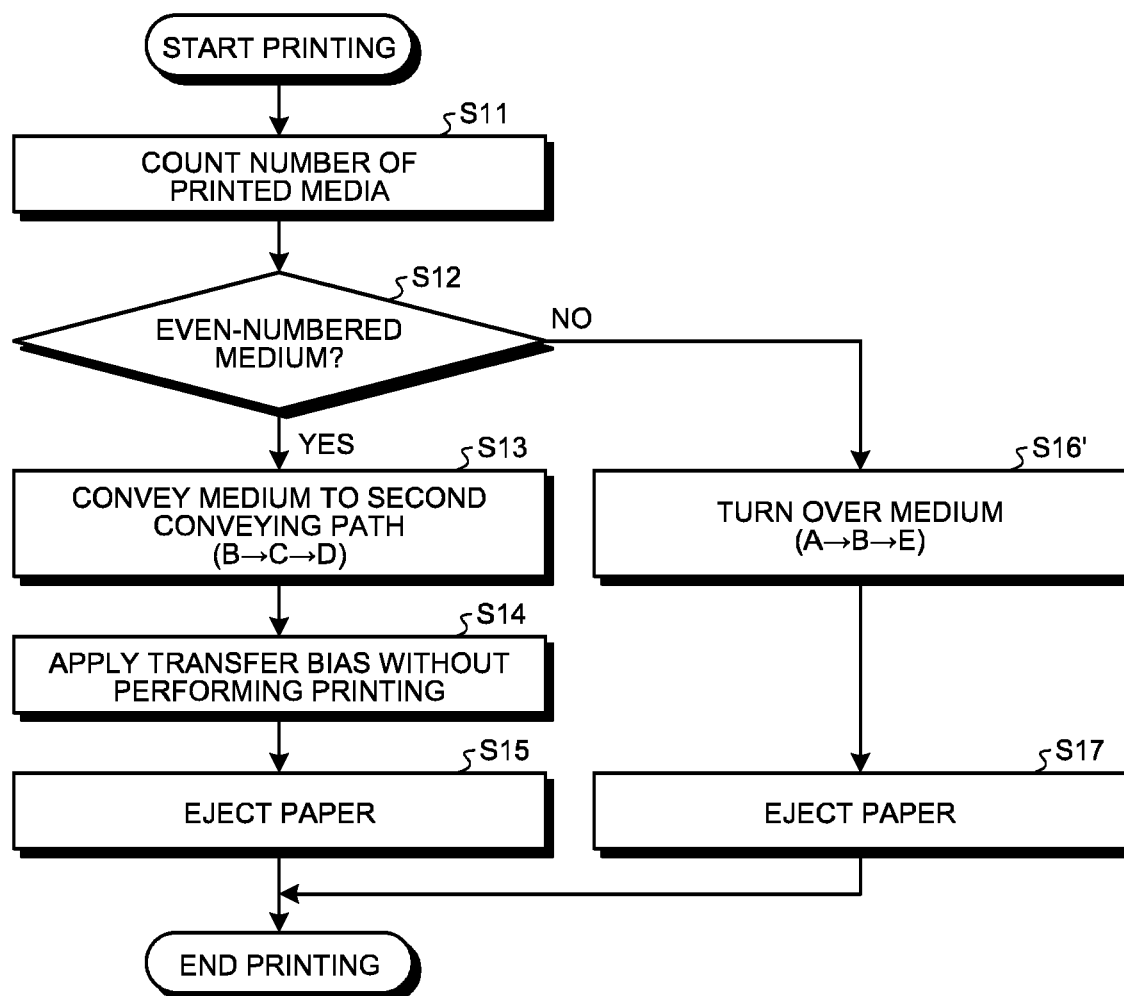


FIG.11

FOURTH MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
THIRD MEDIUM	+	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-	-
SECOND MEDIUM	-	-	-	-	-	-	-	-	-	-	-
	+	+	+	+	+	+	+	+	+	+	+
FIRST MEDIUM	+	+	+	+	+	+	+	+	+	+	+
	-	-	-	-	-	-	-	-	-	-	-



EUROPEAN SEARCH REPORT

Application Number
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