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dium, the reverse voltage unit applies a reverse voltage of an applied voltage having been applied to the transfer unit. The reverse voltage unit applies the reverse voltage to the high-resistance medium subsequent to fixing of the toner. The reverse voltage corresponds to a type of the high-resistance medium.

Diagram illustrating a toner transfer system:

- HIGH-VOLTAGE POWER SOURCE (NEGATIVE-POLARITY OUTPUT)**: Connected to the **REPULSION ROLLER R**.
- REPULSION ROLLER R**: A roller that repels toner from its surface.
- TONER T**: Particles being transferred from the roller to the substrate.
- B**: The substrate or target surface.
- TONER**: A layer of toner on the substrate, shown with negative charges ($-$).
- IB**: A layer of toner on the substrate, shown with positive charges ($+$).
- ELECTRIFICATION CHARGE**: A layer of positive charges ($+$) on the substrate.
- SECONDARY TRANSFER ROLLER**: A roller positioned below the substrate, connected to ground.

Description

BACKGROUND

Technical Field

[0001] Exemplary aspects of the present disclosure relate to an image forming apparatus, a sheet processing method, and a carrier medium.

Related Art

[0002] Electrophotographic image forming apparatuses generally employ a method by which high voltage is used to transfer toner to a printing medium. Moreover, there is an image forming apparatus including a discharging brush disposed in a conveyance path to remove electricity from a surface of a printed medium. The use of the discharging brush avoids degradation in post-processability due to static electricity that is generated or electrical attraction that occurs when printed media are ejected and stacked.

[0003] JP-2016-122154-A discloses an image forming apparatus by which surfaces of coated sheets to contact each other among coated sheets to be stacked are charged with the same polarity to prevent an unfavorable situation in which the coated sheets closely contact each other due to electrostatic action if the coated sheets are stacked on a sheet ejection tray with electric charges remaining on the surfaces of the coated sheets.

[0004] However, a printing medium, for example, a coated sheet, tack paper, a synthetic resin film, and laminated paper, containing a component such as a resin component has a high resistance value (hereinafter such a printing medium is referred to as a high-resistance medium). Thus, higher electrical hysteresis (polarization) occurs inside the high-resistance medium. In the "polarization" state, even if electricity of the high-resistance medium is removed by a member such as a discharging brush, the electricity of the high-resistance medium may not be completely eliminated. Such a situation may cause "polarization" to remain. In a case where a plurality of high-resistance media remaining in the "polarization" state is ejected and stacked, an unfavorable situation in which the high-resistance media stacked one on another are attracted to one another by an electrical factor occurs. That is, polarization per se needs to be eliminated from the high-resistance media.

SUMMARY

[0005] The present disclosure has been made in view of the aforementioned issues, and is directed to an image forming apparatus capable of preventing an unfavorable situation in which high-resistance media stacked one on another are attracted to one another by an electrical factor when the high-resistance media are ejected subsequent to printing. In addition to the image forming appa-

ratus, the present disclosure is directed to a sheet processing method and a carrier medium.

[0006] In at least one embodiment of this disclosure, there is described an improved image forming apparatus that includes a transfer unit, a fixing unit, and a reverse voltage unit. The transfer unit transfers toner corresponding to a print target to a medium. The fixing unit fixes the toner transferred to the medium. In a case in which a high-resistance medium is conveyed as the medium, the reverse voltage unit applies a reverse voltage of an applied voltage having been applied to the transfer unit. The reverse voltage unit applies the reverse voltage to the high-resistance medium subsequent to fixing of the toner. The reverse voltage corresponds to a type of the high-resistance medium.

[0007] Further described is an improved sheet processing method that includes transferring, fixing, and applying. The transferring transfers toner corresponding to a print target to a medium by a transfer unit. The fixing fixes the toner transferred to the medium by a fixing unit. In a case in which a high-resistance medium is conveyed as the medium, the applying applies a reverse voltage of an applied voltage having been applied to the transfer unit. The applying applies the reverse voltage by a reverse voltage unit to the high-resistance medium subsequent to fixing of the toner. The reverse voltage corresponds to a type of the high-resistance medium.

[0008] Still further described is an improved carrier medium that carries computer readable code for controlling a computer to carry out the above sheet processing method.

[0009] According to the present disclosure, when high-resistance media subsequent to printing are ejected, an unfavorable situation in which the high-resistance media stacked one on another are attracted by an electrical factor can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The aforementioned and other aspects, features, and advantages of the present disclosure are better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a diagram illustrating a main portion of a secondary transfer unit of a multifunction peripheral (MFP);

FIG. 2A is a diagram illustrating a molecular composition inside a high-resistance medium prior to a fixing process, and FIG. 2B is a diagram illustrating a molecular composition inside the high-resistance medium subsequent to the fixing process;

FIG. 3 is a diagram illustrating a phenomenon in which high-resistance media stacked one on another electrically stick together if the high-resistance media in a polarization state overlap one another;

FIG. 4 is a block diagram illustrating an MFP accord-

ing to one embodiment;

FIG. 5 is a functional block diagram illustrating the MFP according to the embodiment;

FIG. 6 is a flowchart illustrating a sheet processing operation performed by the MFP according to the embodiment;

FIG. 7 is a diagram illustrating one example of voltage control information stored in the MFP according to the embodiment;

FIGS. 8A, 8B, and 8C are timing charts respectively illustrating times at which a secondary transfer voltage is applied, a sheet sensor output is output, and a reverse voltage is applied in the MFP according to the embodiment;

FIG. 9 is a diagram illustrating a state in which application of a reverse voltage to the high-resistance media subsequent to a fixing process causes facing surfaces of the high-resistance media overlapping one another to have a same polarity in the MFP according to the embodiment;

FIG. 10 is a block diagram illustrating an MFP according to another embodiment;

FIG. 11 is a diagram illustrating one example of voltage control information stored in the MFP according to the embodiment;

FIG. 12 is a flowchart illustrating a sheet processing operation performed by the MFP according to the embodiment;

FIG. 13 is a block diagram illustrating an MFP according to still another embodiment;

FIG. 14 is a functional block diagram illustrating the MFP according to the embodiment;

FIG. 15 is a diagram illustrating one example of allowable resistance value information to be used by the MFP according to the embodiment; and

FIG. 16 is a flowchart illustrating a sheet processing operation performed by the MFP according to the embodiment.

[0011] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION

[0012] In describing embodiments illustrated in the drawings, specific terminology is 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 similar results.

[0013] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings for explaining the following embodiments, the same

reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

[0014] Hereinafter, a multifunction peripheral (MFP) to which as an image forming apparatus, a sheet processing method, and a carrier medium according to each embodiment is applied is described with reference to the drawings.

(Overview)

[0015] A description is first give of a cause of a case where high-resistance media, for example, coated sheets, tack paper, synthetic resin films, and laminated paper, stick to one another due to "polarization" when printing is performed on the high-resistance media and the printed high-resistance media are ejected and stacked.

[0016] FIG. 1 is a diagram schematically illustrating a main portion of a secondary transfer unit disposed in an MFP. As illustrated in FIG. 1, toner T provided on an intermediate transfer belt B by image formation is transferred to a printing medium IB by using pressure generated by contact and electrical repulsive force generated by a same-polarity voltage to be applied to a repulsion roller R from a high-voltage power source G. Since a voltage between several hundred volts and several thousand volts is applied from the high-voltage power source G to the repulsion roller R, a surface of the printing medium IB is charged. The charging generates static electricity that can be a factor of "a jam" in which a printing medium IB is wound around a member such as a conveyance roller or a factor of a stacking failure in a post-process. Generally, a separation voltage is applied to the printing medium IB immediately after a secondary transfer process to remove the electricity from the printing medium IB, or a discharging brush contacts a surface of the printing medium IB subsequent to a fixing process to remove the electricity from the surface of the printing medium IB.

[0017] FIGS. 2A and 2B are diagrams illustrating a molecular composition inside a high-resistance medium such as a synthetic resin film prior and subsequent to a secondary transfer process. FIG. 2A illustrates a molecular composition inside a high-resistance medium prior to a secondary transfer process, whereas FIG. 2B illustrates a molecular composition inside the high-resistance medium subsequent to the secondary transfer process.

[0018] As illustrated in FIG. 2A, polarities of molecules inside the high-resistance medium are randomly arranged prior to the secondary transfer process. For example, in a conductive printing medium such as a paper medium, an internal molecule is movable in a substantially free manner, but a movable range of an electric charge in the high-resistance medium is restricted to a small range inside the high-resistance medium. Accordingly, when a high voltage is applied to the high-resistance medium subsequent to the secondary transfer proc-

ess, the molecules inside the high-resistance medium are aligned (electric dipole) as illustrated in FIG. 2B and a phenomenon called "dielectric polarization (= electric polarization. Hereinafter, simply called polarization)" occurs. Then, in an electrophotographic process in which a voltage having a negative polarity is always applied from the repulsion roller R, a polarity of a print surface of the high-resistance medium becomes a positive polarity (+) and a polarity of a surface on the reverse side of the print surface (a reversed print surface) becomes a negative polarity (-).

[0019] In a conductive printing medium such as a paper medium, since an internal molecule is movable in a substantially free manner, an electric charge on a surface of the printing medium can be removed by application of a separation voltage as described above or by a discharging brush.

[0020] However, in a high-resistance medium having a high resistance similar to a resistance of a dielectric substance, a movable range of an electric charge is restricted to a small range inside the high-resistance medium. Even if a discharging brush is used, transition of a state of the high-resistance medium from a polarization state to a non-polarization state is difficult. If such high-resistance media in a polarization state are ejected and stacked as illustrated in FIG. 3, for example, a print surface having a positive polarity (+) on a first high-resistance medium and a reverse print surface having a negative polarity (-) of a second high-resistance medium are electrically attracted to each other. Consequently, an unfavorable situation in which the high-resistance media stick to each other occurs.

[0021] Accordingly, the MFP according to each of the embodiments applies a reverse voltage to high-resistance media subsequent to printing on an every-other-medium basis. Particularly, an amount of a reverse voltage that not only reverses a polarity in a polarization state but also causes an amount of polarization that balances with polarization of an adjacent medium to be generated is applied to the high-resistance media subsequent to printing on an every-other-medium basis. Therefore, an odd-numbered high-resistance medium can be ejected with a state remaining in the polarization state generated at the printing, whereas an even-numbered high-resistance medium to overlap the odd-numbered high-resistance medium in the polarization state can be in a polarization state the polarity of which is reversed with respect to the polarization state of the odd-numbered high-resistance medium.

[0022] That is, if a print surface of an odd-numbered high-resistance medium has a positive polarity (+), an even-numbered high-resistance medium is placed on the odd-numbered high-resistance medium in an overlapping manner in a state in which a reversed print surface of the even-numbered high-resistance medium has a positive polarity (+). Accordingly, the print surface of the odd-numbered high-resistance medium and the reversed print surface of the even-numbered high-resist-

ance medium each have a positive polarity, and thus electrically repulse each other. Such electrical repulsion can prevent an unfavorable situation in which high-resistance media to be stacked one on another electrically stick to one another.

(First Embodiment)

[0023] Hereinafter, an MFP 100 according to a first embodiment is described. The present embodiment is described using an example in which the MFP 100 applies a reverse voltage that is predetermined for each type of high-resistance medium to high-resistance media subsequent to printing on an every-other-medium basis to cause surfaces of overlapping high-resistance media to have the same polarity, thereby preventing an unfavorable situation in which the high-resistance media electrically stick to one another.

[0024] The high-resistance medium is, for example, a medium that contains a component such as a resin component to have a high resistance similar to a resistance of a dielectric substance. An example of the high-resistance medium is a printing medium such as coated paper, a coated sheet, tack paper, a synthetic resin film, and laminated paper.

[0025] FIG. 4 is a diagram schematically illustrating a hardware configuration of a main portion of the MFP 100 according to the first embodiment. In FIG. 4, the MFP 100 includes a secondary transfer unit 1 (one example of a transfer unit), a high-voltage power source 2, a fixing unit 3, a sheet sensor 4, a reverse voltage unit 5, a high-voltage power source 6, a central processing unit (CPU) 7, an operation unit 8, and a storage unit 10 as a carrier medium.

[0026] The high-voltage power source 2 applies a same-polarity voltage, for example, between several hundred volts and several thousand volts, to the repulsion roller R of the secondary transfer unit 1. The secondary transfer unit 1 uses pressure generated by contact and electrical repulsive force generated by the same-polarity voltage to be applied to the repulsion roller R from the high-voltage power source 2 to transfer toners (yellow (Y), magenta (M), cyan (C), and black (Bk)) provided on the intermediate transfer belt B by image formation to a high-resistance medium. The fixing unit 3 is, for example, a fixing unit employing a heat fixing method. The fixing unit 3 applies heat and pressure to the high-resistance medium on which the toner image has been transferred. The application of heat and pressure fuses the toner, and the image is fixed on the high-resistance medium.

[0027] The sheet sensor 4 detects a conveyance time of the high-resistance medium. The high-voltage power source 6 applies a reverse voltage corresponding to a type of high-resistance medium. According to the present embodiment, in the reverse voltage unit 5, a negative-polarity voltage that is the same polarity as a negative-polarity voltage applied to the repulsion roller R of the

secondary transfer unit 1 is applied to a roller on the side of the back surface of the high-resistance medium. The back surface herein represents an opposite side of a transfer surface of the high-resistance medium in the secondary transfer unit 1. Accordingly, the reverse voltage is applied.

[0028] In the reverse voltage unit 5, a positive-polarity voltage opposite to the negative-polarity voltage applied to the repulsion roller R of the secondary transfer unit 1 may be applied to a roller on the side of the front surface of the high-resistance medium. The front surface herein represents the same side as the transfer surface of the high-resistance medium in the secondary transfer unit 1. Alternatively, in the secondary transfer unit 1, a positive-polarity voltage may be applied to the repulsion roller R on the side of the back surface of the high-resistance medium.

[0029] A voltage value to be applied in the reverse voltage unit 5 is predetermined according to a type of high-resistance medium. The reverse voltage unit 5 applies a reverse voltage of a voltage value designated by the high-voltage power source 6 to the high-resistance medium.

[0030] The CPU 7 comprehensively controls operations of the MFP 100. The operation unit 8 is used to input, for example, a MFP setting, the number of sheets to be printed, and a type of high-resistance medium to undergo printing. The present embodiment is described using an example in which a type of high-resistance medium is input via the operation unit 8. However, information indicating a type of high-resistance medium may be recorded in a high-resistance medium. In such a case, a medium detection unit 9 indicated by a dotted line illustrated in FIG. 4 can, for example, optically or magnetically read the information indicating the type and notify the CPU 7 of the read information indicating the type.

[0031] In the storage unit 10, information such as voltage control information indicating a reverse voltage value for each type of high-resistance medium is stored, in addition to a sheet processing program for controlling application of a reverse voltage to a high-resistance medium. The CPU 7 detects the voltage control information corresponding to the high-resistance-medium type input via the operation unit 8 from the storage unit 10, and instructs the high-voltage power source 6 to apply a reverse voltage of a voltage value indicated in the detected voltage control information on an every-other-medium basis. Accordingly, a polarity of a contact surface of each of high-resistance media that are in the polarization state by the printing and to overlap one another can have the same polarity, and each of the high-resistance media can be prevented from sticking to one another due to an electrical factor.

(Software Configuration and Sheet Processing Operation by Sheet Processing Program)

[0032] The CPU 7 executes a sheet processing program stored in the storage unit 10 to provide functions

of a secondary transfer control unit 25, an acquisition unit 26, a reverse voltage control unit 27, and a sheet ejection control unit 28. In the following description, a function of each of the secondary transfer control unit 25, the acquisition unit 26, the reverse voltage control unit 27, and the sheet ejection control unit 28 is provided by software. However, functions of the secondary transfer control unit 25, the acquisition unit 26, the reverse voltage control unit 27, and the sheet ejection control unit 28 may be partially or entirely provided by hardware such as an integrated circuit (IC).

[0033] The sheet processing program may be recorded and provided in an installable format file or executable format file in a computer readable recording medium such as a compact disc read only memory (CD-ROM) and a flexible disk (FD). Alternatively, the sheet processing program may be recorded and provided in a computer readable recording medium such as a compact disc recordable (CD-R), a digital versatile disc (DVD), Blu-ray Disc (registered trademark), and a semi-conductor memory. Still, the sheet processing program may be installed via a network such as the Internet. In such a case, the installed sheet processing program is provided. Alternatively, the sheet processing program may be preinstalled and provided in a storage such as a read only memory (ROM) inside the apparatus.

[0034] FIG. 6 is a flowchart illustrating a sheet processing operation performed by the MFP 100 according to the first embodiment. The CPU 7 executes the operation of the flowchart illustrated in FIG. 6 by using the secondary transfer control unit 25, the acquisition unit 26, the reverse voltage control unit 27, and the sheet ejection control unit 28 based on the sheet processing program, so that high-resistance media are prevented from sticking to one another.

[0035] In particular, if printing is performed, a user first designates a type of high-resistance medium via the operation unit 8. A type of high-resistance medium may be detected by the medium detection unit 9. In step S1, the secondary transfer control unit 25 detects a type of high-resistance medium based on the designation by the user or a detection output from the medium detection unit 9.

[0036] In step S2, when the user performs a print start operation via the operation unit 8, the secondary transfer control unit 25 instructs the high-voltage power source 2 to apply a same-polarity voltage, for example, between several hundred volts and several thousand volts, corresponding to the type of high-resistance medium.

[0037] That is, in the storage unit 10, for example, voltage control information in which a type of high-resistance medium such as a coated sheet and tack paper is associated with a voltage value to be applied to each type of high-resistance medium as illustrated in FIG. 7 is stored. The example illustrated in FIG. 7 indicates that a first voltage is applied if a high-resistance medium is a coated sheet, and a second voltage is applied if a high-resistance medium is tack paper. The secondary transfer control unit 25 detects a type of high-resistance medium desig-

nated via the operation unit 8 or a voltage corresponding to a type of high-resistance medium detected by the medium detection unit 9 based on the voltage control information, and instructs the high-voltage power source 2 to apply a voltage.

[0038] Accordingly, the high-voltage power source 2 applies the same-polarity voltage having a voltage value corresponding to the type of high-resistance medium to the repulsion roller R of the secondary transfer unit 1, so that the toner provided on the intermediate transfer belt B by image formation is transferred to the high-resistance medium. The fixing unit 3 applies heat and pressure to the high-resistance medium on which the toner image has been transferred. Thus, the toner is fused, and the image is fixed on the high-resistance medium. The high-resistance medium with the fixed image is conveyed to the reverse voltage unit 5. The sheet sensor 4 detects the high-resistance medium to be conveyed to the reverse voltage unit 5.

[0039] Next, in step S3, the reverse voltage control unit 27 controls the high-voltage power source 6 such that a reverse voltage with respect to the same-polarity voltage applied to the high-resistance medium according to the type in the secondary transfer unit 1 is applied to high-resistance media on an every-other medium basis based on a detection output from the sheet sensor 4.

[0040] FIG. 8A is a diagram illustrating a time when a secondary transfer voltage is applied, FIG. 8B is a diagram illustrating a time when the sheet sensor 4 detects a high-resistance medium, and FIG. 8C is a diagram illustrating a time when a reverse voltage is applied. The application of the secondary transfer voltage as illustrated in FIG. 8A causes dielectric polarization to occur on a high-resistance medium, and the resultant high-resistance medium is conveyed to the reverse voltage unit 5 via the fixing unit 3. The sheet sensor 4 outputs a high-level (High) sensor output for a duration of time between detection of an edge of the high-resistance medium to be conveyed to the reverse voltage unit 5 from the fixing unit 3 and detection of a next edge

[0041] Moreover, the reverse voltage control unit 27 controls the high-voltage power source 6 such that a reverse voltage is applied to the high-resistance medium at a time determined based on a conveyance speed of the high-resistance medium, a rise time of the high-voltage power source 6, and a distance between the sheet sensor 4 and the reverse voltage unit 5. Herein, the reverse voltage control unit 27 counts the number of high-resistance media based on a sensor output that is from the sheet sensor 4 and acquired by the acquisition unit 26, and controls application of a reverse voltage such that a reverse voltage is applied on an every-other-medium basis, for example, a second medium, a fourth medium, and a sixth medium as illustrated in FIG. 8C.

[0042] FIG. 8C illustrates an example in which a negative voltage is applied at a time when the high-resistance medium is conveyed from a position of the sheet sensor 4 to the reverse voltage unit 5. A pulse shape of the neg-

ative voltage illustrates a state in which the negative voltage gradually falls to a predetermined potential and then gradually rises to a zero potential after negative-voltage application for a predetermined time.

[0043] In the example, a reverse voltage is applied to an even-numbered medium. However, a reverse voltage can be applied to an odd-number medium such as a first medium, a third medium, and a fifth medium.

[0044] In step S4, the sheet ejection control unit 28 performs ejection control of a sheet ejection unit to alternately eject a high-resistance medium remaining in a state in which dielectric polarization has occurred as a reverse voltage has not been applied by the reverse voltage unit 5 and a high-resistance medium to which a reverse voltage has been applied by the reverse voltage unit 5. FIG. 9 illustrates an example in which an odd-numbered high-resistance medium remaining in a state in which dielectric polarization has occurred as a reverse voltage has not been applied and an even-numbered high-resistance medium to which a reverse voltage has been applied are alternately stacked.

[0045] As illustrated in FIG. 9, a print surface (the top surface) and a reversed print surface (the back surface) of the odd-numbered high-resistance medium remaining in a state in which dielectric polarization has occurred as a reverse voltage has not been applied have a positive polarity (+) and a negative polarity (-), respectively. On the other hand, a print surface (the top surface) and a reversed print surface (the back surface) of the even-numbered high-resistance medium to which a reverse voltage has been applied can have a negative polarity (-) and a positive polarity (+), respectively. Thus, when the odd-numbered high-resistance medium and the even-numbered high-resistance medium overlap, surfaces having the same polarity face each other.

[0046] That is, in the example illustrated FIG. 9, a print surface of a first high-resistance medium remaining in a state in which dielectric polarization has occurred has a positive polarity (+), and a reversed print surface of a second high-resistance medium that is to overlap the first high-resistance medium and to which a reverse voltage has been applied has a positive polarity (+). Accordingly, the first high-resistance medium and the second high-resistance medium repulse each other, and are prevented from sticking to each other. Similarly, a print surface of the second high-resistance medium to which the reverse voltage has been applied has a negative polarity (-), and a reversed print surface of a third high-resistance medium that is to overlap the second high-resistance medium and remains in a state in which dielectric polarization has occurred has a negative polarity (-). Accordingly, the second high-resistance medium and the third high-resistance medium repulse each other, and are prevented from sticking to each other.

(Effect of First Embodiment)

[0047] As described above, the MFP 100 of the present

embodiment applies a reverse voltage corresponding to a type of high-resistance medium on an every-other-medium basis to high-resistance media in a polarization state subsequent to a toner fixing process, and ejects the resultant high-resistance media. The application of a reverse voltage on an every-other-medium basis enables facing surfaces of the respective high-resistance media stacked one on another by ejection to have the same polarity. Accordingly, the high-resistance media stacked one on another by ejection can electrically repulse one another, and thus an unfavorable situation in which the high-resistance media stacked one on another by ejection are attracted (stick to each other) due to an electrical factor can be prevented.

[0048] It is conceivable that an ion generating apparatus could be used to cause polarization inside a high-resistance medium to be close to zero (a pre-printing state). In such a case, however, an appropriate amount of ion needs to be uniformly provided to the high-resistance medium. Consequently, an ion generation amount and an ion generating method need to be adjusted according to a conveyance speed and a characteristic of a printing medium. Hence, constant removal of electricity from various printing media by using the ion generating apparatus is difficult.

[0049] Moreover, an electricity removing device using the ion generating apparatus needs a high-voltage power source for discharge. In addition, a precise conveyance unit as a printing medium conveyance unit that can maintain a constant distance between a discharging electrode and a printing medium is necessary. Hence, arrangement of the electricity removing device using the ion generating apparatus increases a size of the image forming apparatus.

[0050] Alternatively, an electric charge can be injected into a printing medium, for example, coated paper, having good moisture absorbency after the printing medium is once humidified, so that a charging state of the printing medium can be relieved. However, since, for example, a synthetic resin film, one of high-resistance media, has water repellency, humidification of such a medium is difficult. Consequently, the release of the charging state by the electric charge injection subsequent to the humidification is difficult.

[0051] However, the MFP 100 of the first embodiment can not only apply a reverse voltage on an every-other-medium basis to high-resistance media in a polarization state, but also stably prevent attraction of the high-resistance media due to an electrical factor with a simple configuration without cumbersome adjustment and humidification of the high-resistance media.

(First Modification of First Embodiment)

[0052] In the MFP 100 of the above-described first embodiment, the CPU 7 may apply a reverse voltage that is adjusted based on a voltage applied by the high-voltage power source 2 to a high-resistance medium subse-

quent to a fixing process. In such a case, the acquisition unit 26 acquires the voltage applied by the high-voltage power source 2. Then, the sheet ejection control unit 28 makes a fine adjustment of a reverse voltage corresponding to a high-resistance-medium type (see FIG. 7) according to the voltage applied by the high-voltage power source 2. The sheet ejection control unit 28 applies the fine-adjusted reverse voltage to the high-resistance medium subsequent to the fixing process.

[0053] Accordingly, the reverse voltage of a more appropriate value that is adjusted based on the high-resistance-medium type and the voltage used in the secondary transfer can be applied to the high-resistance medium subsequent to the fixing process. Therefore, a polarity of each of the print surface and the reversed print surface of the high-resistance medium in a polarization state can be reversed more accurately, and attraction of the high-resistance media due to an electrical factor can be further prevented.

[0054] Electric charges of respective high-resistance media to be ejected upon receipt of the reverse voltage are preferably equal. If an electric charge of one high-resistance medium is stronger than an electric charge of the other high-resistance medium out of high-resistance media stacked facing each other, an unfavorable situation in which a state of the other high-resistance medium gradually returns to the "polarization state" occurs.

[0055] However, as described in the first modification, a voltage applied to a high-resistance medium is recognized based on a voltage used in secondary transfer, and a reverse voltage adjusted based on a result of the recognition is applied to the high-resistance medium. The application of such an adjusted reverse voltage can equalize electric charges of respective high-resistance media to be ejected and stacked, and can prevent an unfavorable situation in which a stronger electric charge of one high-resistance medium out of stacked high-resistance media causes a state of the other high-resistance medium to return to a "polarization state".

(Second Modification of First Embodiment)

[0056] The MFP 100 of the above-described first embodiment uses the sheet sensor 4 to set a time when a reverse voltage is applied to a high-resistance medium. However, a time when a reverse voltage is applied may be predicted based on a time when a secondary transfer voltage is applied in the secondary transfer unit 1. In such a case, the sheet sensor 4 can be omitted, and the MFP 100 of the embodiment can have a simpler and lower-cost configuration.

(Second Embodiment)

[0057] Next, an MFP 200 according to a second embodiment is described. Usage environment such as humidity and temperature may cause a change of a voltage to be applied to a high-resistance medium. In the second

embodiment, humidity and temperature are detected, and a reverse voltage corresponding to the detected humidity and temperature is applied to a high-resistance medium, so that a stable reverse voltage can be applied.

[0058] The following description of the second embodiment differs from the above-described first embodiment in such a point. Hereinafter, a description is given of a difference between the first embodiment and the second embodiment, and redundant descriptions are omitted.

[0059] FIG. 10 is a block diagram illustrating the MFP 200 according to the second embodiment. As illustrated in FIG. 10, the MFP 200 includes a temperature sensor 11 and a humidity sensor 12 in addition to the components of the MFP 100 according to the first embodiment. The temperature sensor 11 and the humidity sensor 12 detect the current temperature and the current humidity respectively inside the MFP 200, and supply detection outputs to a CPU 7.

[0060] Herein, FIG. 11 illustrates voltage control information stored in a storage unit 10 of the MFP 200 and used for control of a reverse voltage to be applied in a reverse voltage unit 5. In the second embodiment as illustrated in FIG. 11, a reverse voltage to be applied according to temperature and humidity is determined for each type of high-resistance medium. That is, in the MFP 200 of the second embodiment, the voltage control information illustrated in FIG. 11 is provided for each type of high-resistance medium.

[0061] In FIG. 11, a letter "L" represents "Low" indicating that temperature or humidity is low, and a letter "M" represents "Middle" indicating that temperature or humidity is moderate. Moreover, a letter "H" represents "High" indicating that temperature or humidity is high. In addition, the voltage control information illustrated in FIG. 11 indicates that a reverse voltage of a first voltage is applied if both of temperature and humidity are low (both are "L"). Similarly, if humidity is low (L) and temperature is high (H), a reverse voltage of a third voltage is applied. If humidity is high (H) and temperature is moderate (M), a reverse voltage of an eighth voltage is applied.

[0062] FIG. 12 is a flowchart illustrating a sheet processing operation performed by the MFP 200 according to the second embodiment. The sheet processing operation of the second embodiment differs from the sheet processing operation of the first embodiment in that step S5 in which temperature and humidity are detected is performed between step S2 in which a secondary transfer voltage is applied and step S3 in which a reverse voltage is applied according to a type of high-resistance medium.

[0063] That is, when a secondary transfer voltage is applied to a high-resistance medium in step S2, the process proceeds to step S5. In step S5, the temperature sensor 11 and the humidity sensor 12 respectively detect the current temperature and the current humidity inside the MFP 200.

[0064] In step S3, the reverse voltage control unit 27 acquires the current temperature and the current humid-

ity inside the MFP 200 detected by the temperature sensor 11 and the humidity sensor 12 to determine levels (Low, Middle, or High) of the current temperature and the current humidity as described with reference to FIG. 11.

Moreover, the reverse voltage control unit 27, based on a result of the determination about the levels of the temperature and the humidity, refers to voltage control information corresponding to the high-resistance-medium type detected in step S1, and applies a reverse voltage corresponding to the levels of the temperature and the humidity to the high-resistance medium subsequent to a fixing process.

Therefore, the MFP 200 can not only prevent an unfavorable situation in which usage environment lowers a reverse voltage to be applied to a high-resistance medium, but also obtain an effect similar to the effect obtained in the above-described first embodiment.

Similar to the above-described first modification of the first embodiment, the reverse voltage control unit 27 can adjust a reverse voltage corresponding to temperature and humidity based on a voltage applied by the high-voltage power source 2 of the secondary transfer unit 1 to apply the adjusted reverse voltage to a high-resistance medium subsequent to a fixing process. Thus, the reverse voltage of a more appropriate value can be applied to the high-resistance medium subsequent to the fixing process, and an effect similar to the above-described effect can be obtained.

In the second embodiment, the detection outputs of both of the temperature sensor 11 and the humidity sensor 12 are used. However, a reverse voltage of a value corresponding to a detection output of any one of the temperature sensor 11 and the humidity sensor 12 may be applied to a high-resistance medium.

(Third Embodiment)

Next, an MFP 300 according to a third embodiment is described. In addition to the aforementioned usage environment such as temperature and humidity, aged deterioration such as soiling of a roller of a reverse voltage unit 5 may lower a voltage to be applied to a high-resistance medium. The deterioration such as soiling of a roller of the reverse voltage unit 5 may change, for example, a roller resistance of the reverse voltage unit 5, and a voltage to be applied to a high-resistance medium may be lowered due to partial pressure. In the third embodiment, a resistance value of each high-resistance medium after a reverse voltage is applied is detected, and a reverse voltage value is corrected (changed) such that a difference between the detected resistance values of the respective high-resistance media is within a predetermined range. Accordingly, such correction can prevent an unfavorable situation in which a reverse voltage to be applied to the high-resistance medium is lowered due to usage environment and aged deterioration.

The third embodiment is described by referring to differences between the third embodiment and each

of the above-described embodiments, and redundant descriptions are omitted.

[0070] FIG. 13 is a block diagram illustrating the MFP 300 according to the third embodiment. As illustrated in FIG. 13, the MFP 300 includes a temperature sensor 11 and a humidity sensor 12 that are described above in the second embodiment. In addition, the MFP 300 includes a resistance value detection unit 21 disposed in a high-voltage power source 6 that applies a reverse voltage. The resistance value detection unit 21 detects a resistance value of a high-resistance medium to which a reverse voltage has been applied.

[0071] FIG. 14 is a functional block diagram illustrating each function of the MFP 300 according to the third embodiment, and each function of the MFP 300 is provided if a CPU 7 executes a sheet processing program stored in a storage unit 10. As illustrated in FIG. 14, the CPU 7 executes a sheet control program to provide each of functions of a secondary transfer control unit 25, an acquisition unit 26, a reverse voltage control unit 27, and a sheet ejection control unit 28 that are described in the above embodiment, a resistance value determination unit 29, and a change control unit 30.

[0072] The MFP 300 according to the third embodiment has voltage control information corresponding to temperature and humidity of each high-resistance medium, and allowable resistance information. The voltage control information is described above with reference to FIG. 11. The allowable resistance information indicates an allowable resistance value of a high-resistance medium to which a reverse voltage has been applied. The allowable resistance information is defined for each high-resistance medium, for example, "A Ω " for a coated sheet, "B Ω " for tack paper, and "C Ω " for a synthetic resin film.

[0073] FIG. 16 is a flowchart illustrating a sheet processing operation performed by the MFP 300 according to the third embodiment. The sheet processing operation of the third embodiment differs from the sheet processing operation of the above-described second embodiment in that a process (steps S6 through S8) for correcting a reverse voltage value is added between step S3 in which a reverse voltage is applied and step S4 in which a high-resistance medium to which the reverse voltage has been applied is ejected. The process in steps S6 through S8 is performed if a resistance value of the high-resistance medium to which the reverse voltage has been applied is out of a predetermined range.

[0074] That is, in the flowchart illustrated in FIG. 16, in step S3, a reverse voltage control unit 27 applies a reverse voltage corresponding to a type of high-resistance medium, the current temperature, and the current humidity (see FIG. 11) to a high-resistance medium. Then, the process proceeds to step S6. In step S6, the resistance value detection unit 21 detects a resistance value of the high-resistance medium. In one example, the resistance value detection unit 21 detects a resistance value (R) of a high-resistance medium based on a voltage value (V)

that is acquired by application of a predetermined electric current (I) to the high-resistance medium ($R = V/I$). Alternatively, the resistance value detection unit 21 detects a resistance value (R) of a high-resistance medium based on an electric current amount (I) that is acquired by application of a predetermined voltage (V) to the high-resistance medium ($R = V/I$).

[0075] Then, the resistance value determination unit 29 detects an average value of resistance values of a plurality of high-resistance media, for example, five high-resistance media, detected by the resistance value detection unit 21. Moreover, the resistance value determination unit 29 detects an average value of resistance values of next five high-resistance media detected by the resistance value detection unit 21. The resistance value determination unit 29 calculates a difference of the average values as "a resistance value difference".

[0076] The resistance value determination unit 29 may set an average value of resistance values of, for example, five high-resistance media detected first as a reference resistance value. In such a case, the resistance value determination unit 29 calculates a difference between the reference resistance value and an average value of resistance values to be thereafter detected for each five media as "a resistance value difference".

[0077] Alternatively, the resistance value determination unit 29 may calculate a difference between an average value of resistance values of, for example, five high-resistance media detected first and an average value detected in a second time, that is, an average value of resistance values of next five high-resistance media detected as "a resistance value difference". Then, the resistance value determination unit 29 may sequentially calculate "a resistance value difference" based on comparison, for example, a difference between the average value detected in the second time and an average value detected in a third time as "a resistance value difference".

[0078] The description has been given using the example in which the average values of the resistance values of the plurality of high-resistance media are compared. However, resistance values of high-resistance media may be compared one by one, or maximum resistance values, intermediate values, or minimum resistance values of a plurality of high-resistance media may be compared to calculate "a resistance value difference".

[0079] Upon detection of the resistance value difference, the resistance value determination unit 29 refers to allowable resistance value information illustrated in FIG. 15 based on the high-resistance-medium type. Then, in step S7, the resistance value determination unit 29 determines whether the detected resistance value difference is within an allowable range. If the resistance value determination unit 29 determines that the detected resistance value difference is within the allowable range (YES in step S7), the process proceeds to step S4 in which the high-resistance medium is ejected as is.

[0080] On the other hand, if the resistance value determination unit 29 determines that the detected resist-

ance value difference is out of the allowable range (NO in step S7), the process proceeds to step S8. In step S8, the change control unit 30 changes a value of a reverse voltage to be applied to the high-resistance medium from a high-voltage power source 6 to a value causing the above resistance value difference to be within the allowable range. Accordingly, in step S3, the high-voltage power source 6 applies the reverse voltage of the changed value to the high-resistance medium via the reverse voltage unit 5, and the resistance value difference can be set within the allowable range (YES in step S7).

[0081] Therefore, the MFP 300 of the third embodiment detects a resistance value of each high-resistance medium after a reverse voltage is applied, and corrects (changes) a reverse voltage value such that a resistance value difference between the detected high-resistance media is set within a predetermined range. Accordingly, such correction can prevent an unfavorable situation in which a reverse voltage to be applied to the high-resistance medium is lowered due to usage environment and aged deterioration. Moreover, an effect similar to the effect obtained in each of the above-described embodiments can be obtained.

[0082] In the third embodiment, as described above in the first modification of the first embodiment, the reverse voltage control unit 27 may adjust a reverse voltage corresponding to temperature and humidity based on a voltage applied by the high-voltage power source 2 of the secondary transfer unit 1 to apply the adjusted reverse voltage to a high-resistance medium subsequent to a fixing process. In such a case, the reverse voltage of a more appropriate value can be applied to the high-resistance medium subsequent to the fixing process, and an effect similar to the above-described effect can be obtained.

[0083] Each of the above embodiments has been described as one example, and such description is not intended to limit the scope of the disclosure. Each of the embodiments can be executed in other various configurations, and various omissions, replacements, and changes can be made within the scope of the invention.

[0084] For example, in the above-described embodiment, a print surface and a reversed print surface of an odd-numbered high-resistance medium respectively have a positive polarity and a negative polarity, whereas a print surface and a reversed print surface of an even-numbered high-resistance medium respectively have a negative polarity and a positive polarity as described with reference to FIG. 9. However, a print surface and a reversed print surface of an odd-numbered high-resistance medium may respectively have a negative polarity and a positive polarity, whereas a print surface and a reversed print surface of an even-numbered high-resistance medium may respectively have a positive polarity and a negative polarity. Even in such a case, the high-resistance media can be prevented from sticking to each other as similar to the above-described embodiment.

[0085] Moreover, each of the embodiments and each of the modifications of the embodiment are included in

the scope of the invention, and included in the following claims and their equivalents.

[0086] 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, elements and/or features of different illustrative embodiments may be combined with each other and/or substituted for each other within the scope of the present invention.

[0087] Any one of the above-described operations may be performed in various other ways, for example, in an order different from the one described above.

[0088] The present invention can be implemented in any convenient form, for example using dedicated hardware, or a mixture of dedicated hardware and software. The present invention may be implemented as computer software implemented by one or more networked processing apparatuses. The processing apparatuses include any suitably programmed apparatuses such as a general purpose computer, personal digital assistant, mobile telephone (such as a WAP or 3G-compliant phone) and so on. Since the present invention can be implemented as software, each and every aspect of the present invention thus encompasses computer software implementable on a programmable device. The computer software can be provided to the programmable device using any conventional carrier medium (carrier means). The carrier medium includes a transient carrier medium such as an electrical, optical, microwave, acoustic or radio frequency signal carrying the computer code. An example of such a transient medium is a TCP/IP signal carrying computer code over an IP network, such as the Internet. The carrier medium may also include a storage medium for storing processor readable code such as a floppy disk, hard disk, CD ROM, magnetic tape device or solid state memory device.

Claims

1. An image forming apparatus (100, 200, 300) comprising:

a transfer unit (1) configured to transfer toner corresponding to a print target to a medium;
a fixing unit (3) configured to fix the toner transferred to the medium; and
a reverse voltage unit (5) configured to apply, in a case in which a high-resistance medium is conveyed as the medium, a reverse voltage of an applied voltage having been applied to the transfer unit, the reverse voltage unit being configured to apply the reverse voltage to the high-resistance medium subsequent to fixing of the toner, and the reverse voltage corresponding to a type of the high-resistance medium.

2. The image forming apparatus according to claim 1,

wherein the reverse voltage unit adjusts a value of the reverse voltage corresponding to the type of the high-resistance medium according to a value of the applied voltage having been applied to the transfer unit, and applies the adjusted value of the reverse voltage to the high-resistance medium.

3. The image forming apparatus according to claim 1, further comprising at least one of a temperature sensor (11) configured to detect a temperature inside the image forming apparatus and a humidity sensor (12) configured to detect a humidity inside the image forming apparatus, wherein the reverse voltage unit adjusts a value of the reverse voltage corresponding to the type of the high-resistance-medium according to at least one of the detected temperature and the detected humidity and applies the adjusted value of the reverse voltage to the high-resistance medium, or adjusts a value of the reverse voltage corresponding to the type of the high-resistance-medium according to at least one of the detected temperature and the detected humidity and a value of the applied voltage having been applied to the transfer unit and applies the adjusted value of the reverse voltage to the high-resistance medium.
4. The image forming apparatus according to any one of claims 1 through 3, further comprising:
 - a resistance value determination unit (29) configured to determine whether a resistance value difference of a plurality of high-resistance media including the high-resistance medium to which reverse voltages have been applied is a predetermined resistance value difference corresponding to the type of the high-resistance-medium, and
 - a change control unit (30) configured to change, in a case in which the resistance value difference is out of an allowable range, a value of the reverse voltage to be applied from the reverse voltage unit such that the resistance value difference is set within the allowable range.
5. The image forming apparatus according to claim 4, wherein the resistance value determination unit detects a difference between an average value of resistance values of a plurality of high-resistance media to which reverse voltages have been applied and an average value of resistance values of a next plurality of high-resistance media as the resistance value difference.
6. A sheet processing method comprising:
 - transferring toner corresponding to a print target to a medium by a transfer unit;

fixing the toner transferred to the medium by a fixing unit; and

applying, in a case in which a high-resistance medium is conveyed as the medium, a reverse voltage of an applied voltage having been applied to the transfer unit, the applying applying the reverse voltage by a reverse voltage unit to the high-resistance medium subsequent to fixing of the toner, and the reverse voltage corresponding to a type of the high-resistance medium.

7. A carrier medium (10) carrying computer readable code for controlling a computer to carry out the sheet processing method according to claim 6.

FIG. 1

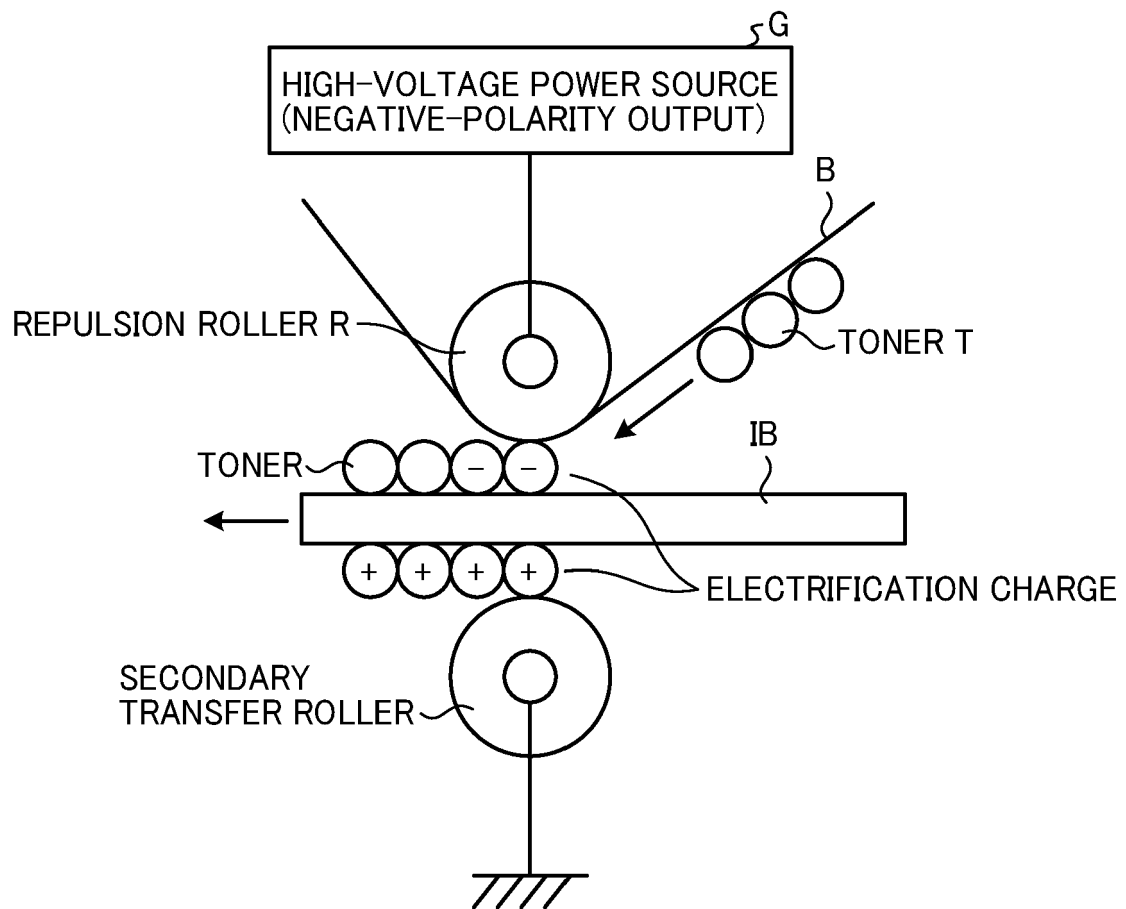


FIG. 2A

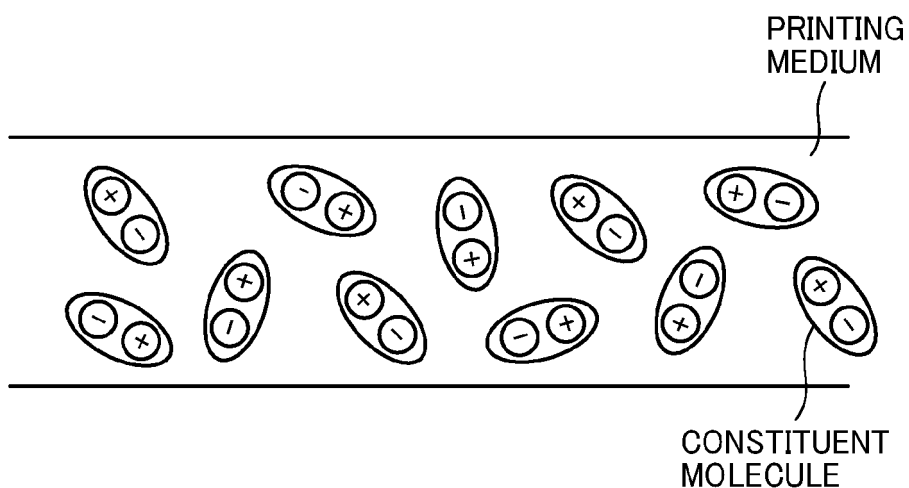


FIG. 2B

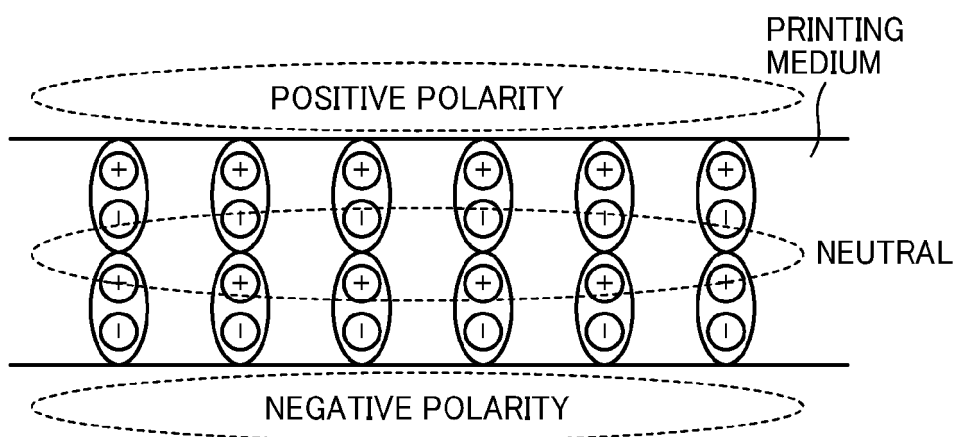


FIG. 3

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

FIG. 4

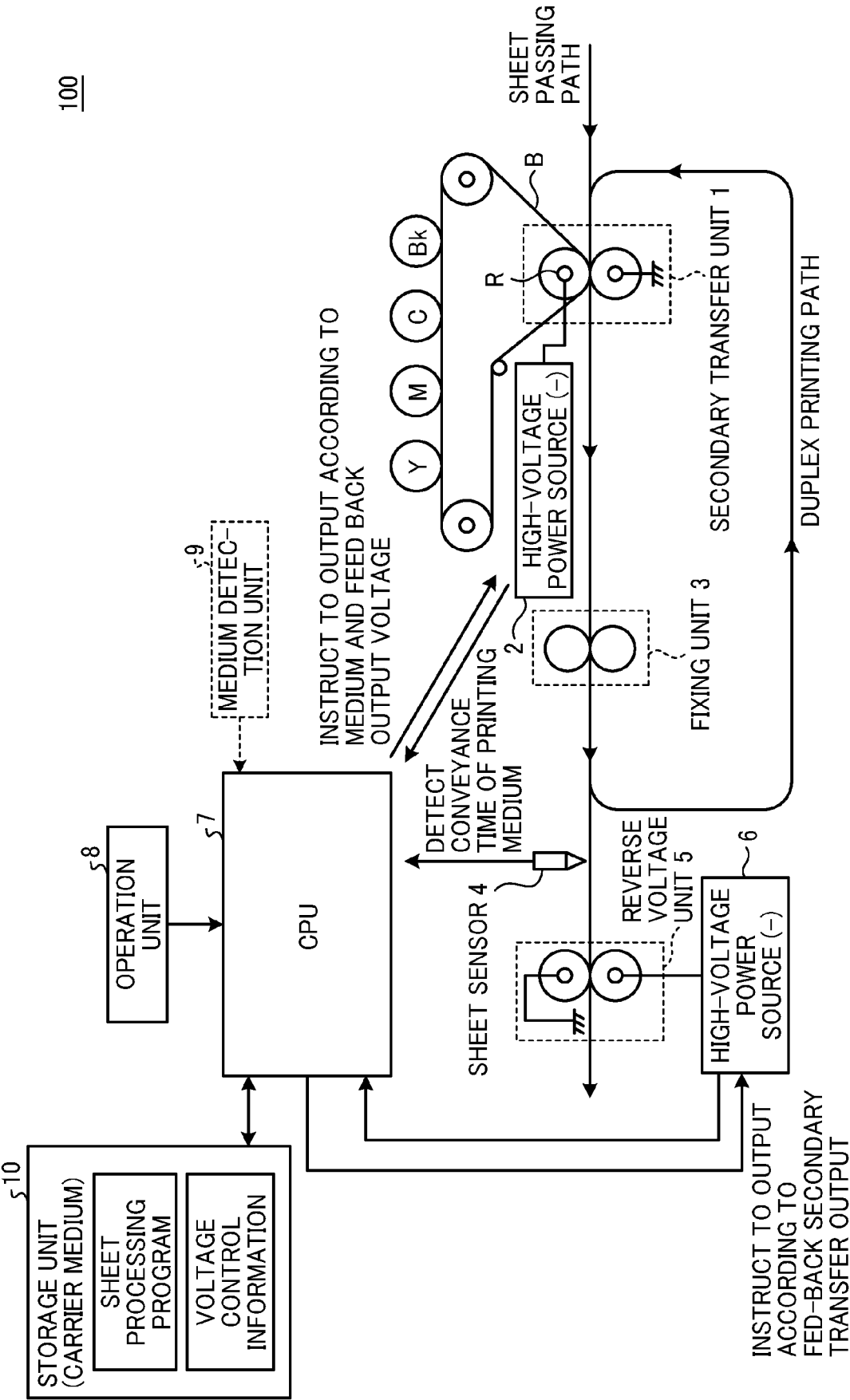


FIG. 5

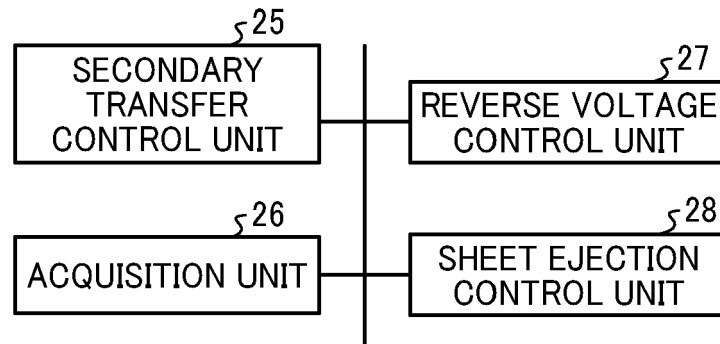


FIG. 6

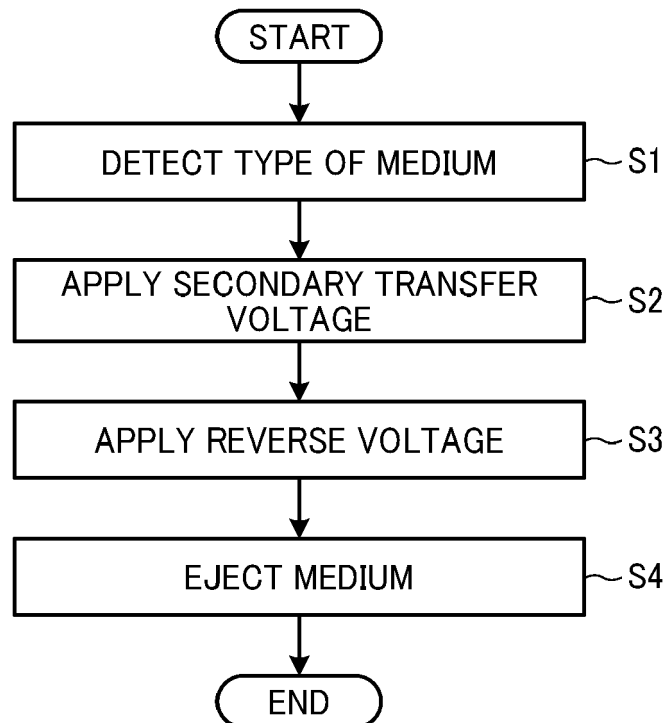


FIG. 7

	VALUE OF VOLTAGE TO BE APPLIED
COATED SHEET	FIRST VOLTAGE
TACK PAPER	SECOND VOLTAGE
SYNTHETIC RESIN FILM	THIRD VOLTAGE
LAMINATED PAPER	FOURTH VOLTAGE
⋮	⋮

FIG. 8A

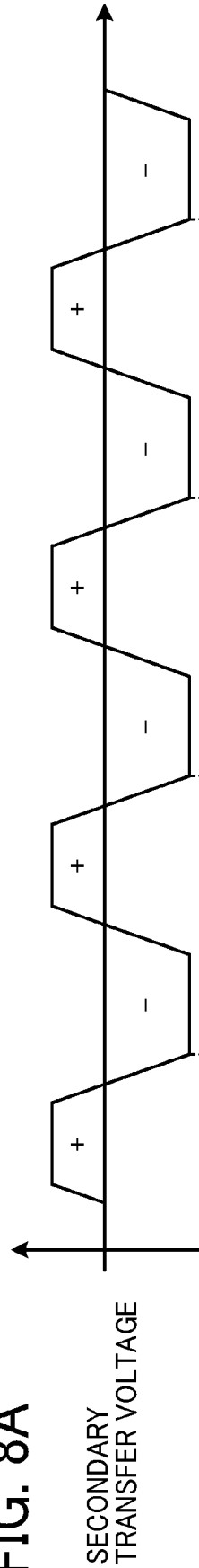


FIG. 8B



FIG. 8C

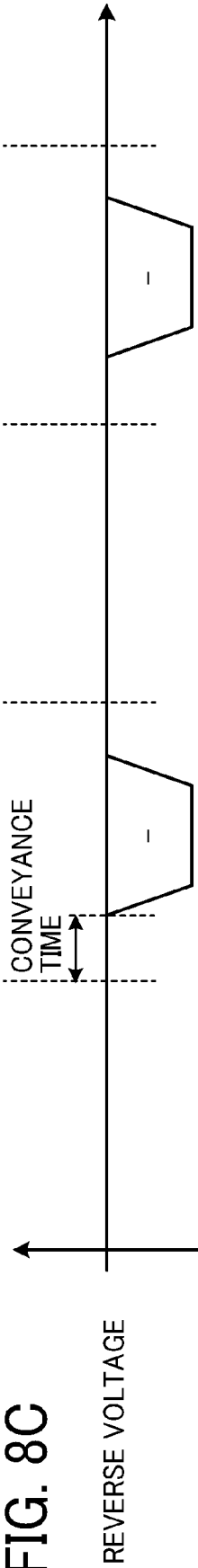


FIG. 9

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

FIG. 10

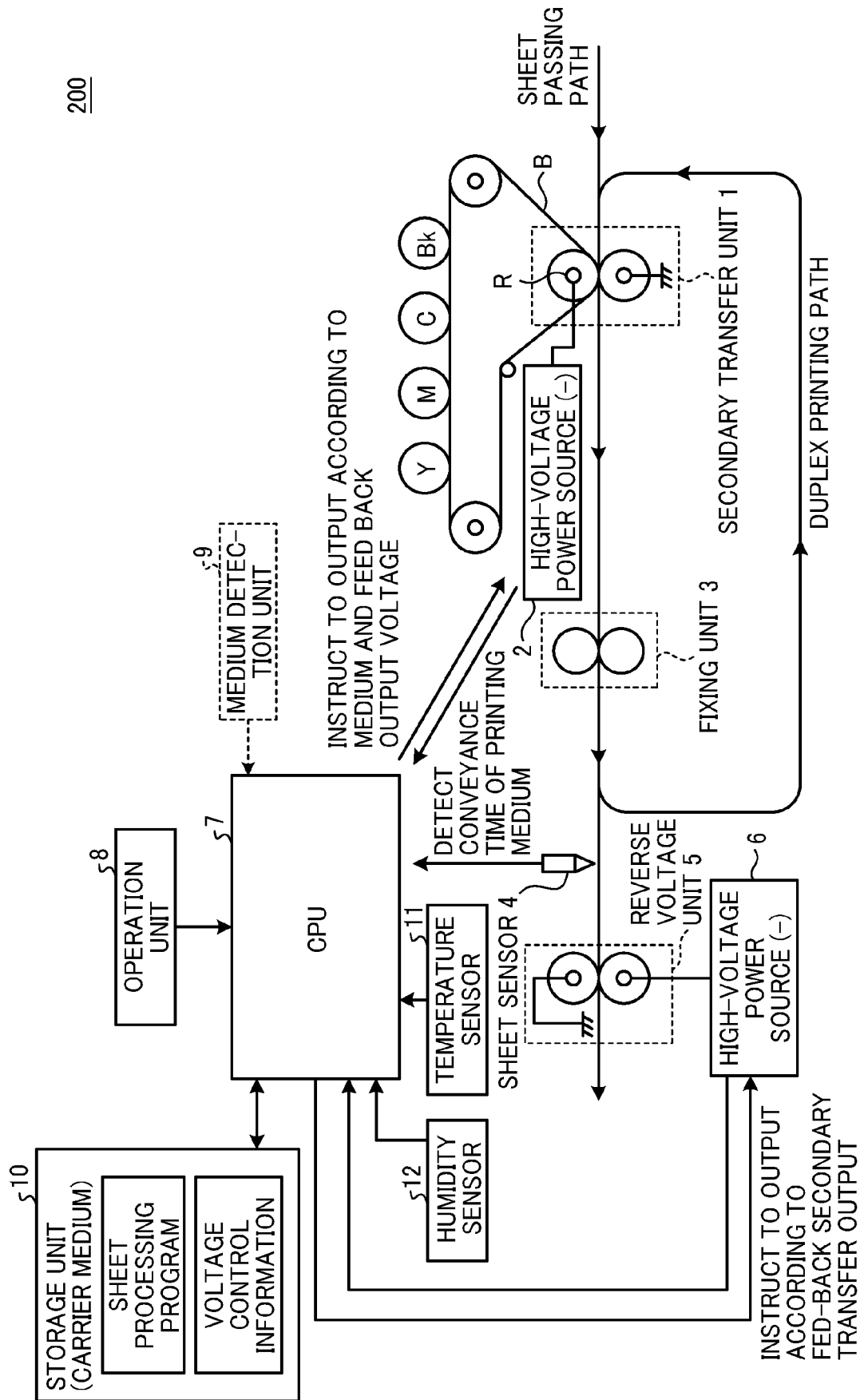


FIG. 11

TEMPER- ATURE (DEGREE) HUMIDITY (%)	L	M	H
L	FIRST VOLTAGE	SECOND VOLTAGE	THIRD VOLTAGE
M	FOURTH VOLTAGE	FIFTH VOLTAGE	SIXTH VOLTAGE
H	SEVENTH VOLTAGE	EIGHTH VOLTAGE	NINTH VOLTAGE

FIG. 12

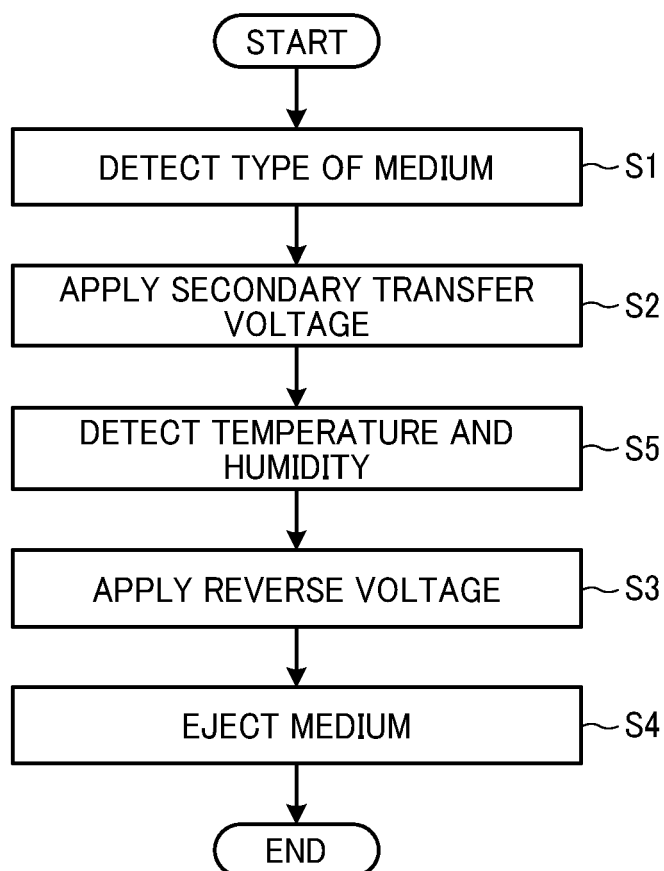


FIG. 13

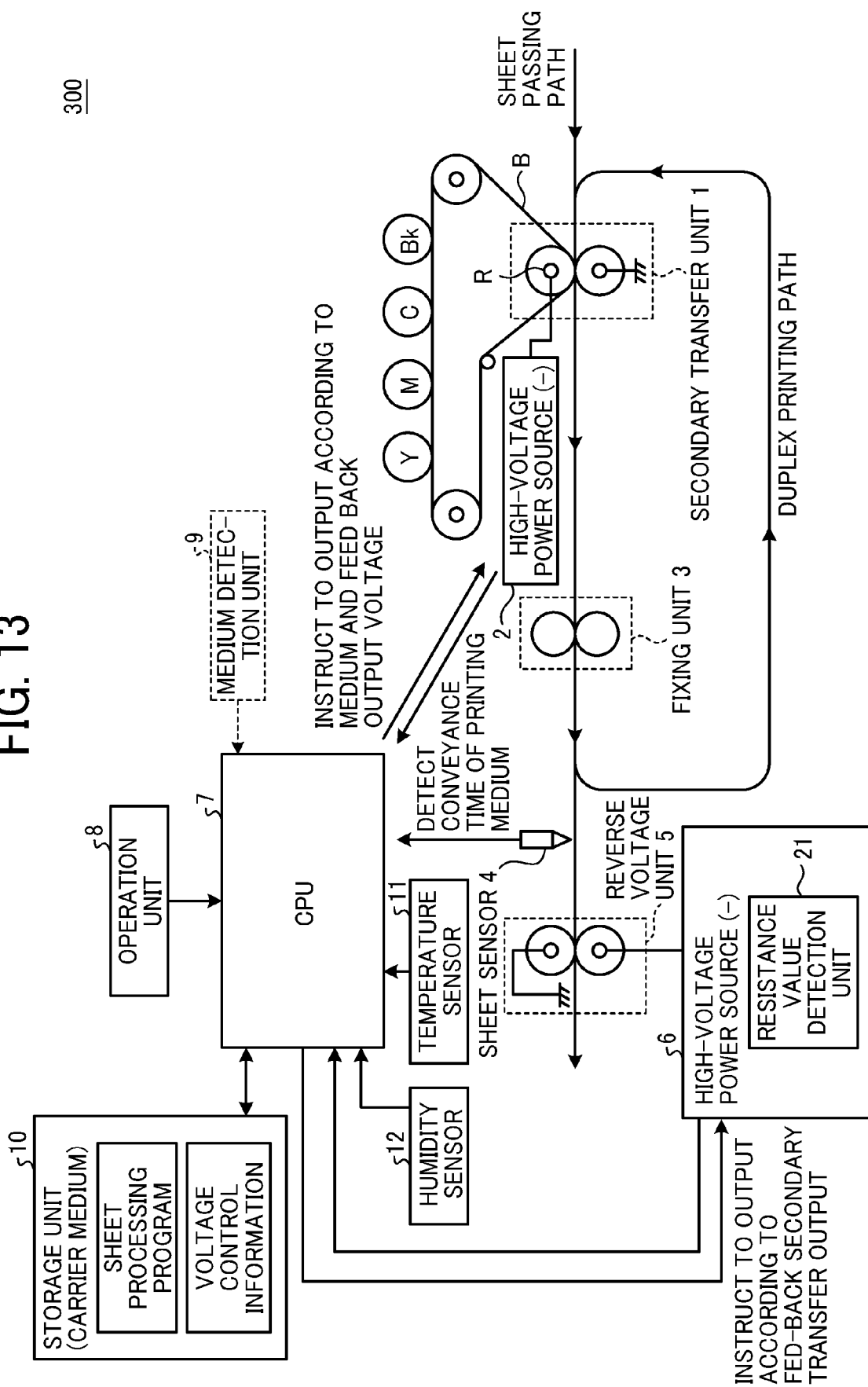


FIG. 14

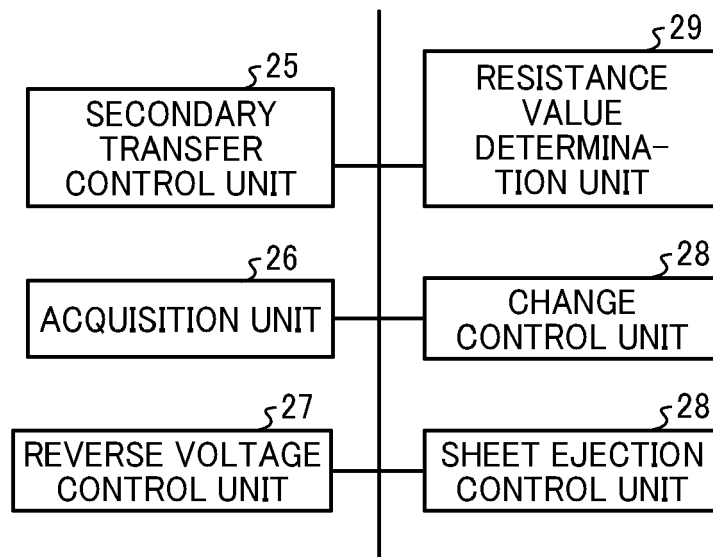
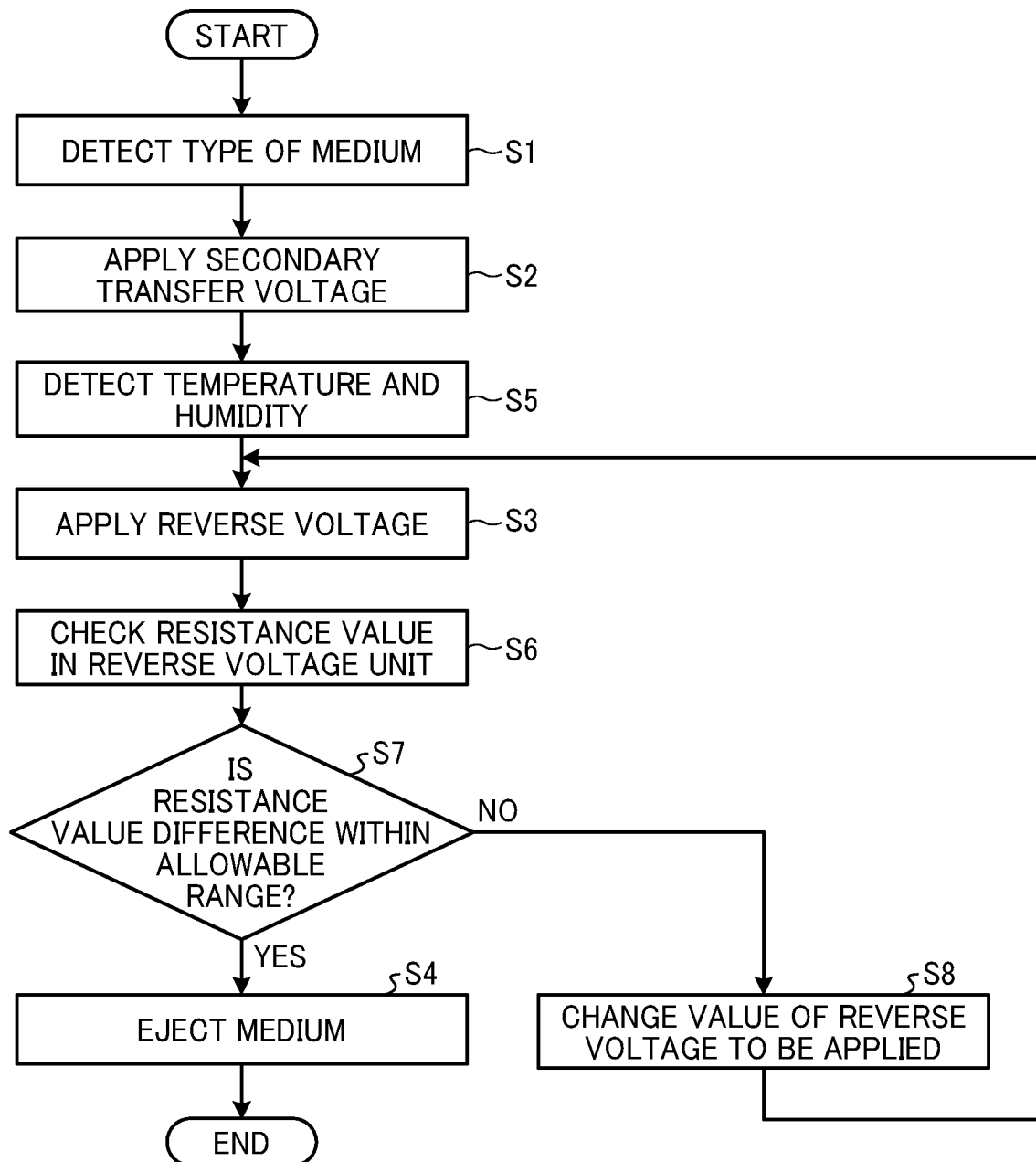


FIG. 15

	ALLOWABLE RESISTANCE VALUE DIFFERENCE
COATED SHEET	A Ω
TACK PAPER	B Ω
SYNTHETIC RESIN FILM	C Ω
LAMINATED PAPER	D Ω
⋮	⋮

FIG. 16





EUROPEAN SEARCH REPORT

Application Number
EP 20 20 4339

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			TECHNICAL FIELDS SEARCHED (IPC)
			G03G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 March 2021	Examiner Rubio Sierra, F
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 20 20 4339

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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