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(54) Image forming apparatus having transfer drum cleaner.

(57) An image forming apparatus (100) comprises a transfer drum (11) for holding paper (P), and can be switched between a monocolor mode in which an image is transferred to the paper (P) held only once and a multicolor mode in which an image having a plurality of colors is transferred thereto such that the colors are fused with each other a plurality of times. A paper feeding path (14), a separating claw (1) for separating from the transfer drum (11) the paper to which the image is transferred, and a cleaner (2) for cleaning the surface of the transfer drum (11) are disposed in that order along the direction of rotation of the transfer drum (11) around the transfer drum (11). When the image forming apparatus (100) is in the monocolor mode, the cleaner (2) is always abutted on the surface of the transfer drum (11), so that the surface of the transfer drum is always cleaned. Accordingly, the cleaner (2) need not be frequently abutted on the surface of the transfer drum (11) or separated from the surface of the transfer drum (11) in the monocolor mode, thereby to make it easy to control the cleaner (2) in the monocolor mode.

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to an image forming apparatus so adapted that a transfer material is held by holding means such as a transfer drum in transferring to the transfer material a toner image formed on a photosensitive drum. More particularly, it relates to an image forming apparatus having an improvement in a control operation of a cleaner provided for holding means such as a transfer drum.

Description of the Prior Art

Conventionally, a color copying machine having a transfer drum has been known (For example, U. S. Patent Nos. 4,766,463 and 3,729,311, and Japanese Patent Laid-Open Gazette No. 113481/1988). In this type of color copying machine, a transfer process and a separation process are carried out. In the transfer process, a transfer material (plain paper, a transparent resin sheet for an over head projector, label paper, a post card or the like) is held with it being wound around the peripheral surface of a transfer drum, the transfer drum around which the transfer material is wound is synchronously rotated with it being abutted on a photosensitive drum, and an image formed on the photosensitive drum is transferred to the transfer material. In the separation process, the transfer material to which the image is transferred is separated from the transfer drum.

Furthermore, the conventional color copying machine is generally made switchable between a monocolor mode in which a monochromatic image is obtained or a multicolor mode in which a color image having a plurality of colors fused with each other is obtained. In the monocolor mode, the transfer process is carried out only once, to obtain a monochromatic image. In the multicolor mode, the transfer process is carried out using three colors, that is, cyan, magenta and yellow or in some cases, four colors, that is, cyan, magenta, yellow and black such that the colors are fused with each other three or four times for each color, to obtain a color image.

On the other hand, since the transfer drum holds the transfer material by electrostatic adsorption, dirt such as toner particles and paper powder is liable to adhere to the surface thereof. In addition, at the time of transfer, a toner image may, in some cases, be erroneously transferred to the surface of the transfer drum which is not covered with the transfer material so that the surface of the transfer drum becomes dirty. If the dirt on the surface of the transfer drum is left, the transfer material is not sufficiently adsorbed by the transfer drum in winding the transfer material around the transfer drum, the reverse surface of the transfer material wound becomes dirty, and the toner image is not sufficiently transferred to the transfer material.

Such construction that dirt on the surface of the transfer drum is removed by a transfer drum cleaner has been conventionally adopted.

One of the prior arts of most particular interest to the present invention is a transfer drum cleaner which is described in Japanese Patent Laid-Open Gazette No. 57069/1981. The transfer drum described in this gazette is provided on the downstream side of a separating claw and on the upstream side of a paper feeding path in the direction of rotation of a transfer drum. In such an arrangement of the separating claw, the transfer drum cleaner and the paper feeding path, a transfer material held by the transfer drum is separated from the transfer drum by the separating claw, the surface of the transfer drum from which the transfer material is separated is cleaned by the cleaner, and the transfer material is fed to the cleaned surface of the transfer drum from the paper feeding path.

Meanwhile, in the prior art described in the above described Japanese Patent Laid-Open Gazette No. 57069/1981, the position of the transfer drum cleaner is not changed depending on an operation mode of a color copying machine. That is, in the above described prior art, when the operation mode of the color copying machine is in a monocolor mode and a multicolor mode, the transfer drum cleaner is abutted on the surface of the transfer drum or is separated therefrom at exactly the same timing. Particularly when monochromatic copies are continuously made in the monocolor mode, therefore, a switching operation of abutting the transfer drum cleaner on the surface of the transfer drum or separating the transfer drum cleaner therefrom must be frequently performed. Accordingly, in continuous copying in the monocolor mode, the position of the transfer drum cleaner must be frequently switched, so that there is a possibility of an adverse effect such as an abnormal sound or vibration due to the switching.

SUMMARY OF THE INVENTION

The present invention has been made so as to solve the above described problem and has for its object to provide an image forming apparatus capable of obtaining a good image without the possibility of an abnormal sound or vibration by changing a control method of a transfer drum cleaner.

Briefly stated, in the present invention, such control is carried out in the multicolor mode that

the transfer drum cleaner is abutted on the surface of a transfer material holding member for a constant time in synchronism with a separating operation of a separating claw or the like, while being separated from the surface thereof in the other times. On the other hand, in the monocolor mode, the transfer drum cleaner is always abutted on the surface of the transfer material holding member such that the surface of the holding member is always cleaned by the transfer drum cleaner, to eliminate frequent switching control of the transfer drum cleaner in the monocolor mode.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross sectional view showing the schematic construction of a full color copying machine according to one embodiment of the present invention;

Figs. 2 and 3 are enlarged sectional views illustrating the vicinity of a transfer drum, where Fig. 2 is a diagram showing an instantaneous state where a clip in the forward end of paper held by the transfer drum is released, and Fig. 3 is a diagram showing a state where paper is rotated for the second and subsequent transfer in a multicolor mode;

Fig. 4 is a diagram of a transfer drum as viewed from a direction at right angles to its peripheral surface for explaining the positional relation between a clip provided for a transfer drum and a separating claw;

Fig 5 is a block diagram showing the construction of a control circuit of the full color copying machine according to the present embodiment, which shows only portions associated with the present invention;

Fig. 6A is a timing chart showing the relation between the rotation of the transfer drum in the multicolor mode and a clip solenoid, a separating claw solenoid and a cleaner solenoid; and

Fig. 6B is a timing chart showing the relation between the rotation of the transfer drum in a monocolor node and a clip solenoid, a separating claw solenoid and a cleaner solenoid.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a cross sectional view showing the schematic construction of a full color copying machine 100 according to one embodiment of the present invention.

The full color copying machine 100 comprises a document mounting stand 3 for mounting a document and a reading sensor unit 4 for reading the contents of a document (not shown) mounted on the document mounting stand 3. A lamp 5 for illuminating the document is contained in the reading sensor unit 4. In addition, there are provided a moving device (not shown) for moving the reading sensor unit 4 in a direction indicated by an arrow X, a laser scan unit 6 which receives a signal from the reading sensor unit 4 for outputting laser light corresponding to the signal, a photosensitive drum 7 on which an electrostatic latent image is formed by exposure to the laser light outputted from the laser scan unit 6, and four developing units 81, 82, 83 and 84 for developing the electrostatic latent image on the photosensitive drum 7. Magenta, cyan, yellow and black toner particles are respectively contained in the four developing devices 81, 82, 83 and 84. The four developing devices 81, 82, 83 and 84 are attached to an elevator mechanism 9 and are moved up and down by the elevator mechanism 9, so that any one of the developing devices is selectively abutted on the photosensitive drum 7.

Furthermore, there is provided a transfer drum 11 for holding a transfer material such as paper. In the position for transfer, the peripheral surface of the photosensitive drum 11 is abutted on the peripheral surface of the photosensitive drum 7. The photosensitive drum 11 is rotated in a direction indicated by an arrow Y at a peripheral speed which is equal to the peripheral speed of the photosensitive drum 7 as the photosensitive drum 7 is rotated. A transferring corona discharger 15 is fixedly provided so as to be opposed to the position for transfer inside of the transfer drum 11. The transferring corona discharger 15 discharges high-frequency AC for transferring the toner image on the photosensitive drum 7 to the paper held on the peripheral surface of the transfer drum 11. In addition, there are provided a pair of separating corona dischargers 16 for removing charges charged on the paper to which the toner image is transferred such that the paper is easily separated from the transfer drum 11, a separating claw 1 for separating the paper from the transfer drum 11 to introduce the paper into a conveying belt 17, and a cleaner 2 for removing dirt on the peripheral surface of the transfer drum 11 from which the paper is separated. The separating claw 1 and the cleaner 2 are not always brought into contact with the peripheral surface of the transfer drum 11 but are switched between an operating state where it is in close proximity to or abutted on the peripheral surface of the transfer drum 11 and a non-operating state where it is separated from the peripheral surface of the transfer drum 11.

Additionally, there are provided two paper feeding cassettes 12a and 12b containing the paper serving as the transfer material, a manual paper feeding port 13 for manually feeding the paper, a paper conveying path 14 for conveying the paper into the transfer drum 11, a pair of registration rollers 10 for adjusting the timing of paper feeding to the transfer drum 11, a conveying belt 17 for conveying the paper separated from the transfer drum 11 by the separating claw 1, and a fixing device 18 which receives the paper conveyed by the conveying belt 17 for fixing the toner image on the paper.

Figs. 2 and 3 are enlarged cross sectional views illustrating the vicinity of a transfer drum 11. In Figs. 2 and 3, the internal structure of the transfer drum 11 is also shown.

Particularly, Fig. 2 shows an instantaneous state where toner particles having the last color are transferred in a monocolor mode or a multicolor mode, and a clip holding the forward end of paper is opened so that the paper begins to be separated from the transfer drum 11. On the other hand, Fig. 3 shows a state where toner particles having the first color or the second color are transferred in the multicolor mode.

Referring to Figs. 2 and 3, a transfer drum 11 is rotated in a direction indicated by an arrow Y. A pair of separating corona dischargers 16 is provided on the downstream side of a transferring corona discharger 15, a separating claw 1 for separating the paper from the transfer drum 11 is provided on the downstream of the separating corona dischargers 16, and a cleaner 2 for cleaning dirt on the peripheral surface of the transfer drum 11 is provided on the downstream side of the separating claw 1 on the basis of the direction of rotation of the transfer drum 11.

The separating claw 1 is provided so as to be displaceable by a solenoid 1a between a state where it is in close proximity to the transfer drum 11 (a state shown in Fig. 2) and a state where it is separated from the transfer drum 11 (a state shown in Fig. 3).

The cleaner 2 has a casing 22, and a fur brush 21 provided in contact with the surface of the transfer drum 11 for removing dirt or abnormal matter adhering to the surface of the transfer drum 11, and a flicker 23 for sweeping the dirt or abnormal matter adhering to the fur brush 21 down are arranged in the casing 22. In addition, the dirt or abnormal matter sweeped down from the fur brush 21 by the flicker 23 is contained in a dirt containing portion 24 provided in the lower end of the casing 22. The cleaner 2 is made switchable by a solenoid 2a between a state where it is abutted on the transfer drum 11 (a state shown in Fig. 2) and a state where it is separated from the surface of the transfer drum 11 (a state shown in Fig. 3).

A shade 94 and a reference position detecting switch (TIM) 95 are disposed inside of the transfer drum 11. The shade 94 is fixed to the transfer drum 11 and is rotated with the transfer drum 11. The reference position detecting switch 95 is fixed to a predetermined position in the transfer drum 11 and is not rotated with the transfer drum 11. If the transfer drum 11 is rotated once, the shade 94 is rotated once. When the shade 94 crosses the reference position detecting switch 95, the reference position detecting switch 95 provides a detection output. This detection output indicates the number of rotation of the transfer drum 11 and that the transfer drum 11 reaches a predetermined reference position.

In the transfer drum 11, a clip solenoid 91 is fixedly disposed. In addition, there are provided an arm member 92 which is swinged by the clip solenoid 91, and two pressing members 93a and 93b which are displaced outward in synchronism with the swing of the arm member 92 in a predetermined direction and are returned to the normal state in synchronism with the swing of the arm member 92 in the opposite direction. The arm member 92 and the two pressing members 93a and 93b are disposed in a fixed state independently of the rotation of the transfer drum 11.

A recess portion 96 is formed in a predetermined position on the peripheral surface of the transfer drum 11, and a clip 97 is disposed within the recess portion 96. When the transfer drum 11 is rotated for a predetermined time from a reference position (for example, a position where the shade 94 crosses the reference position detecting switch 95), the clip 97 is opposed to one of the pressing members 93a. At this time, if the clip solenoid 91 is turned on for a short time, the arm member 92 is swinged, and the pressing member 93a is displaced outward and is returned to the normal position in synchronism with the swing. The clip 97 is opened for a short time and then, is closed by the displacement of the pressing member 93a. If the forward end of the paper is fed into the clip 97 from the paper feeding path 14 in synchronization with the opening and closing of the clip 97, therefore, the forward end of the paper is held by the clip 97.

Furthermore, if the transfer drum 11 is rotated through approximately 180° from the position, the clip 97 is opposed to the other pressing member 93b. At this time, therefore, if the clip solenoid 91 is turned on for a short time to displace the other pressing member 93b by the arm member 92, the clip 97 can be opened for a short time, thereby to make it possible to release the holding of the forward end of the paper by the clip 97.

In Fig. 2, the opened clip 97 and the end of the

separating claw 1 in close proximity to the transfer drum 11 seem to be brought into contact with each other. However, the clip 97 and the separating claw 1 are so arranged as to be shifted in the vertical direction to the paper, in Fig. 2. Accordingly, the opened clip 97 and the end of the separating claw 1 are not brought into contact with each other.

More specifically, the arrangement of the clip 97 and the separating claw 1 in the direction of the axis of the transfer drum 11 is as shown in Fig. 4. In Fig. 4, two clips 97 are provided in a recess portion 96 formed in a transfer drum 11, and the clip 97 can hold the forward end of paper P. Four separating claws 1 are arranged so as not to be overlapped with the clips 97 in the direction of the axis of the transfer drum 11, and enter a space between the paper P which is not held by the clip 97 and the peripheral surface of the transfer drum 11 to separate the paper P from the transfer drum 11.

Fig. 5 is a block diagram showing the construction of a control circuit of a full color copying machine 100 according to the present embodiment, which shows only portions associated with the present invention.

An operation panel 22 is provided on, for example, the upper surface of the full color copying machine 100, and comprises a multicolor mode setting key 22a and a monocolor mode setting key 22b.

When the multicolor mode setting key 22a is pressed, a multicolor mode signal is applied to a CPU 23. In addition, when a monocolor mode setting key 22b is pressed, a monocolor mode signal is applied to the CPU 23. The CPU 23 carries out on-off control of a clip solenoid 91, a separating claw solenoid 1a and a cleaner solenoid 2a in synchronism with a copying operation of the full color copying machine 100 in response to the color mode signal applied.

Figs. 6A and 6B are timing charts showing the relation between the timing of the above described on-off control of the clip solenoid 91, the separating claw solenoid 1a and the cleaner solenoid 2a by the CPU 23 and the timing of the opening and closing of the clip 97 (see Figs. 2 and 3) opened and closed by the clip solenoid 91. Fig. 6A is a timing chart in a multicolor mode, and Fig. 6B is a timing chart in a monocolor mode.

Referring now to Fig. 6A, in the multicolor mode, both the separating claw solenoid 1a and the cleaner solenoid 2a are turned on so that the separating claw 1 and the cleaner 2 are in close proximity to or abutted on the surface of the transfer drum 11 at the time point where the rotation of the transfer drum 11 is started. When the clip 97 reaches the position for paper feeding after an elapse of a predetermined time since the transfer drum 11 passed through a reference position, the clip solenoid 91 is turned on for a short time, so that the clip 97 is opened and closed in the position for paper feeding on the basis of the turn-on to hold the forward end of the paper P. Thereafter, the separating claw solenoid 1a and the cleaner solenoid 2a are turned off, so that the separating claw 1 and the cleaner 2 are separated from the surface of the transfer drum 11. The transfer drum 11 is rotated four times so as to carry out the transfer process of a toner image having four colors.

In the case of the fourth rotation of the transfer drum 11, when the clip 97 reaches the position for separation after the transfer drum 11 is rotated for a predetermined time since the timing when the transfer drum 11 reaches the reference position was detected by the reference position detecting switch 95 (see Fig. 2), the clip solenoid 91 is turned on for a short time. Consequently, the clip 97 is opened and closed in the position for separation. At the same time, the separating claw solenoid 1a is turned on, so that the separating claw 1 is in close proximity to the surface of the transfer drum 11. Therefore, the holding of the forward end of the paper is released by the opening of the clip 97 and at the same time, the separating claw 1 enters a space between the paper P and the transfer drum 11, to separate the forward end of the paper P from the surface of the transfer drum 11. Thereafter, the clip 97 is closed.

Furthermore, the cleaner solenoid 2a is turned on at the same time that the separating claw solenoid 1a is turned on, so that the cleaner 2 is brought into contact with the surface of the transfer drum 11. Therefore, the surface of the transfer drum 11 from which the paper P is separated by the separating claw 1 is cleaned by the cleaner 2.

Although in the above described embodiment, the timings when the separating claw solenoid 1a and the cleaner solenoid 2a are turned on and off are exactly the same, the timing when the cleaner solenoid 2a is turned on or off may be delayed by a very short time from the timing when the separating claw solenoid 1a is turned on or off.

In the case of continuous copying, the above described operations are repeated.

On the other hand, on-off control of the clip solenoid 91, the separating claw solenoid 1a and the cleaner solenoid 2a in the monocolor mode is as shown in Fig. 6B.

Referring to Fig. 6B, in the monocolor mode, copying on one paper is completed by one rotation of the transfer drum 11. Therefore, the clip solenoid 91 is turned on for a short time at the timing when the clip 97 reaches the position for paper feeding after an elapse of a very short time since the timing when the transfer drum 11 reaches the reference position was detected by the reference

position detecting switch 95 (see Fig. 2), so that the clip 97 is opened and closed. In synchronization with the opening and closing, the forward end of the paper P is fed into the clip 97, so that the forward end of the paper is held by the clip 97. The paper P whose forward end is held by the clip 97 is rotated with it adhering to the surface of the transfer drum 11 by static electricity or the like. In the position for transfer, a toner image is transferred to the paper from the photosensitive drum 7. Thereafter, charges charged on the paper P are removed by the separating corona dischargers 16. At the timing when the clip 97 reaches the position for separation, the clip solenoid 91 is turned on for a short time. Correspondingly, the clip 97 is opened for a short time.

On the other hand, the separating claw solenoid 1a and the cleaner solenoid 2a are always turned on. Therefore, the separating claw 1 is always in close proximity to the surface of the transfer drum 11, and the cleaner 2 is always brought into contact with the surface of the transfer drum 11.

Accordingly, if the clip 97 is opened for a short time in the position for separation, the separating claw 1 enters a space between the paper P whose forward end is not held by the opening and the surface of the transfer drum 11, so that the paper P is separated from the surface of the transfer drum 11. The surface of the transfer drum 11 from which the paper P is separated is cleaned by the cleaner 2.

More specifically, in the monocolor mode, no paper exists on the surface of the transfer drum 11 from the position for separation to the position for paper feeding on the downstream side thereof. Therefore, the cleaner 2 disposed between the positions can be always brought into contact with the surface of the transfer drum 11. Consequently, it is not necessary in the monocolor mode that the cleaner solenoid 2a for bringing the cleaner 2 into contact with the surface of the transfer drum 11 or separating the cleaner 2 from the surface of the transfer drum 11 is controlled as described above, so that the cleaner solenoid 2a may be always turned on.

The same is true for the separating claw 1. The separating claw solenoid 1a for controlling the separating claw 1 may be always turned on in the monocolor mode.

In the above described manner, according to the embodiment of the present invention, the separating claw solenoid 1a and the cleaner solenoid 2a may be always turned on in the monocolor mode, so that it is easy to control the two solenoids. Furthermore, the separating claw solenoid 1a and the cleaner solenoid 2a need not be frequently turned on and/or off in continuous copying in the monocolor mode, so that there is no possibility of an abnormal sound, vibration or the like.

Although in the above described embodiment, the separating claw 1 and the cleaner 2 are respectively controlled by separate solenoids 1a and 2a, both may be controlled by the same solenoid. That is, since the separating claw 1 and the cleaner 2 are simultaneously in close proximity to or abutted on the surface of the transfer drum 11 and are simultaneously separated from the surface of the transfer drum 11, the separating claw 1 and the cleaner 2 can be also connected to each other such that they are controlled by a single solenoid.

Although in the above described embodiment, description was made of the full color copying machine by way of example, the present invention can be similarly applied to a printer capable of doing multicolor printing.

Furthermore, the transfer drum may be replaced with a transfer material holding belt.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

Claims

1. An image forming apparatus (100) having holding means (11) for holding a transfer material (P) in transferring an image formed to the transfer material (P), the holding means (11) comprising a transfer material holding surface moved in an endless manner in a predetermined direction (Y), and being switchable between a monocolor mode in which an image having one color is transferred to the transfer material (P) held on the holding surface only once and a multicolor mode in which an image having a plurality of colors is transferred to the transfer material (P) with the colors being fused with each other a plurality of times, comprising:

transfer material feeding means (14) for feeding the transfer material (P) to the holding surface (11), separating means (1) for separating from the holding surface (11) the transfer material (P) to which the image is transferred, and cleaning means (2) for cleaning the holding surface (11) which are disposed in that order along the direction (Y) of movement of the transfer material holding surface (11):

cleaning switching means (2a) for switching the cleaning means (2) between an operable state where it is abutted on the holding surface (11) and a non-operable state where it

is separated from the holding surface (11);

operation mode determining means (23) for determining whether the operation mode is a monocolor mode or a multicolor mode; and

cleaner control means (23) for bringing the cleaning switching means (2a) into the operable state in response to a monocolor mode determination output of the determining means (23).

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

separation switching means (1a) for switching the separating means (1) between an operable state where it is in close proximity to or abutted on the holding surface (11) and a non-operable state where it is separated from the holding surface (11), and

separation control means (23) for always bringing the separation switching means (1a) into an operable state in response to the monocolor mode determination output of the determining means (23).

3. The image forming apparatus according to claim 1 or 2, wherein

the separation switching means (1a) and the cleaning switching means (2a) are formed of common switching means, and the cleaning means (2) is abutted on the holding surface (11) at the same time that the separating means (1) is in close proximity to or abutted on the holding surface (11), and the cleaning means (2) is separated from the holding surface (11) at the same time that the separating means (1) is separated from the holding surface (11).

FIG.1

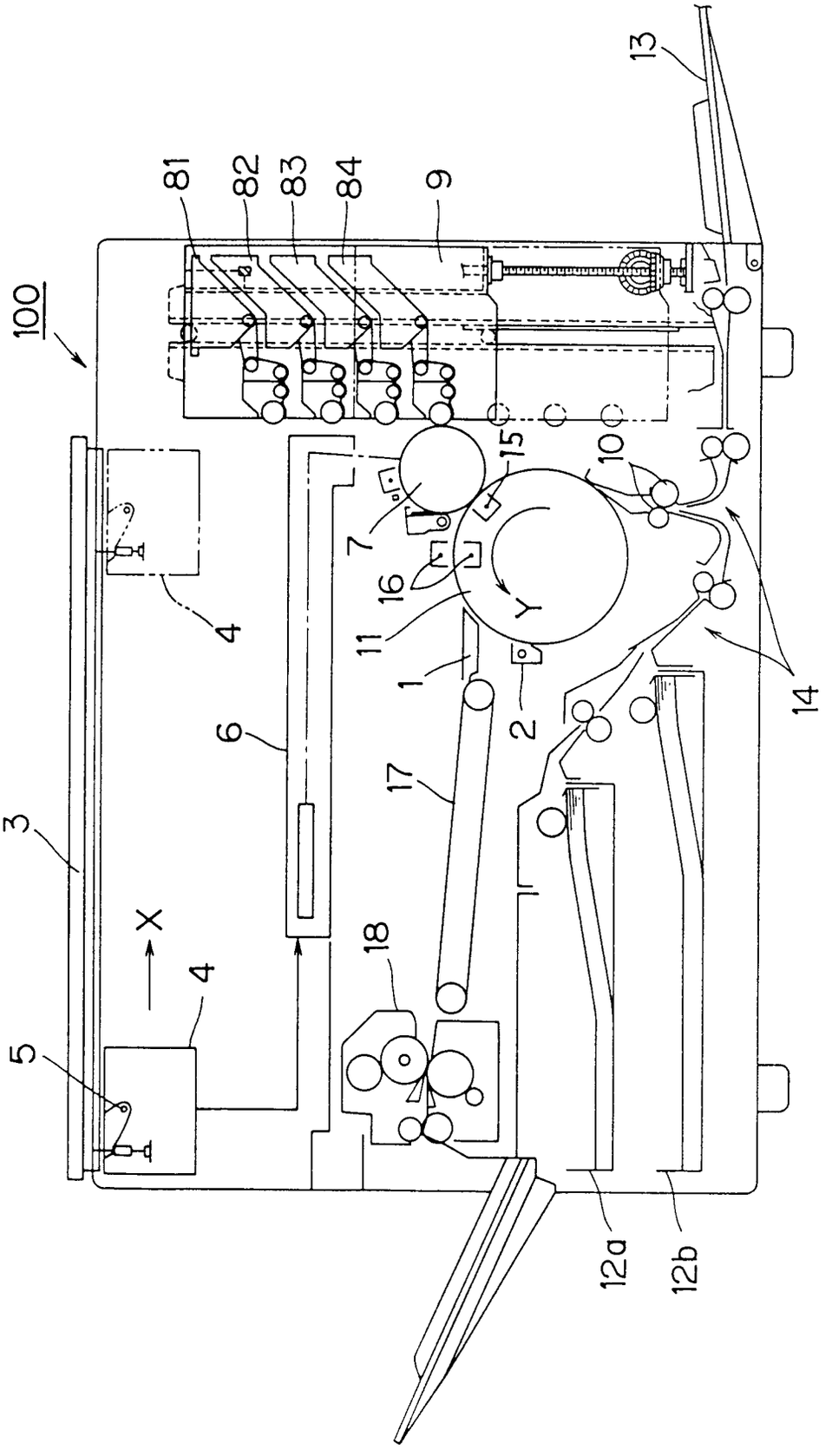


FIG.2

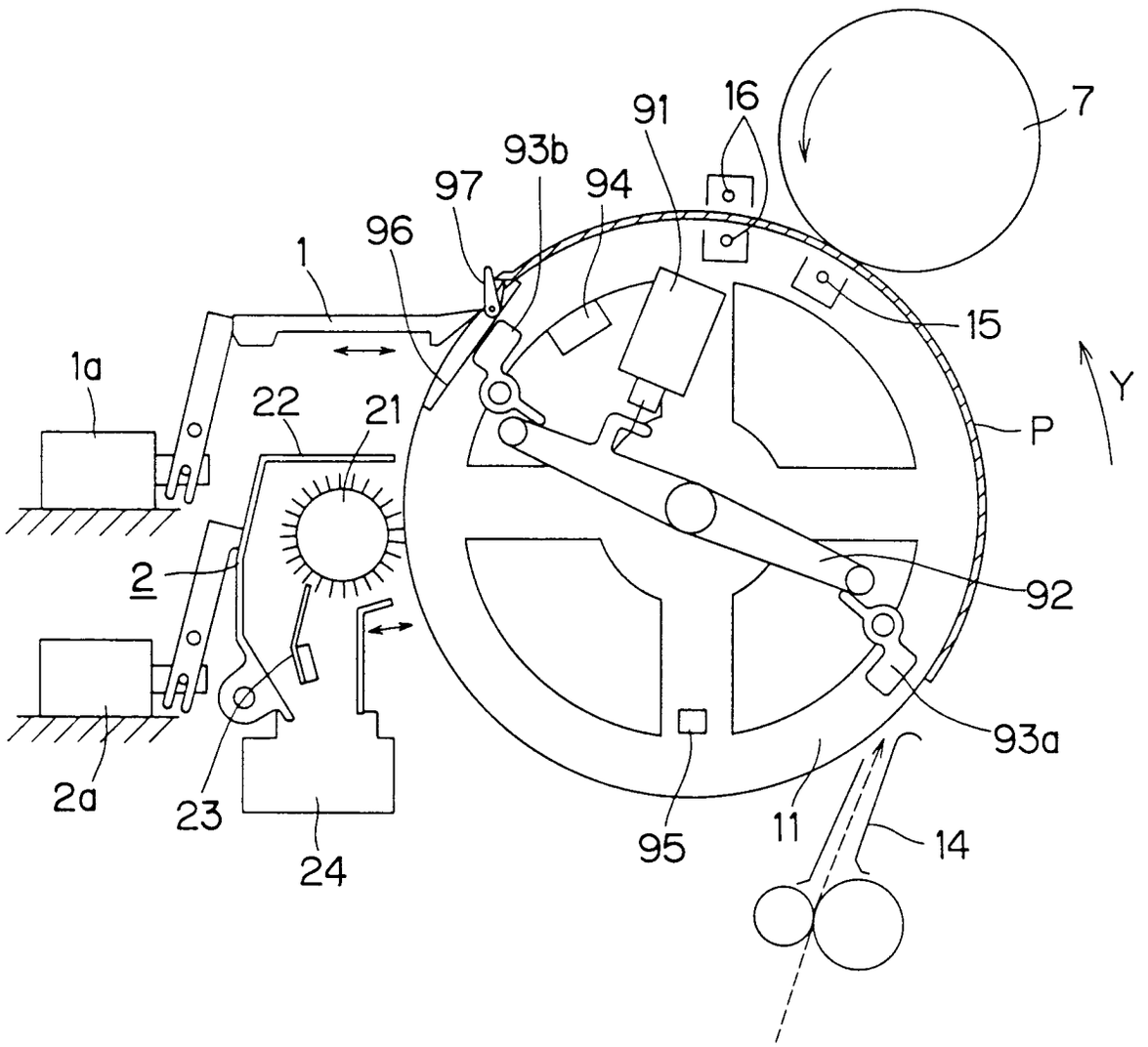


FIG.3

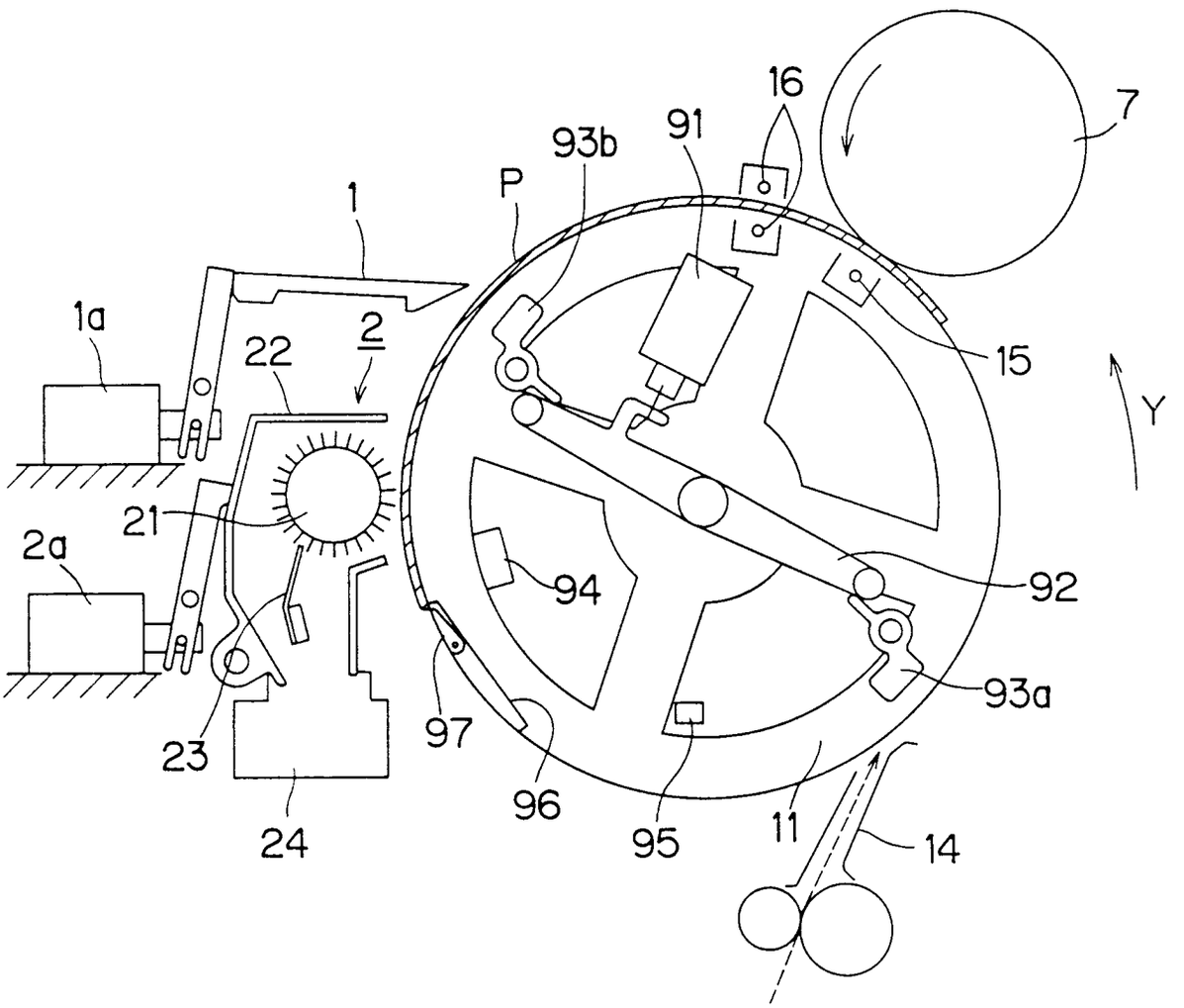


FIG.4

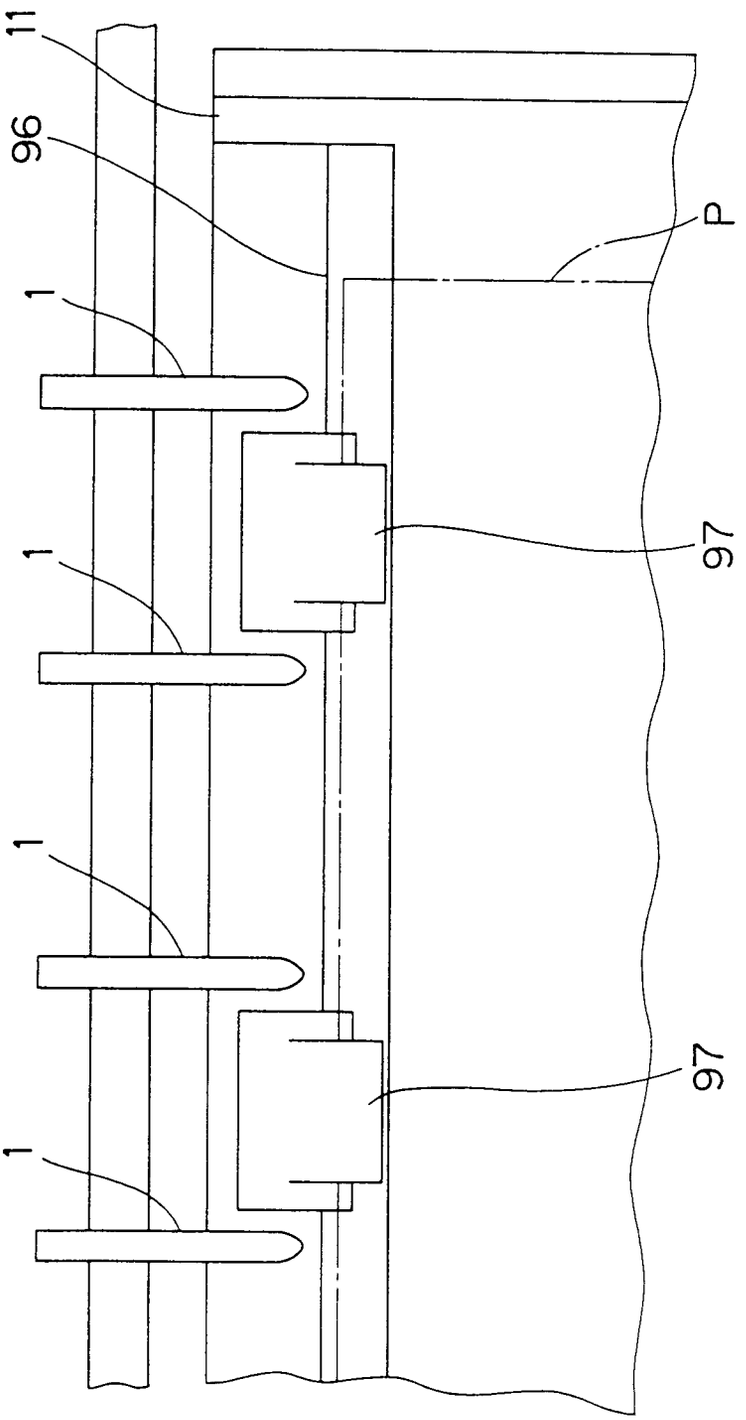
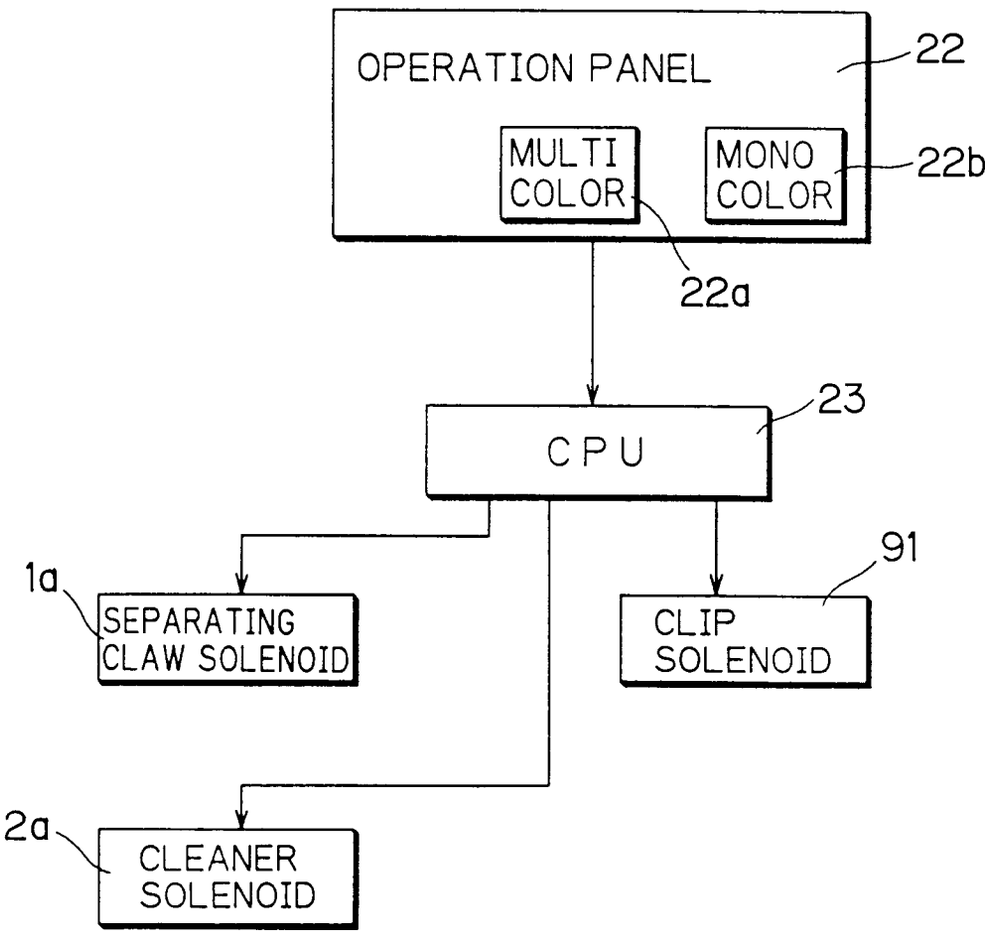


FIG.5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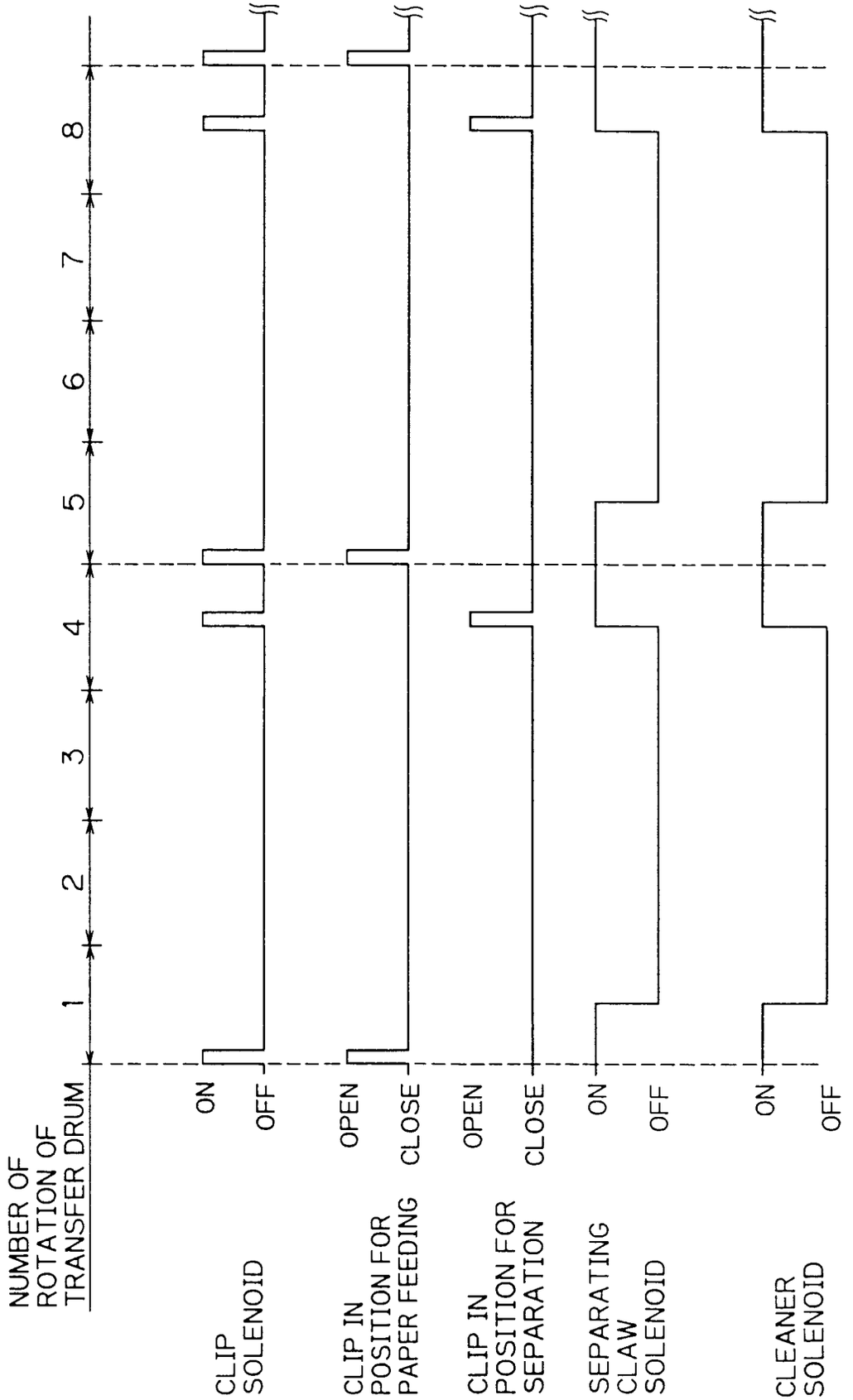
22
MULTI COLOR
MONO COLOR
22b
22a
CPU
23
1a
SEPARATING CLAW SOLENOID
91
CLIP SOLENOID
2a
CLEANER SOLENOID

FIG.6A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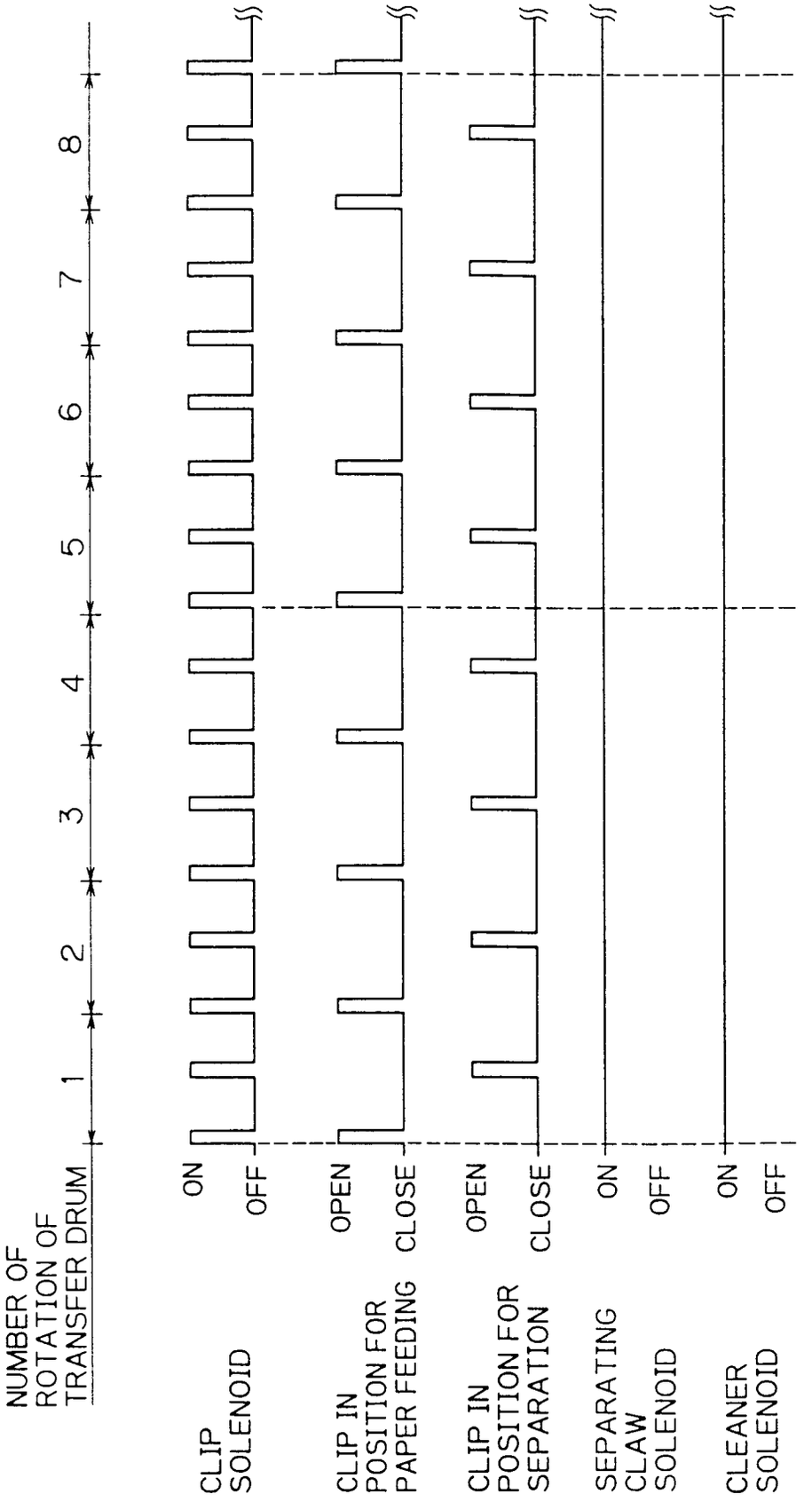
CLIP IN POSITION FOR PAPER FEEDING
OPEN
CLOSE
CLIP IN POSITION FOR SEPARATION
OPEN
CLOSE
SEPARATING CLAW SOLENOID
ON
OFF
CLEANER SOLENOID
ON
OFF

FIG.6B


NUMBER OF ROTATION OF TRANSFER DRUM
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SEPARATING CLAW SOLENOID
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CLEANER SOLENOID
ON
OFF