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(54) Title: MAGNET DISPOSED UNDER INTERMEDIATE TRANSFER BELT

(57) Abstract: A cleaning device for an image forming apparatus includes at least one magnet disposed adjacent an inner peripheral surface of the endless belt of the image forming apparatus, and an electrostatic device disposed in contact with an outer peripheral surface of the endless belt, downstream the at least one magnet, in a travelling direction of the endless belt.



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MAGNET DISPOSED UNDER INTERMEDIATE TRANSFER BELT

BACKGROUND

[0001] Some image forming apparatuses include an intermediate transfer belt that receives a toner image from a photosensitive drum and transfers the toner image to a print medium. The intermediate transfer belt is an endless belt that carries the toner image on an outer peripheral surface thereof. After the toner image is transferred from the intermediate transfer belt to the print medium, a residual amount of toner remaining on the intermediate transfer belt may cause an adverse effect on formation of a subsequent toner image. Therefore, before the intermediate transfer belt receives the subsequent toner image, the remaining toner on the intermediate transfer belt may be cleaned.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Fig. 1 is a schematic diagram of an image forming apparatus including an intermediate transfer belt and a cleaning device for the intermediate transfer belt according to an example of the present disclosure.

Fig. 2A is a schematic diagram of a cleaning device for an intermediate transfer belt according to an example.

Fig. 2B is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 3A is a schematic diagram of a cleaning device for an intermediate

transfer belt according to another example.

Fig. 3B is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 4 is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 5 is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 6 is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 7 is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 8 is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 9 is a schematic diagram of a cleaning device for an intermediate transfer belt according to another example.

Fig. 10A is a schematic diagram of an example transfer conveyance belt in a single-color image forming apparatus.

Fig. 10B is a schematic diagram of an example transfer conveyance belt in a color image forming apparatus.

DETAILED DESCRIPTION

[0003] An example image forming apparatus is provided with a cleaning device for an intermediate transfer belt. According to examples, the cleaning device may include at least one magnet that is disposed adjacent to an inner peripheral surface of the intermediate transfer belt so as to attract carrier particles to an

outer peripheral surface of the intermediate transfer belt and hold the carrier particles on the outer peripheral surface, and an electrostatic cleaning mechanism (or electrostatic device) that is disposed downstream of the at least one magnet in a travelling direction of the intermediate transfer belt to be in contact with the outer peripheral surface of the intermediate transfer belt so as to remove toner particles from the outer peripheral surface of the intermediate transfer belt.

[0004] In the following description, with reference to the drawings, the same reference numbers are assigned to the same components or to similar components having the same function, and overlapping description is omitted.

[0005] Fig. 1 shows an image forming apparatus 1 including a cleaning device 100 for an intermediate transfer belt 31 according to an example of the present disclosure. The example image forming apparatus 1 includes four toner bottles (or toner tanks) 10Y, 10M, 10C, 10K, four developing devices 20Y, 20M, 20C, 20K, four photosensitive drums 40Y, 40M, 40C, 40K, four charging rollers 41Y, 41M, 41C, 41K, and four cleaning units 43Y, 43M, 43C, 43K. In the present description, the characters "Y," "M," "C" and "K" in the reference signs represent the colors namely yellow, magenta, cyan and black, respectively, of toner used in the corresponding components. The image forming apparatus 1 includes a recording medium conveyance unit 70, a transfer device 30, an exposure unit 42, a fixing device 50 and a discharge device 60. The transfer device 30 includes an intermediate transfer belt 31, suspension rollers 34, 35, 36, 37, which support (or suspend) the intermediate transfer belt 31 to rotate, four primary transfer rollers 32Y, 32M, 32C, 32K and a secondary transfer roller 33, which rotates by following the movement of the intermediate transfer belt 31 while pressing a print

medium P against the intermediate transfer belt 31. The suspension roller 37 is a driving roller to enable the intermediate transfer belt 31 to rotate in the direction of the arrows. The image forming apparatus 1 includes a processor 80 to control operations of various components of the image forming apparatus 1, and a memory 82 to store various control instructions executed by the processor 80 or related data.

[0006] In the example image forming apparatus 1, the photosensitive drums 40Y, 40M, 40C, 40K are charged via the charging rollers 41Y, 41M, 41C, 41K, respectively, and the exposure unit 42 form electrostatic latent images on the respective photosensitive drums 40Y, 40M, 40C, 40K, in accordance with image data. The electrostatic latent images are developed by the respective developing devices 20Y, 20M, 20C, 20K, with toners supplied from respective the toner bottles 10Y, 10M, 10C, 10K, so as to form toner images of four the colors, respectively, on the photosensitive drums 40Y, 40M, 40C, 40K. The intermediate transfer belt 31 receives the toner images from the photosensitive drums 40Y, 40M, 40C, 40K at respective primary transfer nip regions 38Y, 38M, 38C, 38K in a sequential order, and layers the toner images to combine them into a single composite toner image on the intermediate transfer belt 31. The composite toner image is subsequently transferred from the intermediate transfer belt 31 to the print medium P at a secondary transfer nip region 39 by the secondary transfer roller 33. The toner image transferred onto the print medium P is subsequently fixed on the print medium P at the fixing device 50 which includes a heating roller 52 and a pressing roller 54. Print media P are initially stored in a cassette K, and the recording medium conveyance unit 70 conveys the print media P one at a time, from the cassette, along a conveyance path P1 to

be subjected to the transferring of the toner image via the secondary transfer roller 33 and to the fixation of the toner image by the fixing device 50, and to be discharged by the discharge device 60 which includes discharge rollers 62, 64.

[0007] Fig. 2A shows an example cleaning device 100 for the intermediate transfer belt 31 shown in Fig. 1. After the toner image has been transferred from the intermediate transfer belt 31 to the print medium P via the secondary transfer roller 33, toner particles (indicated by white circles) may remain on an outer peripheral surface of the intermediate transfer belt 31. Part of the toner particles remaining on the outer peripheral surface of the intermediate transfer belt 31 is affected by an adsorption bias voltage applied to the secondary transfer roller 33, so that the charged polarity thereof is inverted. This allows positively-charged toner particles and negatively-charged toner particles to remain in a mixed state on the outer peripheral surface of the intermediate transfer belt 31. The cleaning device 100 is a device for removing such remaining toner particles that may possibly have an adverse effect on image formation.

[0008] The cleaning device 100 includes first and second magnets 110, 120 that are disposed adjacent to the inner peripheral surface of the intermediate transfer belt 31 and attract and hold carrier particles to and on the outer peripheral surface of the intermediate transfer belt 31, and an electrostatic cleaning mechanism (or electrostatic device) 130 that is disposed in contact with the outer peripheral surface of the intermediate transfer belt 31 to remove from the intermediate transfer belt 31, toner particles conveyed through carrier particles during rotation of the intermediate transfer belt 31. On the intermediate transfer belt 31, a trace amount of carrier particles also remains in addition to the above-described remaining toner particles. The first and second magnets 110, 120 attract and

hold those carrier particles (indicated by gray circles) to and on the outer peripheral surface of the intermediate transfer belt 31. In order to capture a certain amount of carrier particles above each of the first and second magnets 110, 120 in a short period of time, the carrier particles may be replenished from a carrier box 140 which will be described further below.

[0009] On the outer peripheral surface of the intermediate transfer belt 31, positively-charged toner particles and negatively-charged toner particles remain in a mixed state, as described above. However, toner particles that are passed through a region of the outer peripheral surface of the intermediate transfer belt 31 holding carrier particles, and that are conveyed to the electrostatic cleaning mechanism 130, have a reduced adhesive force to the intermediate transfer belt 31 due to collisions with the carrier particles. Additionally, friction with the carrier particles causes such toner particles to be charged with a specific same polarity (negative or positive). In some examples, such toner particles that are passed through the region on the outer peripheral surface of the intermediate transfer belt 31 holding the carrier particles, and that are conveyed to the electrostatic cleaning mechanism 130 are all substantially charged with a specific same polarity (negative or positive). This allows the cleaning device 100 to remove the remaining toner particles by a single electrostatic cleaning mechanism 130, thereby reducing a production cost of the cleaning device 100.

[0010] A first magnet 110 may be disposed adjacent to the inner peripheral surface of the intermediate transfer belt 31, for example, upstream of the electrostatic cleaning mechanism 130 in the travelling direction of the intermediate transfer belt 31. The first magnet 110 may be disposed in contact with the inner peripheral surface of the intermediate transfer belt 31 via a sliding

member 111. According to examples, the sliding member 111 may be an adhesive tape, which is made of a low frictional material, such as fluoro-resins or ultrahigh molecular weight polyethylene, that is affixed on a top surface of the first magnet 110. Namely, an adhesive side of the tape is affixed to the top surface of the first magnet 110, and a low-friction side of the tape, opposite the adhesive side, contacts the inner peripheral surface of the intermediate transfer belt 31 to reduce friction between the magnet and the belt. The sliding member 111 reduces a friction between the first magnet 110 and the inner peripheral surface of the intermediate transfer belt 31 thereby not to hinder the travelling of the intermediate transfer belt 31, and also works to prevent the first magnet 110 from being worn out. In some examples where the first magnet 110 has a sturdy and smooth surface (a surface in contact with the intermediate transfer belt 31), the sliding member 111 may be omitted. By positioning the first magnet 110 in contact with the inner peripheral surface of the intermediate transfer belt 31, the first magnet 110 attracts carrier particles from a certain distance with a stable force, without causing the intermediate transfer belt 31 to oscillate.

[0011] The first magnet 110 has magnetic poles N and S at opposite ends thereof, in the travelling direction of the intermediate transfer belt 31 (e.g., the travelling direction of a portion of the intermediate transfer belt 31 in contact with the first magnet 110). In some examples, the magnetic poles N and S may be interchanged (arranged opposite) with respect to those illustrated in Fig. 2A. The first magnet 110 may include two yokes 112-1, 112-2 disposed adjacent to the respective ends (magnetic poles N and S) of the first magnet 110. The yokes 112-1, 112-2 concentrate a magnetic flux of the first magnet 110 to upper sides of the yokes 112-1, 112-2, to enhance an adsorption force of the first magnet 110.

In one example, the yokes 112-1, 112-2 may be made of an iron plate. The yokes 112-1, 112-2 may be bonded to both ends of the first magnet 110 with an adhesive or the like. In some examples where a sufficient adsorption force is generated without the yokes 112-1, 112-2, the yokes 112-1, 112-2 may be omitted.

[0012] The first magnet 110 may extend substantially over an entire width of the intermediate transfer belt 31, so as to remove remaining toner over the entire width of the intermediate transfer belt 31. In other examples, the first magnet 110 may extend over a portion of the entire width of the intermediate transfer belt 31. This configuration may be suitable, for example, to selectively clean that width portion of the intermediate transfer belt 31, or in other examples when the rest of the entire width of the intermediate transfer belt 31 is covered with another magnet.

[0013] The first magnet 110 may be made of a permanent magnet, so as to constantly hold the carrier particles on the outer peripheral surface of the intermediate transfer belt 31 regardless of whether or not the image forming apparatus is supplied with power (and therefore, whether or not the cleaning device 100 is supplied with power), and thereby minimize the necessity of replenishment of carrier particles. In other examples, an electromagnet may be used as the first magnet 110.

[0014] The second magnet 120 is configured in a similar manner as the first magnet 110, and is disposed downstream of the first magnet 110 in the travelling direction of the intermediate transfer belt 31. The second magnet 120 operates in a similar manner as the first magnet 110 to attract and hold carrier particles to and on the outer peripheral surface of the intermediate transfer belt 31. If toner particles to be conveyed to the electrostatic cleaning mechanism 130 can be

charged to the same polarity by the first magnet 110 alone, then the second magnet 120 may be omitted. In addition, the cleaning device 100 may include one or more additional magnets such as a third magnet or a fourth magnet, in addition to the first and second magnets 110, 120, in order to charge the toner particles to be conveyed to the electrostatic cleaning mechanism 130, to the same polarity. The additional one or more magnets such as the third magnet or the fourth magnet may be configured in a similar manner as the first magnet 110 and the second magnet 120, respectively, and positioned downstream the second magnet 120 in the travelling direction of the intermediate transfer belt 31. Components of the second magnet 120 similar to components of the first magnet 110, are indicated by reference numbers obtained by adding 10 to the respective reference numbers of the corresponding components of the first magnet 110, and overlapping description thereof is omitted.

[0015] By referring to Fig. 1 together with Fig. 2A, the first and second magnets 110, 120 are disposed at a position toward the right end portion along an undersurface (that is, inner peripheral surface) of an upper portion of the circular intermediate transfer belt 31. In other examples, the first and second magnets 110, 120 may be disposed at a position closer to the center, or may be disposed at a position to the left of the center. In addition, Fig. 2A shows that the first and second magnets 110, 120 are disposed along an undersurface (that is, inner peripheral surface) of the upper portion of the circular intermediate transfer belt 31. In other examples, the first and second magnets 110, 120 may be disposed along a top surface (also along the inner peripheral surface) of a lower portion of the circular intermediate transfer belt 31, or may be disposed along an inner side (e.g., inner peripheral surface) of a side portion of the circular intermediate

transfer belt 31.

[0016] The electrostatic cleaning mechanism 130 may include a hard roller 132 disposed in contact with the outer peripheral surface of the intermediate transfer belt 31, a scraper 136 disposed in contact with an outer peripheral surface of the hard roller 132, and a voltage source 134 to apply an adsorption bias voltage to the hard roller 132. The electrostatic cleaning mechanism 130 is disposed downstream of the first magnet 110 and the second magnet 120, in the travelling direction of the intermediate transfer belt 31. The hard roller 132 is rotated in the direction of the arrow by a driving device. The polarity of the adsorption bias voltage to be applied to the hard roller 132 is set to a polarity that is opposite to a charged polarity (namely, the polarity to which the toner particles are charged due to the friction between the toner particles and the carrier particles) of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 130, and the hard roller 132 and the scraper 136 are charged to the same polarity as the polarity of this adsorption bias voltage. Accordingly, the hard roller 132 can electrostatically adsorb the remaining toner particles from the surface of the intermediate transfer belt 31. According to examples, the adsorption bias voltage may have a value within the range of +100 to +500 V or within the range of -100 to -500 V. In some examples, the adsorption bias voltage may be +200 V or -200 V. Toner particles adsorbed onto the outer peripheral surface of the hard roller 132 are subsequently scraped off from the outer peripheral surface of the hard roller 132 by the scraper 136.

[0017] The toner particles scraped off from the outer peripheral surface of the hard roller 132 by the scraper 136 may be subsequently conveyed to and collected into a waste toner collection container via a toner conveyance

mechanism (or toner conveyance device). The waste toner collection container may be offset from the intermediate transfer belt 31 in the widthwise direction (e.g., the waste toner collection container may be disposed outside the width of the intermediate transfer belt 31). In one example, the toner conveyance mechanism may include an auger disposed adjacent to and in parallel with the scraper 136, and an elongated housing enclosing the scraper 136 and the auger together in such a manner as to allow the scraper 136 to contact the hard roller 132. The auger is rotated by a driving device such as a motor, conveys toner particles scattered in the housing toward an outlet port provided at one end of the housing in a width direction of the intermediate transfer belt 31, and discharges the toner particles through the outlet port to the waste toner collection container. Depending on examples, the toner conveyance mechanism may be provided by any suitable mechanism or device that can convey scraped-off toner particles to a waste toner collection box without dropping them on the intermediate transfer belt 31.

[0018] In one example, the hard roller 132 may include a metal roller disposed in contact with the outer peripheral surface of the intermediate transfer belt 31. The metal roller may be formed of a material such as stainless steel, nickel-plated iron and nickel-plated aluminum. Since a metal roller is low in cost and has a long lifespan as compared to a brush roller, it can significantly reduce the production cost of a cleaning device 100. In one example, the scraper 136 may include a thin stainless steel plate. A trace amount of remaining carrier particles that would be conveyed beyond the secondary transfer nip region 39 by the intermediate transfer belt 31 is captured on the outer peripheral surface of the intermediate transfer belt 31 by the first and second magnets 110 and 120 (the

same may apply to carrier particles supplied from the carrier box 140 described below) so as not to be conveyed to the electrostatic cleaning mechanism 130, in order to prevent or reduce the risk of carrier particles causing damage to the surface of the intermediate transfer belt 31 even when the hard roller 132 is used in the electrostatic cleaning mechanism 130.

[0019] In the example of Fig. 2A, the voltage source 134 is configured so as to apply an adsorption bias voltage to the hard roller 132. In other examples, the voltage source 134 may be configured so as to apply an adsorption bias voltage to the scraper 136. For example, the voltage source 134 may be configured so as to apply an adsorption bias voltage to at least one among the hard roller 132 and the scraper 136. In addition, the rotational direction of the hard roller 132 may be opposite to the direction illustrated in the figure. In such a case, the scraper 136 may be disposed, for example, at an opposite side of the hard roller 132, relative to the position illustrated in Fig. 2A.

[0020] The combination of materials constituting the above-described toner particles and carrier particles determines a polarity to which the toner particles are charged by friction between the toner particles and carrier particles. This combination of materials may be determined at the time of designing an image forming apparatus depending on the charging characteristic of a photosensitive material used for a photosensitive drum. For example, when an OPC (organic photoconductor) is used for a photosensitive drum, the OPC is in many cases charged positively at the time of exposure, and therefore, a combination of materials is selected so that the toner particles are negatively charged through friction with the carrier particles. Meanwhile, when a photosensitive material having a characteristic to be negatively charged at the time of exposure is used

as a photosensitive drum, a combination of materials is selected so that the toner particles are positively charged through friction with the carrier particles. In any case, an adsorption bias voltage to be applied to the hard roller 132 by the voltage source 134 is set to a polarity opposite to the polarity (known polarity based on the design of an image forming apparatus) to which toner particles are charged by friction between toner particles and carrier particles as described above.

[0021] The hard roller 132 may substantially extend over the entire width of the intermediate transfer belt 31, in order to remove remaining toner over the entire width of the intermediate transfer belt 31. However, in another example, the hard roller 132 may extend over a portion of the entire width of the intermediate transfer belt 31. This configuration may be suitable, for example, to selectively clean that width portion of the intermediate transfer belt 31, or in other examples when the rest of the entire width of the intermediate transfer belt 31 is covered with another cleaning mechanism (or cleaning device).

[0022] By referring to Fig. 1 together with Fig. 2A, the electrostatic cleaning mechanism 130 is disposed relatively close to the first and second magnets 110 and 120. In other examples, the electrostatic cleaning mechanism 130 may be disposed at a position further away from the first and second magnets 110 and 120. According to examples, the electrostatic cleaning mechanism 130 may be disposed at any suitable position along the outer peripheral surface of the intermediate transfer belt 31 to follow the transfer of a toner image from the intermediate transfer belt 31 to a print medium P and to precede the transfer of a subsequent toner image from the photosensitive drum 40Y to the intermediate transfer belt 31. Since the remaining toner may be conveyed in a state where it is adhered to a side portion or an undersurface portion of the outer peripheral

surface of the intermediate transfer belt 31 irrespective of gravity, the electrostatic cleaning mechanism 130 can be disposed at any position along the outer peripheral surface of the intermediate transfer belt 31. For example, the electrostatic cleaning mechanism 130 may be disposed at a position downstream of the secondary transfer nip region 39 and upstream of any of primary transfer nip regions 38Y, 38M, 38C and 38K along the outer peripheral surface of the intermediate transfer belt 31. The degree of disposition flexibility of the electrostatic cleaning mechanism 130 enhances the degree of design flexibility of the cleaning device 100, and this may be useful for size-reduction of the image forming apparatus 1 including the cleaning device 100.

[0023] In addition, the example electrostatic cleaning mechanism 130 is disposed at a position toward the right end portion along a top surface (that is, outer peripheral surface) of an upper portion of the circular intermediate transfer belt 31. In other examples, the electrostatic cleaning mechanism 130 may be disposed at a position closer to the center or may be disposed at the center or at a position to the left from the center. Further, in Fig. 2A, the electrostatic cleaning mechanism 130 is disposed along the top surface (namely, the outer peripheral surface) of the upper portion of the circular intermediate transfer 31. In other examples, the electrostatic cleaning mechanism 130 may be disposed along an undersurface (also the outer peripheral surface) at a lower portion of the circular intermediate transfer belt 31, or may be disposed along an outer side (also the outer peripheral surface) of the side portion of the circular intermediate transfer belt 31.

[0024] In some examples, the cleaning device 100 is disposed above the intermediate transfer belt 31 and includes a carrier box 140 to store carrier

particles to be supplied onto the outer peripheral surface of the intermediate transfer belt 31. The carrier box 140 stores the carrier particles for replenishment. The carrier box 140 is disposed upstream of the first and second magnets 110, 120 in the travelling direction of the intermediate transfer belt 31. A user may remove a seal tape 142 that covers an opening of the carrier box 140 to direct the carrier particles onto the outer peripheral surface of the intermediate transfer belt 31. With the rotation of the intermediate transfer belt 31, the replenished carrier particles are conveyed, at the start of operation of the image forming apparatus 1, to above the first and second magnets 110, 120, and they are attracted in that region and held on the outer peripheral surface of the intermediate transfer belt 31 by the first and second magnets 110, 120. Since the amount of carrier particles remaining on the intermediate transfer belt 31 after transfer of a toner image to a print medium P is very minimal, a certain period of time may lapse until the first and second magnets 110, 120 capture an amount of carrier particles to adjust the charge of remaining toner particles to the same polarity. Supplying carrier particles in advance from the carrier box 140 before the operation of the image forming apparatus 1 after the installation thereof enables the cleaning device 100 to exhibit good performance immediately after the start of operation of the image forming apparatus 1. In other examples, the cleaning device 100 may be configured to automatically wind and remove the seal tape 142 by a winding mechanism (or winding device) that may be coupled to a rotational shaft of a roller (for example, roller 37) at the start of operation of the image forming apparatus 1.

[0025] Fig. 1 shows an example image forming apparatus 1 having four kinds (e.g., four colors) of toner as an example of an image forming apparatus including

a cleaning device for an intermediate transfer belt according to the present disclosure. In other examples, the cleaning device 100 can be implemented in an image forming apparatus having more kinds (e.g., colors) of toner, or in an image forming apparatus having fewer kinds (e.g., colors) of toner. Colors of toner are also not limited to the examples described herein. The cleaning device 100 can be implemented in any image forming apparatus having an intermediate transfer belt and a two-component developer containing toner and carrier.

[0026] Fig. 2B shows a cleaning device 200 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 100 shown in Fig. 2A. The cleaning device 200 is different from the cleaning device 100 in that the cleaning device 200 includes a voltage source 250 to apply a charging voltage to each of the first and second magnets 210, 220. The polarity of a charging bias voltage applied by the voltage source 250 is set to the same polarity as the polarity to which the toner particles are charged further to friction between toner particles and carrier particles. This can support the action of the first and second magnets 210, 220 to adjust the charged polarity of remaining toner particles to the same specific polarity. The charging bias voltage to be applied by the voltage source 250 is applied to each of yokes 212-1, 212-2 of the first magnet 210, and each of yokes 222-1, 222-2 of the second magnet. For example, the charging bias voltage to be applied by the voltage source 250 may have a value within the range of -1 to -2 kV or within the range of +1 to +2 kV. In one example, the charging bias voltage may be -1 kV or +1 kV. Other components of the cleaning device 200 that are similar to components of the cleaning device 100, are indicated by reference numbers obtained by adding 100 to the respective reference numbers of the corresponding components of the

cleaning device 100, and overlapping description thereof is omitted.

[0027] Fig. 3A shows a cleaning device 300 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 100 shown in Fig. 2A. The cleaning device 300 is different from the cleaning device 100 in that a first magnet 310 has magnetic poles N, S at opposite ends of the first magnet 310 in the direction vertical to the intermediate transfer belt 31 and includes a cap-shaped yoke 312 to cover a back face and side faces of the first magnet 310 when viewed from the intermediate transfer belt 31. The magnetic poles N and S may be arranged in reverse order of those illustrated in the figure. The yoke 312 can concentrate a magnetic flux of the first magnet 310 above the yoke 312 to improve an adsorption force of the first magnet 310. In one example, the yoke 312 may be a cap made of iron. The yoke 312 may be joined to the first magnet 310 with an adhesive or the like. In some examples where a sufficient adsorption force is generated without the yoke 312, the yoke 312 may be omitted. Although Fig. 3A shows a single magnet 310, in other examples, the cleaning device 300 may further be provided, downstream of the first magnet 310 in the travelling direction of the intermediate transfer belt 31, with another magnet such as a second magnet or a third magnet configured in the same manner as the first magnet 310. Other components of the cleaning device 300 that are similar to components of the cleaning device 100, are indicated by reference numbers obtained by adding 200 to the respective reference numbers of the corresponding components of the cleaning device 100, and overlapping description thereof is omitted.

[0028] Fig. 3B shows a cleaning device 400 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 300 shown

in Fig. 3A. The cleaning device 400 is different from the cleaning device 300 in that the cleaning device 400 includes a voltage source 450 to apply a charging bias voltage to a first magnet 410. The polarity of the charging bias voltage to be applied by the voltage source 450 is set to the same polarity as the polarity to which toner particles are charged by friction between toner particles and carrier particles. This can improve the action of the first magnet 410 to adjust the charged polarity of remaining toner particles to the same specific polarity. The voltage source 450 to be applied by the voltage source 450 is applied to a yoke 412 of the first magnet 410. In some examples, the charging bias voltage to be applied by the voltage source 450 may have a value within the range of -1 to -2 kV or within the range of +1 to +2 kV. In one example, the charging bias voltage may be -1 kV or +1 kV. Other components of the cleaning device 400 that are similar to components of the cleaning device 300, are indicated by reference numbers obtained by adding 100 to the respective reference numbers of the corresponding components of the cleaning device 300, and overlapping description thereof is omitted.

[0029] Fig. 4 shows a cleaning device 500 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 100 shown in Fig. 2A. The cleaning device 500 is different from the cleaning device 100 in that an electrostatic cleaning mechanism (electrostatic device) 530 includes a brush roller 538 disposed in contact with the outer peripheral surface of the intermediate transfer belt 31, a hard roller 532 disposed in contact with an outer peripheral surface of the brush roller 538, a scraper 536 disposed in contact with an outer peripheral surface of the hard roller 532, and a voltage source 534 to apply an adsorption bias voltage to the hard roller 532. In one example, the

brush roller 538 may include a cylindrical cored bar, a fabric base bonded to an outer peripheral surface thereof, and brush bristles transplanted in the fabric base. The brush bristles may be formed of a conductive material such as nylon or acrylic in which conductive materials are kneaded. Each of the brush roller 538 and the hard roller 532 is rotated by a driving device in the direction of the arrow. An adsorption bias voltage to be applied to the hard roller 532 is set to a polarity opposite to a charged polarity of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 530, and the brush roller 538, the hard roller 532 and the scraper 536 are charged to the same polarity as the polarity of the adsorption bias voltage. This enables the brush roller 538 to scrape the remaining toner particles from the surface of the intermediate transfer belt 31, and to electrostatically adsorb them. The toner particles adsorbed onto the outer peripheral surface of the brush roller 538 are subsequently adsorbed onto the outer peripheral surface of the hard roller 532, and finally, scraped off from the outer peripheral surface of the hard roller 532 by the scraper 536. The cleaning device 500 may further have a voltage source such as the voltage source 250 shown in Fig. 2B. In the example of Fig. 4, the voltage source 534 is configured so as to apply an adsorption bias voltage to the hard roller 532. However, in another example, the voltage source 534 may be configured so as to apply an adsorption bias voltage to the scraper 536, or may be configured so as to apply an adsorption bias voltage to the brush roller 538. For example, the voltage source 534 may be configured so as to apply an adsorption bias voltage to at least one among the brush roller 538, the hard roller 532 and the scraper 536. In addition, the rotational direction of the hard roller 532 may be opposite to the direction illustrated in the figure. In such a configuration, the scraper 536 may

be disposed, for example, at an opposite side of the hard roller 532, relative to the position illustrated in Fig. 4. The rotational direction of the brush roller 538 may be also opposite to the direction illustrated in the figure. Further, in the cleaning device 500, the brush roller 538 may be replaced with a sponge roller. Other components of the cleaning device 500 that are similar to components of the cleaning device 100, are indicated by reference numbers obtained by adding 400 to the respective reference numbers of the corresponding components of the cleaning device 100, and overlapping description thereof is omitted.

[0030] Fig. 5 shows a cleaning device 600 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 300 shown in Fig. 3A. The cleaning device 600 is different from the cleaning device 300 in that an electrostatic cleaning mechanism (or electrostatic device) 630 includes a brush roller 638 disposed in contact with the outer peripheral surface of the intermediate transfer belt 31, a hard roller 632 disposed in contact with an outer peripheral surface of the brush roller 638, a scraper 636 disposed in contact with an outer peripheral surface of the hard roller 632, and a voltage source 634 to apply an adsorption bias voltage to the hard roller 632. In one example, the brush roller 638 may include a cylindrical cored bar, a fabric base bonded to an outer peripheral surface thereof, and brush bristles transplanted in the fabric base. The brush bristles may be formed of a conductive material such as nylon or acrylic in which conductive particles are kneaded. Each of the brush roller 638 and the hard roller 632 is rotated by a driving device in the direction of the arrow. An adsorption bias voltage to be applied to the hard roller 632 is set to a polarity opposite to a charged polarity of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 630, and the brush roller 638, the hard roller

632 and the scraper 636 are charged to the same polarity as the polarity of the adsorption bias voltage. This enables the brush roller 638 to scrape the remaining toner particles from the surface of the intermediate transfer belt 31, and to electrostatically adsorb them. The toner particles adsorbed onto the outer peripheral surface of the brush roller 638 are subsequently adsorbed onto the outer peripheral surface of the hard roller 632, and finally, scraped off from the outer peripheral surface of the hard roller 632 by the scraper 636. The cleaning device 600 may further have a voltage source such as the voltage source 450 shown in Fig. 3B. In the example of Fig. 5, the voltage source 634 is configured so as to apply an adsorption bias voltage to the hard roller 632. However, in another example, the voltage source 634 may be configured so as to apply an adsorption bias voltage to the scraper 636, or may be configured so as to apply an adsorption bias voltage to the brush roller 638. In some examples, the voltage source 634 may be configured so as to apply an adsorption bias voltage to at least one among the brush roller 638, the hard roller 632 and the scraper 636. In addition, the rotational direction of the hard roller 632 may be opposite to the direction illustrated in the figure. In such a configuration, the scraper 636 may be disposed, for example, at an opposite side of the hard roller 632, relative to the position illustrated in Fig. 5. The rotational direction of the brush roller 638 may be also opposite to the direction illustrated in the figure. Further, in the cleaning device 600, the brush roller 638 may be replaced with a sponge roller. Other components of the cleaning device 600 that are similar to components of the cleaning device 300, are indicated by reference numbers obtained by adding 300 to the respective reference numbers of the corresponding components of the cleaning device 300, and overlapping description thereof is omitted.

[0031] Fig. 6 shows a cleaning device 700 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 100 shown in Fig. 2A. The cleaning device 700 is different from the cleaning device 100 in that an electrostatic cleaning mechanism (or electrostatic device) 730 includes a brush roller 738 disposed in contact with the outer peripheral surface of the intermediate transfer belt 31, a metal rod 736 disposed in contact with an outer peripheral surface of a brush roller 738, and a voltage source 734 to apply an adsorption bias voltage to the brush roller 738. In some examples, the brush roller 738 may include a cylindrical cored bar, a fabric base bonded to an outer peripheral surface thereof, and brush bristles transplanted in the fabric base. The brush bristles may be formed of a conductive material such as nylon or acrylic in which conductive particles are kneaded. The brush roller 738 is rotated in the direction of the arrow by a driving device. The polarity of the adsorption bias voltage to be applied to the brush roller 738 is set to a polarity opposite to a charged polarity (namely, the polarity to which toner particles are charged due to the friction between the toner particles and the carrier particles) of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 730, and the brush roller 738 and the metal rod 736 are charged to the same polarity as the polarity of the adsorption bias voltage. This enables the brush roller 738 to scrape the remaining toner particles from the surface of the intermediate transfer belt 31 and to electrostatically adsorb them. The scraped toner particles are adsorbed onto the outer peripheral surface of the brush roller 738 and rotated in that state, and subsequently, the toner particles are knocked off from the outer peripheral surface of the brush roller 738 by the metal rod 736. The metal rod 736 may be formed of a material such as stainless steel, nickel-plated iron or

nickel-plated aluminum. In some examples, the metal rod 736 may have a rounded cross-section (for example, a circular or oval cross-section). This allows the metal rod 736 to remove toner particles from the outer peripheral surface of the brush roller 738 without damaging the brush roller 738. The cleaning device 700 may further have a voltage source such as the voltage source 250 shown in Fig. 2B. In the example of Fig. 6, the voltage source 734 is configured so as to apply an adsorption bias voltage to the brush roller 738. In other examples, the voltage source 734 may be configured to apply an adsorption bias voltage to the metal rod 736. According to examples, the voltage source 734 may be configured so as to apply an adsorption bias voltage to at least one among the brush roller 738 and the metal rod 736. In addition, the rotational direction of the brush roller 738 may be opposite to the direction illustrated in the figure. In such a configuration, the scraper 736 may be disposed, for example, at an opposite side of the brush roller 738, relative to the position illustrated in Fig. 6. Further, in the cleaning device 700, the brush roller 738 may be replaced with a sponge roller. Other components of the cleaning device 700 that are similar to components of the cleaning device 100, are indicated by reference numbers obtained by adding 600 to the respective reference numbers of the corresponding components of the cleaning device 100, and overlapping description thereof is omitted.

[0032] Fig. 7 shows a cleaning device 800 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 300 shown in Fig. 3A. The cleaning device 800 is different from the cleaning device 300 in that an electrostatic cleaning mechanism (or electrostatic device) 830 includes a brush roller 838 disposed in contact with the outer peripheral surface of the

intermediate transfer belt 31, a metal rod 836 disposed in contact with an outer peripheral surface of a brush roller 838, and a voltage source 834 to apply an adsorption bias voltage to the brush roller 838. In some examples, the brush roller 838 may include a cylindrical cored bar, a fabric base bonded to an outer peripheral surface thereof, and brush bristles transplanted in the fabric base. The brush bristles may be formed of a conductive material such as nylon or acrylic in which conductive particles are kneaded. The brush roller 838 is rotated in the direction of the arrow by a driving device. The polarity of the adsorption bias voltage to be applied to the brush roller 838 is set to a polarity opposite to a charged polarity (namely, the polarity to which toner particles are charged friction due to the between the toner particles and the carrier particles) of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 830, and the brush roller 838 and the metal rod 836 are charged to the same polarity as the polarity of the adsorption bias voltage. This enables the brush roller 838 to scrape the remaining toner particles from the surface of the intermediate transfer belt 31 and to electrostatically adsorb them. The scraped toner particles are adsorbed onto the outer peripheral surface of the brush roller 838 and rotated in that state, and subsequently, the toner particles are knocked off from the outer peripheral surface of the brush roller 838 by the metal rod 836. The metal rod 836 may be formed of a material such as stainless steel, nickel-plated iron or nickel-plated aluminum. In some examples, the metal rod 836 may have a rounded cross-section (for example, a circular or oval cross-section). This allows the metal rod 836 to remove toner particles from the outer peripheral surface of the brush roller 838 without damaging the brush roller 838. The cleaning device 800 may further have a voltage source such as the voltage source

450 shown in Fig. 3B. In the example of Fig. 7, the voltage source 834 is configured to apply an adsorption bias voltage to the brush roller 838. However, in another example, the voltage source 834 may be configured so as to apply an adsorption bias voltage to the metal rod 836. For example, the voltage source 834 may be configured to apply an adsorption bias voltage to at least one among the brush roller 838 and the metal rod 836. In addition, the rotational direction of the brush roller 838 may be opposite to the direction illustrated in the figure. In such a configuration, the scraper 836 may be disposed, for example, at an opposite side of the brush roller 838, relative to the position illustrated in Fig. 7. Further, in the cleaning device 800, the brush roller 838 may be replaced with a sponge roller. Other components of the cleaning device 800 that are similar to components of the cleaning device 300, are indicated by reference numbers obtained by adding 500 to the respective reference numbers of the corresponding components of the cleaning device 300, and overlapping description thereof is omitted.

[0033] Fig. 8 shows a cleaning device 900 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 100 shown in Fig. 2A. The cleaning device 900 is different from the cleaning device 100 in that an electrostatic cleaning mechanism (or electrostatic device) 930 includes a sponge roller 938 disposed in contact with the outer peripheral surface of the intermediate transfer belt 31, a brush roller 932 disposed in contact with an outer peripheral surface of the sponge roller 938, a metal rod 936 disposed in contact with an outer peripheral surface of the brush roller 932, and a voltage source 934 to apply an adsorption bias voltage to the sponge roller 938. In some examples, the sponge roller 938 may include a cylindrical cored bar and an elastic material

layer formed on an outer peripheral surface thereof. The elastic material layer may be formed of a conductive material such as conductive polyurethane foam. In some examples, the brush roller 932 may include a cylindrical cored bar, a fabric base bonded to an outer peripheral surface thereof, and brush bristles transplanted in the fabric base. The brush bristles may be formed of a conductive material such as nylon or acrylic in which conductive particles are kneaded. Each of the sponge roller 938 and the brush roller 932 is rotated by a driving device in the direction of the arrow. The adsorption bias voltage to be applied to the sponge roller 938 is set to a polarity opposite to a charged polarity of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 930, and the sponge roller 938, the brush roller 932 and the metal rod 936 are charged to the same polarity as the polarity of the adsorption bias voltage. This enables the sponge roller 938 to electrostatically adsorb the remaining toner particles from the surface of the intermediate transfer belt 31. The toner particles adsorbed onto the outer peripheral surface of the sponge roller 938 are subsequently scraped by the brush roller 932 and rotated in a state where they are adsorbed onto the outer peripheral surface of the brush roller 932, and additionally, the toner particles are knocked off by the metal rod 936 from the outer peripheral surface of the brush roller 932. The metal rod 936 may be formed of a material such as stainless steel, nickel-plated iron or nickel-plated aluminum. In some examples, the metal rod 936 may have a rounded cross-sectional shape (for example, a circular or oval cross-section). This enables the metal rod 936 to remove toner particles from the outer peripheral surface of the brush roller 932 without damaging the brush roller 932. The cleaning device 900 may further have a voltage source such as the voltage source 250 shown in Fig.

2B. In the example of Fig. 8, the voltage source 934 is configured so as to apply an adsorption bias voltage to the sponge roller 938. However, in another example, the voltage source 934 may be configured to apply an adsorption bias voltage to the metal rod 936, or may be configured to apply an adsorption bias voltage to the brush roller 932. For example, the voltage source 934 may be configured so as to apply an adsorption bias voltage to at least one among the sponge roller 938, the brush roller 932 and the metal rod 936. In addition, the rotational direction of the brush roller 932 may be opposite to the direction illustrated in the figure. In such a configuration, the scraper 936 may be disposed, for example, at an opposite side of the brush roller 932, relative to the position illustrated in Fig. 8. The rotational direction of the sponge roller 938 may be also opposite to the direction illustrated in the figure. Other components of the cleaning device 900 that are similar to components of the cleaning device 100, are indicated by reference numbers obtained by adding 800 to the respective reference numbers of the corresponding components of the cleaning device 100, and overlapping description thereof is omitted.

[0034] Fig. 9 shows a cleaning device 1000 for the intermediate transfer belt 31 according to another example, which is similar to the cleaning device 300 shown in Fig. 3A. The cleaning device 1000 is different from the cleaning device 300 in that an electrostatic cleaning mechanism (or electrostatic device) 1030 includes a sponge roller 1038 disposed in contact with the outer peripheral surface of the intermediate transfer belt 31, a brush roller 1032 disposed in contact with an outer peripheral surface of the sponge roller 1038, a metal rod 1036 disposed in contact with the brush roller 1032, and a voltage source 1034 to apply an adsorption bias voltage to the sponge roller 1038. In some examples, the sponge roller 1038

may include a cylindrical cored bar and an elastic material layer formed on an outer peripheral surface thereof. The elastic material layer may be formed of a conductive material such as conductive polyurethane foam. In one example, the brush roller 1032 may include a cylindrical cored bar, a fabric base bonded to an outer peripheral surface thereof, and brush bristles transplanted in the fabric base. The brush bristles may be formed of a conductive material such as nylon or acrylic in which conductive particles are kneaded. Each of the sponge roller 1038 and the brush roller 1032 is rotated by a driving device in the direction of the arrow. The adsorption bias voltage to be applied to the sponge roller 1038 is set to a polarity opposite to a charged polarity of remaining toner particles to be conveyed to the electrostatic cleaning mechanism 1030. The sponge roller 1038, the brush roller 1032 and the metal rod 1036 are charged to the same polarity as the polarity of the adsorption bias voltage. This enables the sponge roller 1038 to electrostatically adsorb the remaining toner particles from the surface of the intermediate transfer belt 31. The toner particles adsorbed onto the outer peripheral surface of the sponge roller 1038 are subsequently scraped by the brush roller 1032 and rotated in a state where they are adsorbed onto the outer peripheral surface of the brush roller 1032. Additionally, the toner particles are knocked off by the metal rod 1036 from the outer peripheral surface of the brush roller 1032. The metal rod 1036 may be formed of a material such as stainless steel, nickel-plated iron or nickel-plated aluminum. In some examples, the metal rod 1036 may have a rounded cross-sectional shape (for example, a circular or oval cross-section). This enables the metal rod 1036 to remove toner particles from the outer peripheral surface of the brush roller 1032 without damaging the brush roller 1032. The cleaning device 1000 may further have a voltage source

such as the voltage source 450 shown in Fig. 3B. In the example of Fig. 9, the voltage source 1034 is configured so as to apply an adsorption bias voltage to the sponge roller 1038. However, in another example, the voltage source 1034 may be configured so as to apply an adsorption bias voltage to the metal rod 1036, or may be configured so as to apply an adsorption bias voltage to the brush roller 1032. For example, the voltage source 1034 may be configured so as to apply an adsorption bias voltage to at least one among the sponge roller 1038, the brush roller 1032 and the metal rod 1036. In addition, the rotational direction of the brush roller 1032 may be opposite to the direction illustrated in the figure. In such a configuration, the metal rod 1036 may be disposed, for example, at an opposite side of the brush roller 1032, relative to the position illustrated in Fig. 9. The rotational direction of the sponge roller 1038 may be also opposite to the direction illustrated in the figure. Other components of the cleaning device 1000 that are similar to components of the cleaning device 300, are indicated by reference numbers obtained by adding 700 to the respective reference numbers of the corresponding components of the cleaning device 300, and overlapping description thereof is omitted.

[0035] Cleaning operation of a transfer conveyance belt

The expression "transfer conveyance belt" may refer to an endless belt that conveys a print medium to a position between a photosensitive drum and a transfer roller, for example, when a toner image is directly transferred from the photosensitive drum to the print medium. The transfer conveyance belt conveys the print medium toward a subsequent device (for example, a fixing device) after the transferring of the toner image. A transfer conveyance belt has an outer peripheral surface formed of an elastic material such as urethane and is able to

convey a print medium in a state where the print medium is adhered to an outer peripheral surface of the transfer conveyance belt. In a color image forming apparatus, a transfer conveyance belt is configured to carry a toner image on its outer peripheral surface in order to correct color misregistration. The above-described example cleaning devices 100, 200, 300, 400, 500, 600, 700, 800, 900 and 1000 for an "intermediate transfer belt" can be implemented as a cleaning device for a "transfer conveyance belt", as such a transfer conveyance belt may have the same or a similar structure as an intermediate transfer belt, as will be described.

[0036] As one example of a transfer conveyance belt, Fig. 10A shows a transfer conveyance belt 131 in a single-color (or monochrome) image forming apparatus that directly transfers a toner image from a photosensitive drum 144 to a print medium P. The transfer conveyance belt 131 is suspended between two suspension rollers 137, 138. The suspension roller 137 is a driving roller to enable the transfer conveyance belt 131 to rotate in the direction of the arrow. The transfer roller 139 is disposed in contact with an inner peripheral surface of the transfer conveyance belt 131 in such a manner as to face the photosensitive drum 144. The transfer conveyance belt 131 supports a rear surface of the print medium P and therefore, the transfer conveyance belt 131 does not make direct contact with a toner image on the photosensitive drum 144 during printing operation. However, factors other than printing operations (for example, paper jam) may generate adhesion of toner or carrier on an outer peripheral surface of the transfer conveyance belt 131, which may thereby cause staining. Thus, it may be necessary to clean the adhered toner from the transfer conveyance belt 131. All of the above-exemplified cleaning devices 100, 200, 300, 400, 500, 600,

700, 800, 900 and 1000 for an intermediate transfer belt can be implemented as a cleaning device for the transfer conveyance belt 131.

[0037] As one example of a transfer conveyance belt, Fig. 10B shows a transfer conveyance belt 231 in a color image forming apparatus, in which toner images of four colors are directly combined on a print medium. The transfer conveyance belt 231 is suspended between two suspension rollers 237, 238. The suspension roller 237 is a driving roller to enable the transfer conveyance belt 231 to rotate in the direction of the arrow. Four transfer rollers 232Y, 232M, 232C, 232K are disposed in contact with an inner peripheral surface of the transfer conveyance belt 231 in such a manner as to face photosensitive drums 240Y, 240M, 240C, 240K, respectively. The transfer conveyance belt 231 supports a rear surface of the print medium and therefore, during printing operation, the transfer conveyance belt 231 may not directly contact a toner image on the photosensitive drums 240Y, 240M, 240C, 240K. However, factors other than printing operations (for example, paper jam) may generate adhesion of toner or carrier on an outer peripheral surface of the transfer conveyance belt 231, which may thereby cause staining. Accordingly, it may be necessary to clean the adhered toner from the transfer conveyance belt 231. In addition, for correction of color misregistration, a color image forming apparatus may directly transfer a toner band of YMCK on the transfer conveyance belt 231 and read it by a sensor. Thus, after correction of color misregistration, toner used for the correction of color misregistration is to be cleaned before printing. All of the above-described example cleaning devices 100, 200, 300, 400, 500, 600, 700, 800, 900 and 1000 for an intermediate transfer belt can be implemented as a cleaning device for the transfer conveyance belt 231.

[0038] It is to be understood that not all aspects, advantages and features described herein may necessarily be achieved by, or included in, any one particular example. Indeed, having described and illustrated various examples herein, it should be apparent that other examples may be modified in arrangement and detail is omitted.

CLAIMS

1. A cleaning device for an endless belt in an image forming apparatus, comprising:

at least one magnet disposed adjacent an inner peripheral surface of the endless belt; and

an electrostatic device disposed in contact with an outer peripheral surface of the endless belt, downstream the at least one magnet, in a travelling direction of the endless belt.

2. The cleaning device according to claim 1, comprising one sliding member between each of the at least one magnet and the inner peripheral surface of the endless belt.

3. The cleaning device according to claim 1, wherein each of the at least one magnet includes at least one yoke.

4. The cleaning device according to claim 3,
wherein each of the at least one magnet has magnetic poles at opposite ends of the magnet, in the travelling direction of the endless belt, and
wherein the at least one yoke comprises two yokes disposed adjacent the opposite ends, respectively, in each of the at least one magnet.

5. The cleaning device according to claim 3,
wherein each of the at least one magnet has magnetic poles at opposite

ends of the magnet, in a direction perpendicular to the endless belt,

wherein each of the at least one magnet has a rear face located opposite the endless belt, and side faces extending from the rear face toward the endless belt, and

wherein the at least one yoke comprises a cap-shaped yoke covering the rear face and the side faces of each of the at least one magnet.

6. The cleaning device according to claim 1,

wherein the electrostatic device includes:

a hard roller disposed in contact with the outer peripheral surface of the endless belt;

a scraper disposed in contact with an outer peripheral surface of the hard roller; and

a first voltage source to apply a bias voltage to at least one among the hard roller and the scraper.

7. The cleaning device according to claim 1,

wherein the electrostatic device includes:

a brush roller disposed in contact with the outer peripheral surface of the endless belt;

a hard roller disposed in contact with an outer peripheral surface of the brush roller;

a scraper disposed in contact with an outer peripheral surface of the hard roller; and

a first voltage source to apply a bias voltage to at least one of the

brush roller, the hard roller and the scraper.

8. The cleaning device according to claim 1,
wherein the electrostatic device includes:

a sponge roller disposed in contact with the outer peripheral surface of the endless belt;

a hard roller disposed in contact with an outer peripheral surface of the sponge roller;

a scraper disposed in contact with an outer peripheral surface of the hard roller; and

a first voltage source to apply a bias voltage to at least one among the sponge roller, the hard roller and the scraper.

9. The cleaning device according to claim 1,
wherein the electrostatic device includes:

a brush roller disposed in contact with the outer peripheral surface of the endless belt;

a metal rod disposed in contact with an outer peripheral surface of the brush roller; and

a first voltage source to apply a bias voltage to at least one among the brush roller and the metal rod.

10. The cleaning device according to claim 1,
wherein the electrostatic device includes:

a sponge roller disposed in contact with the outer peripheral

surface of the endless belt;

a brush roller disposed in contact with an outer peripheral surface of the sponge roller;

a metal rod disposed in contact with an outer peripheral surface of the brush roller; and

a first voltage source to apply a bias voltage to at least one of the sponge roller, the brush roller and the metal rod.

11. The cleaning device according to claim 1, wherein the at least one magnet comprises at least one permanent magnet.

12. The cleaning device according to claim 1, comprising a second voltage source to apply a charging bias voltage to each of the at least one magnet.

13. The cleaning device according to claim 1, comprising:

a carrier box disposed above the endless belt, upstream the at least one magnet, in the travelling direction of the endless belt, to store carrier particles to be supplied to the outer peripheral surface of the endless belt.

14. An image forming device, comprising:

a cleaning device including:

at least one magnet disposed adjacent an inner peripheral surface of the an endless belt of the imaging forming device, in order to attract carrier particles to an outer peripheral surface of the endless belt; and

an electrostatic device disposed in contact with an outer

peripheral surface of the endless belt, downstream the at least one magnet, in a travelling direction of the endless belt, in order to remove toner particles having been charged by the carrier particles.

15. The image forming device according to claim 14, wherein the endless belt is an intermediate transfer belt or a transfer conveyance belt.

Fig.1

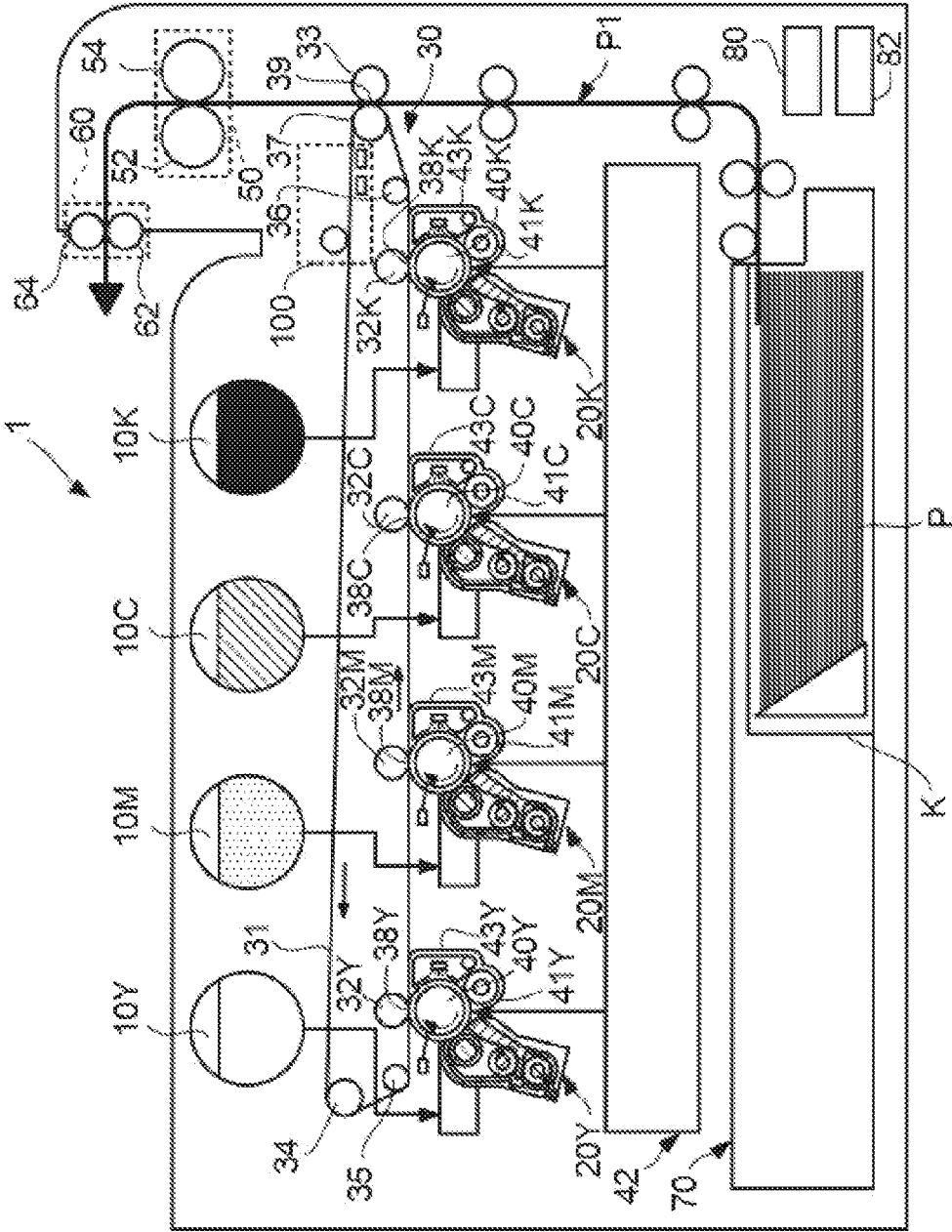


Fig. 2A

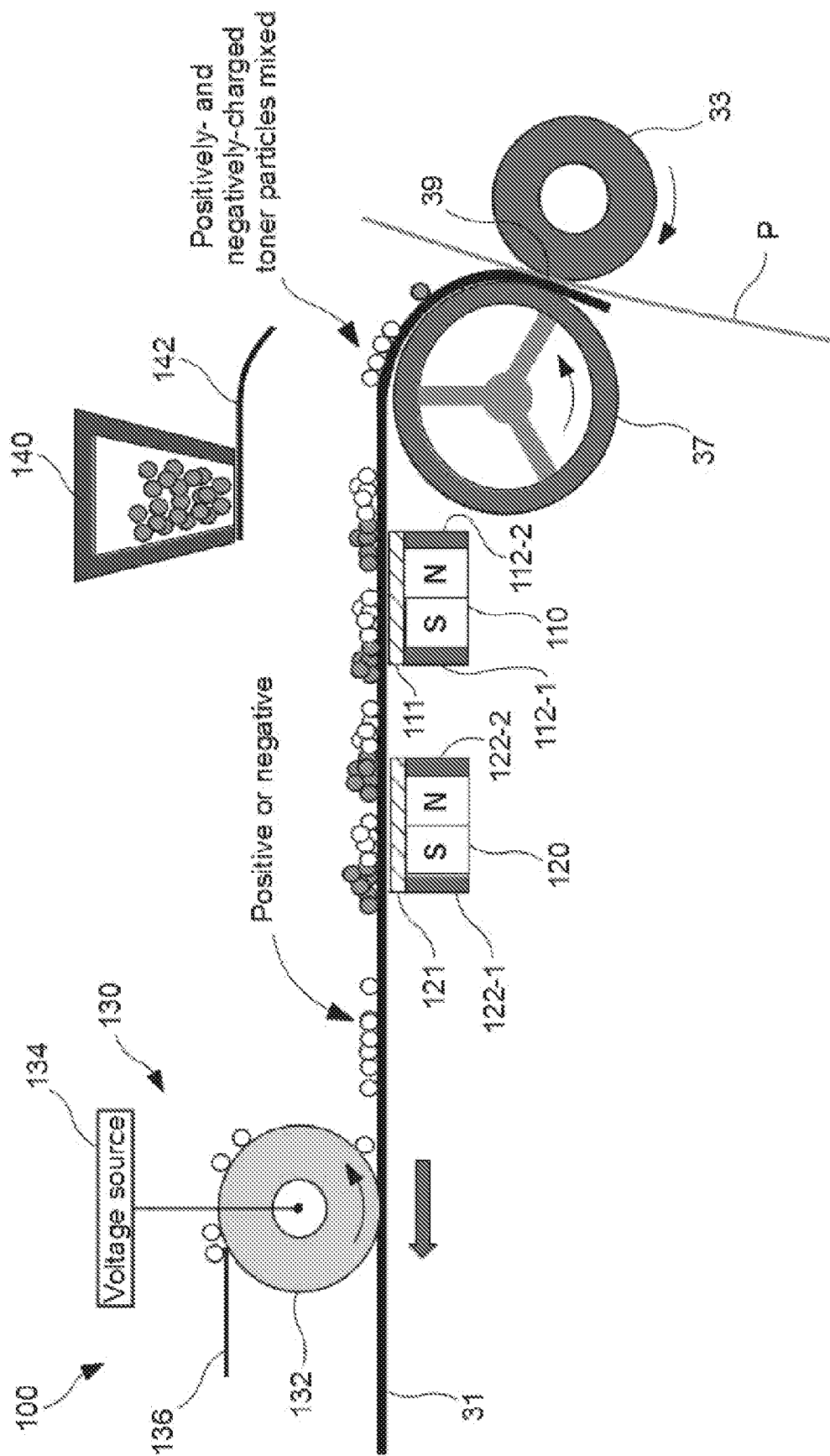


Fig.2B

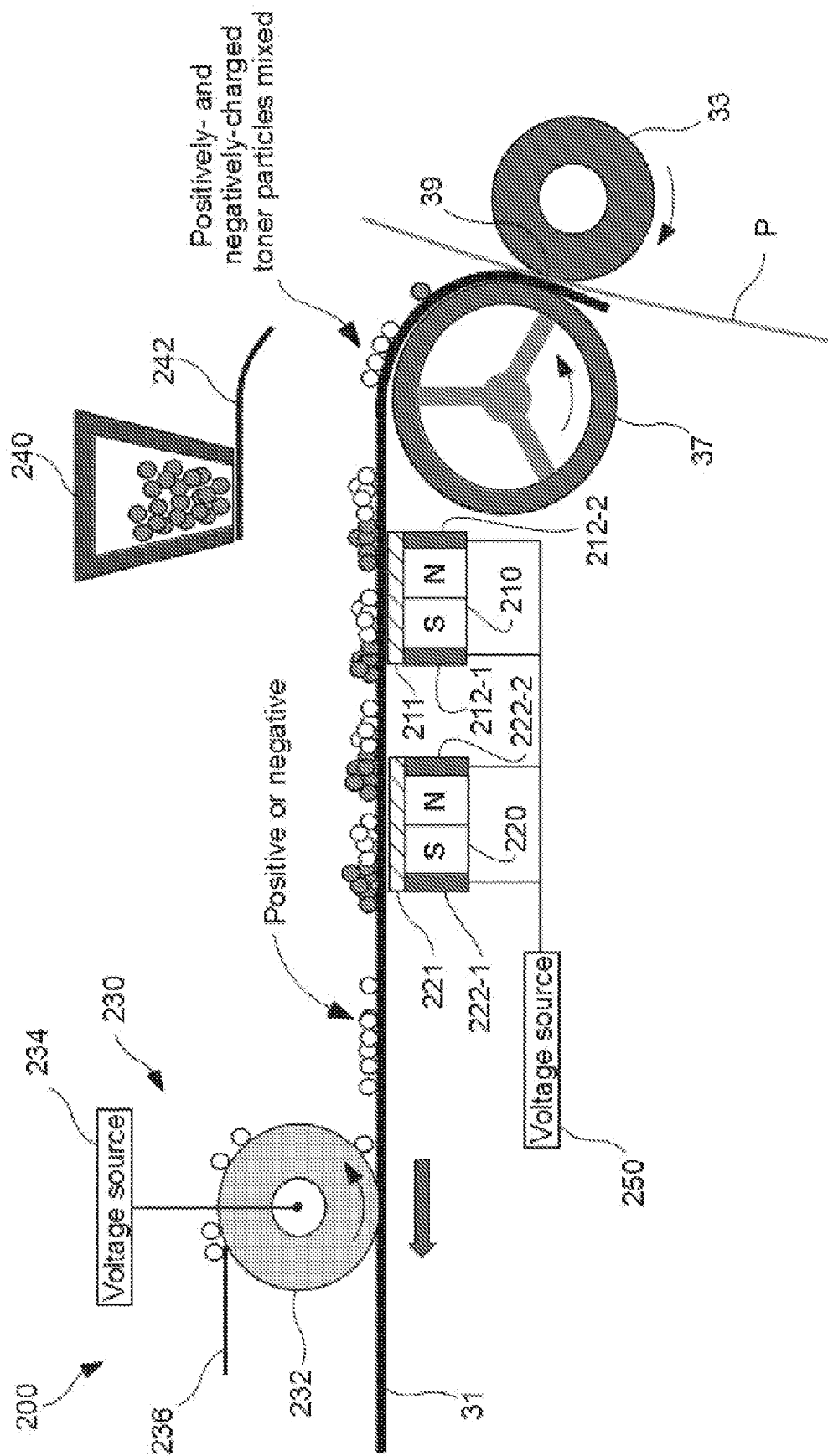


Fig.3A

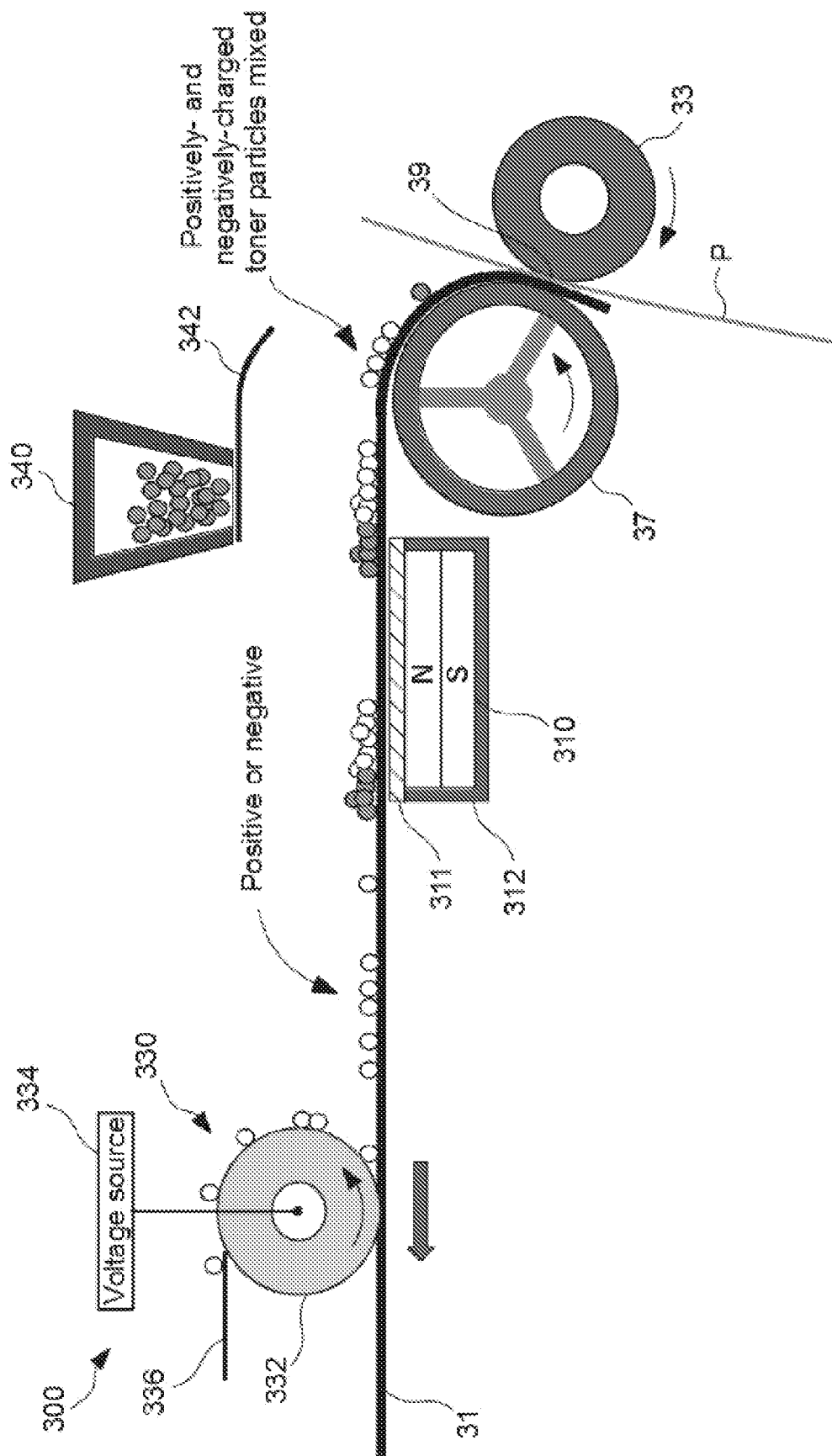


Fig.3B

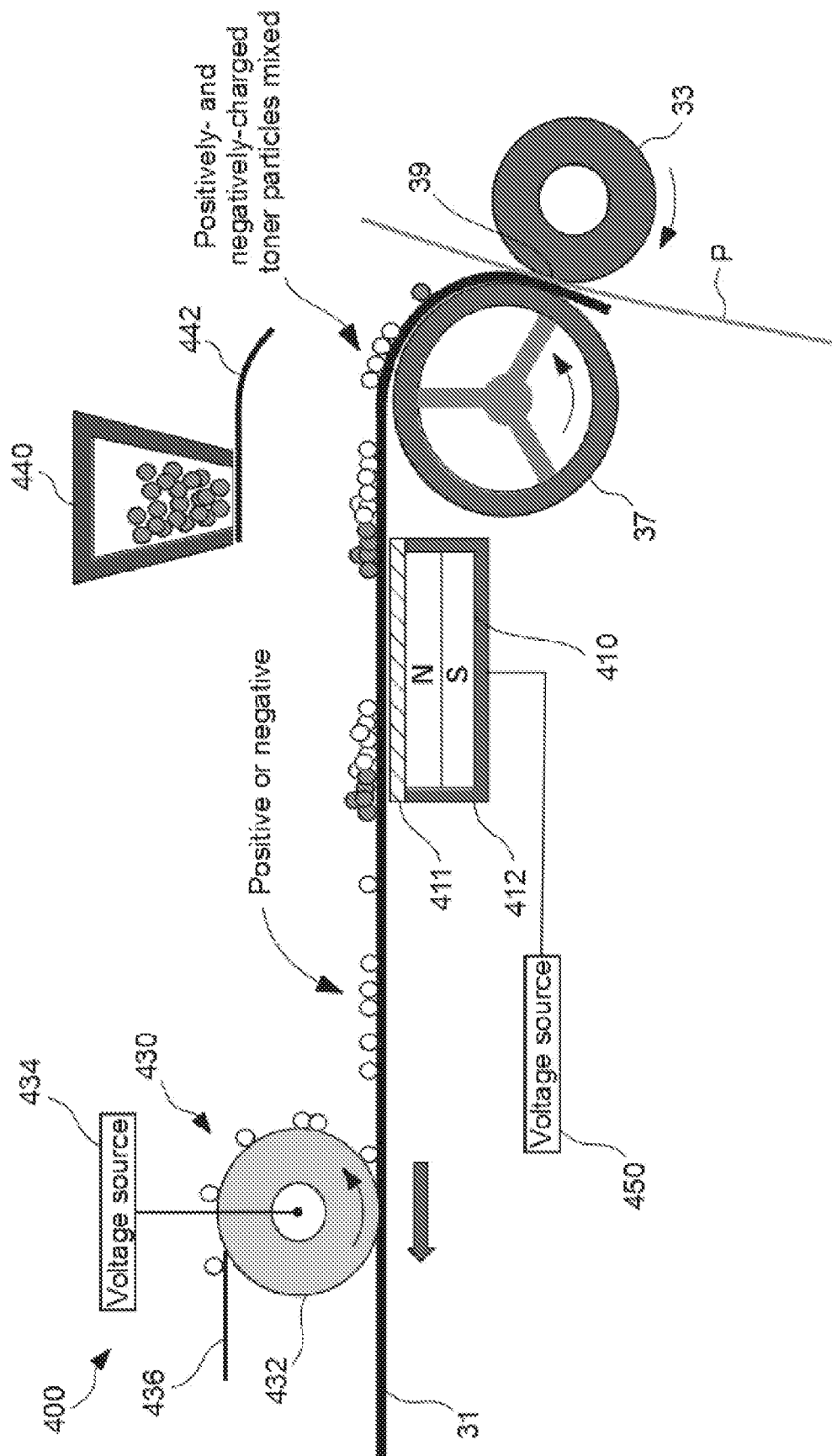


Fig.4

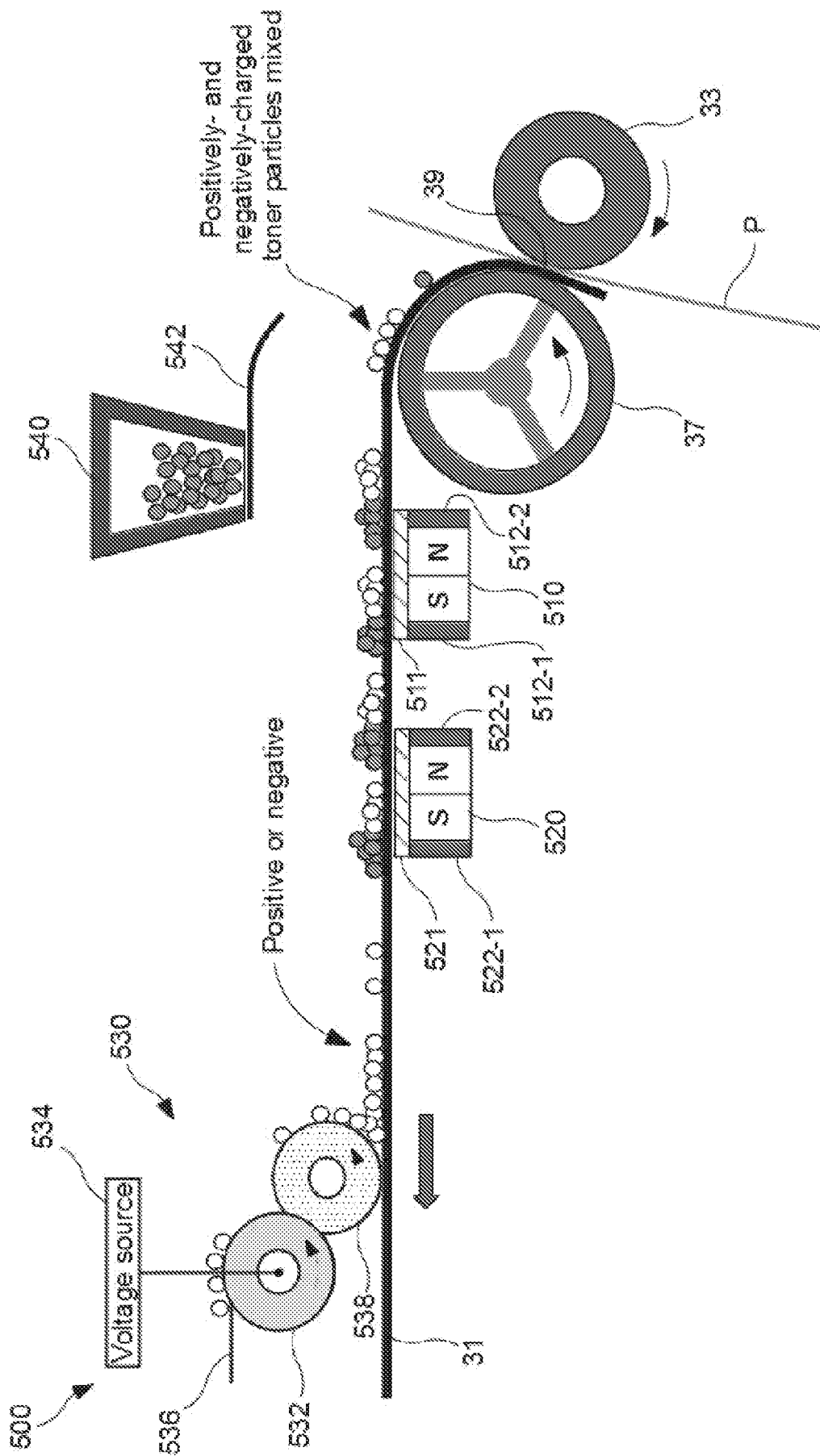


Fig. 5

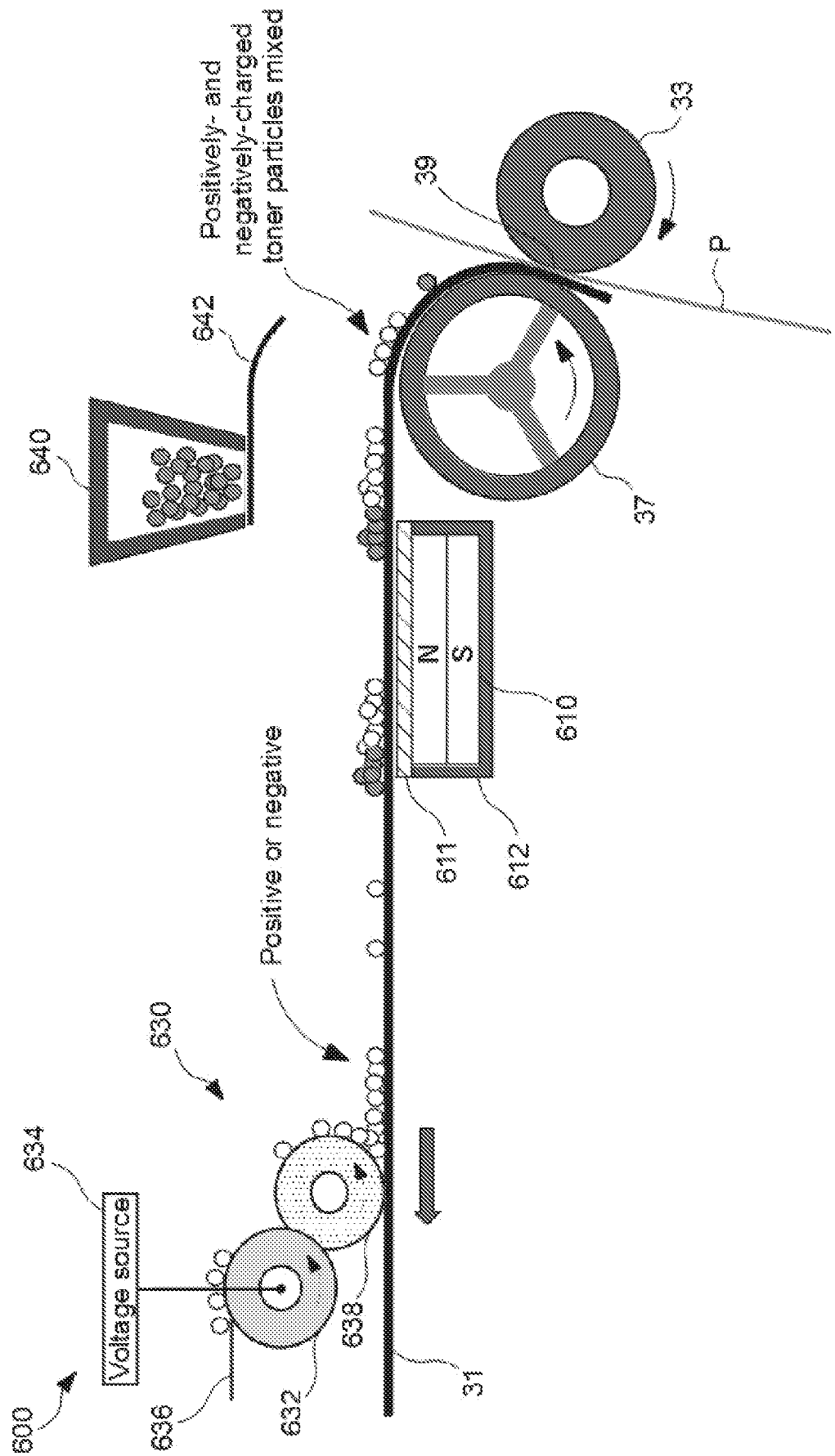


Fig. 6

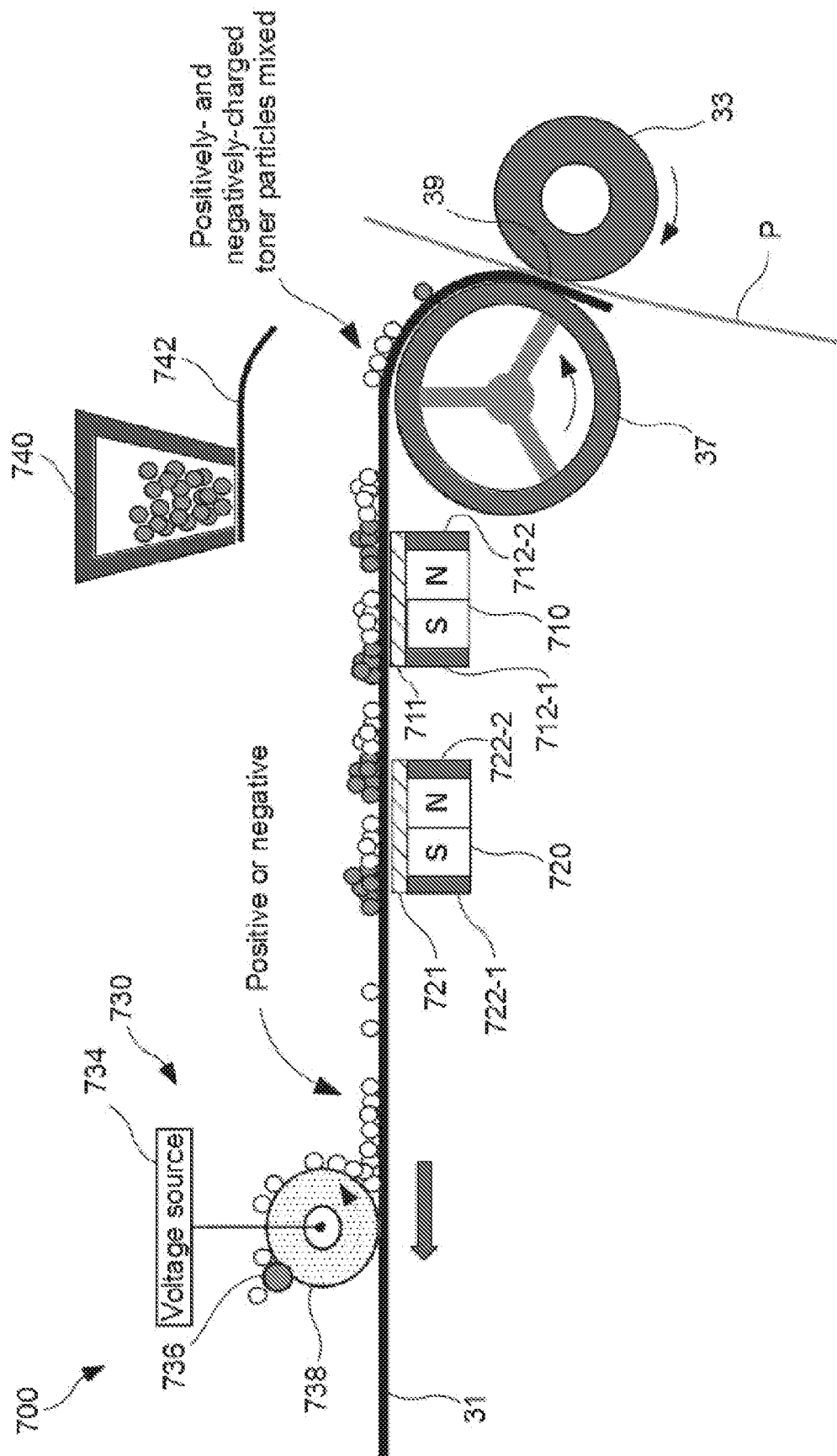


Fig.7

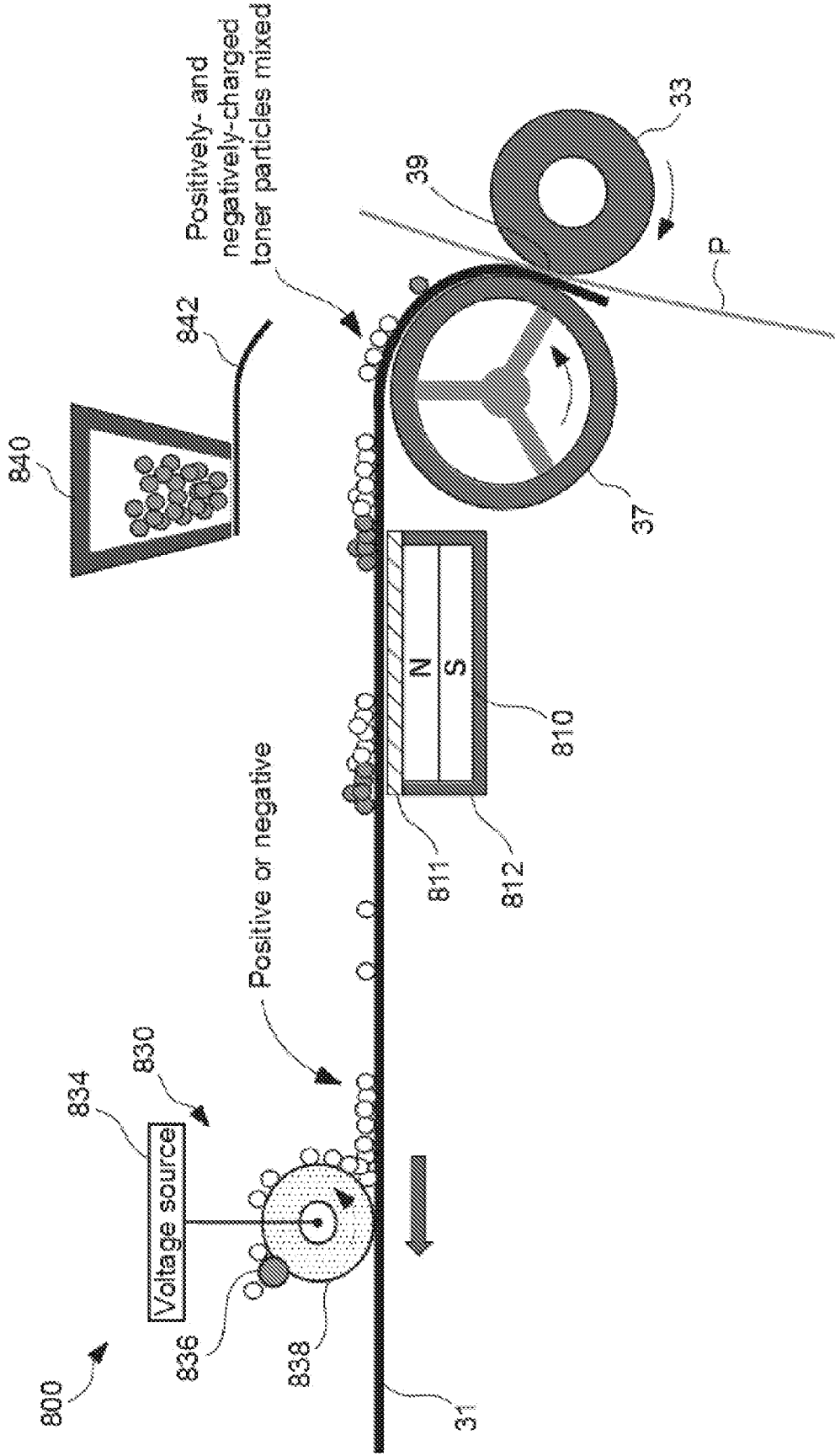


Fig.8

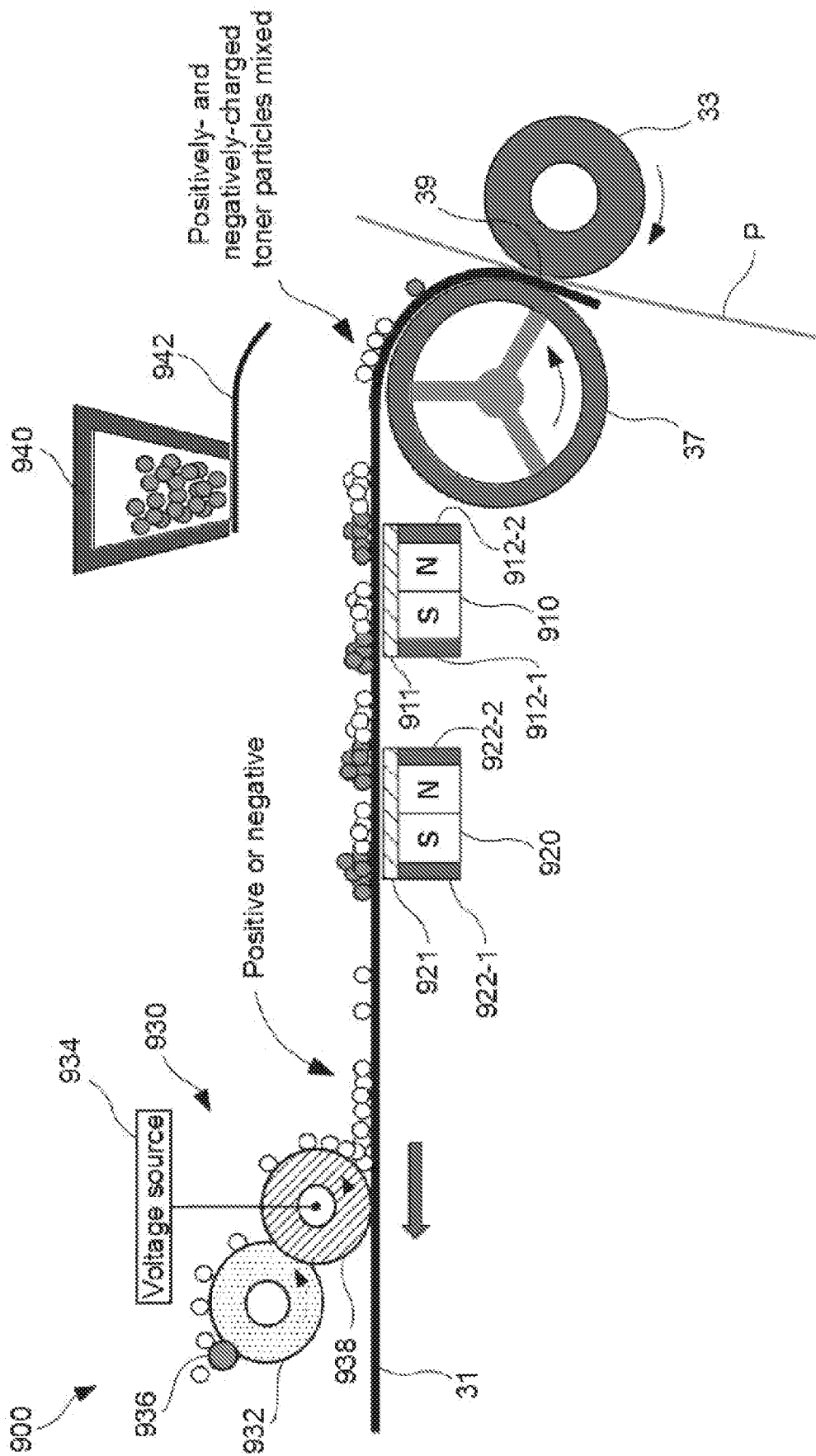
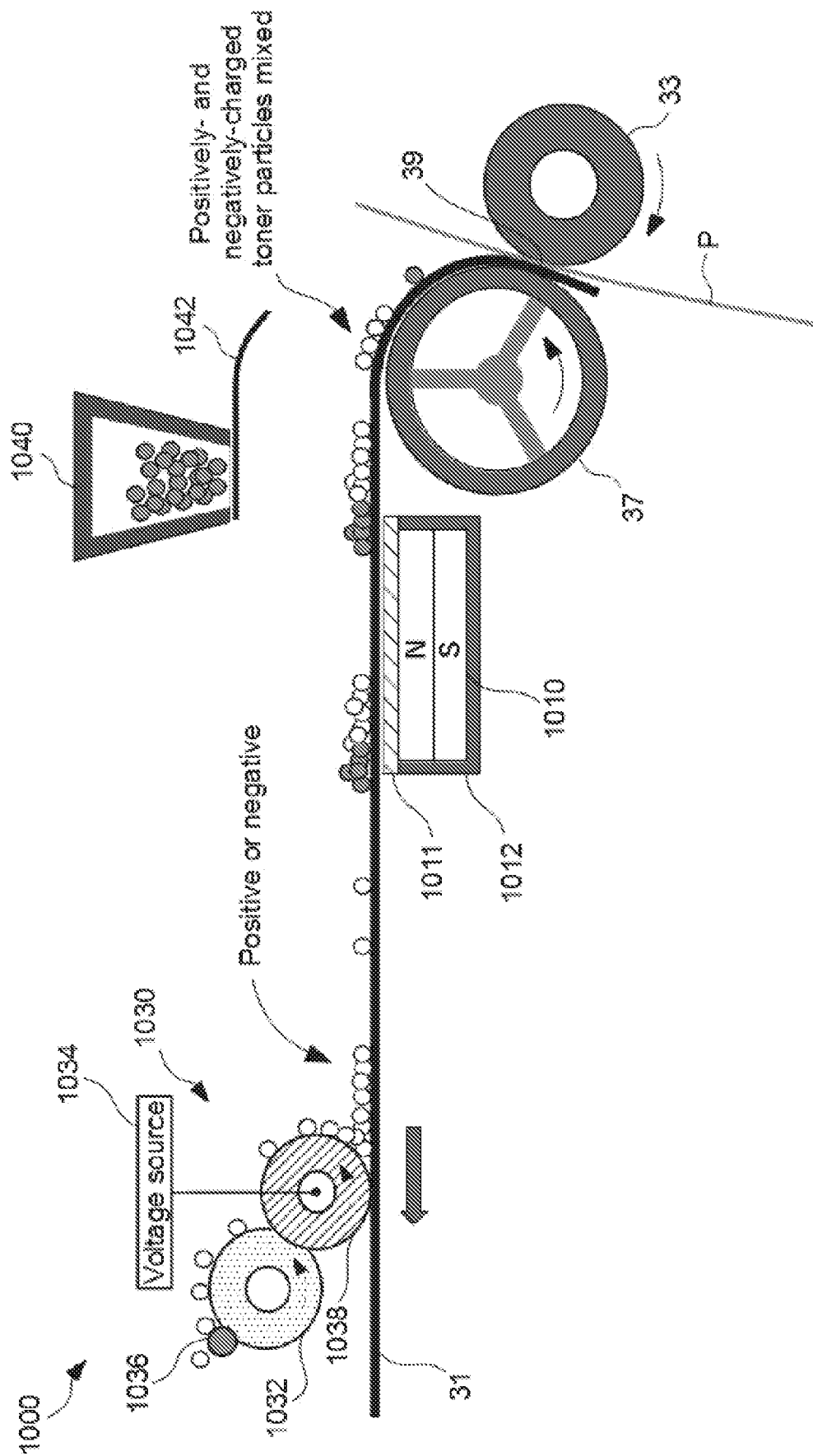


Fig.9



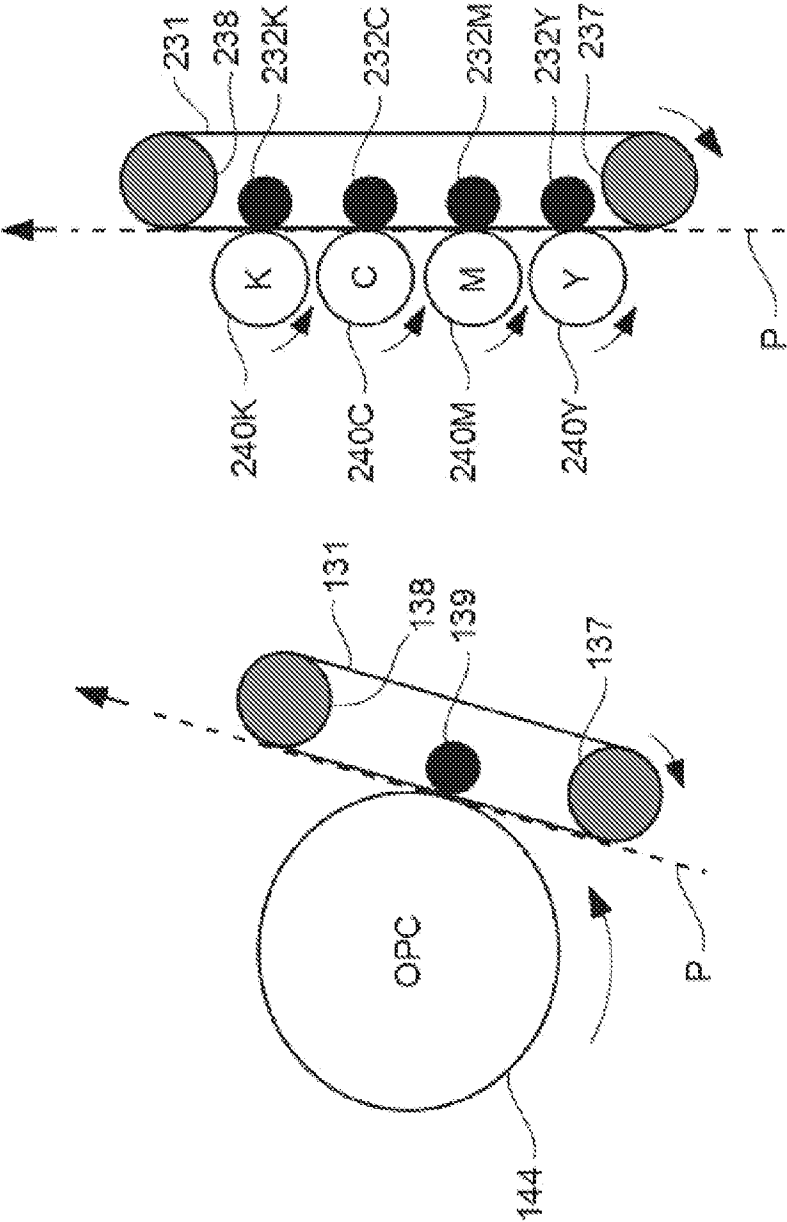


Fig.10B

Fig.10A

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2021/035172

A. CLASSIFICATION OF SUBJECT MATTER <i>G03G 15/095 (2006.01)</i>		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) G03G		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSearch (RUPTO internal), USPTO, PAJ, K-PION, Esp@cenet, Information Retrieval System of FIPS		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005017869 A (RICOH CO LTD) 20.01.2005, paragraphs [0011], [0070], [0071], [0073], fig. 2, 12	1-3, 14, 15
Y		11, 13
A		4-10, 12
Y	US 4556890 A (XEROX CORPORATION) 03.12.1985, fig. 1	11, 13
A	JP 2001305876 A (CANON INC) 02.11.2001	1-15
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search 30 August 2021 (30.08.2021)	Date of mailing of the international search report 02 September 2021 (02.09.2021)	
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