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(71) Applicant: EASTMAN KODAK COMPANY [US/US];
343 State Street, Rochester, NY 14650 (US).(72) Inventor: RANDALL, Kent, Allen ; 816 Westwood Trail,
Webster, NY 14580 (US).(74) Agent: TREASH, Leonard, W., Jr.; 343 State Street, Ro-
chester, NY 14650-2201 (US).

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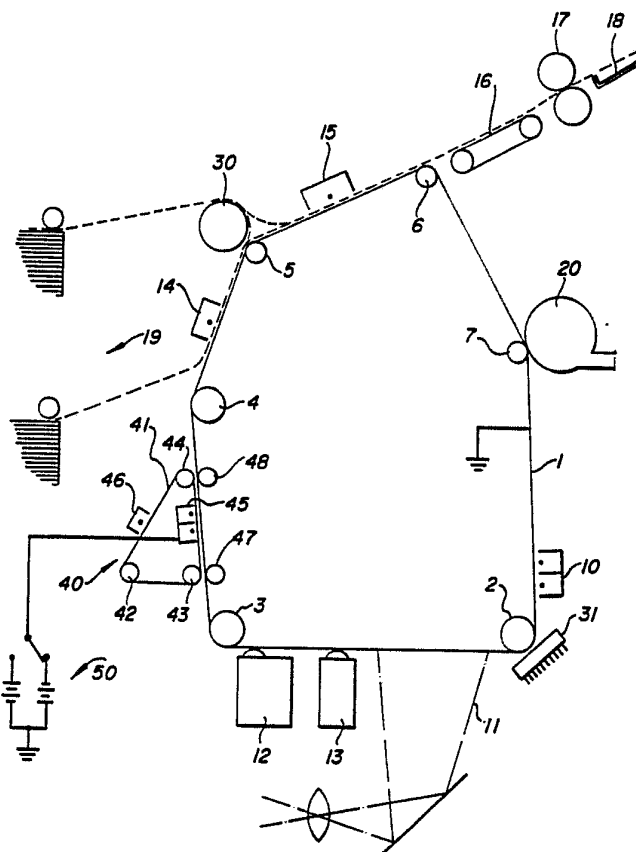
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(54) Title: A METHOD AND APPARATUS OF FORMING COMBINED TONER IMAGES

(57) Abstract

Toner images are combined for later transfer to a receiving sheet by forming first and second toner images on an image member (1) and transferring the first toner image to an intermediate member (41; 54). The first toner image is transferred back to the image member in registration with a second toner image to form a combined toner image.



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⁺ Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

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A METHOD AND APPARATUS OF FORMING
COMBINED TONER IMAGES

FIELD OF THE INVENTION

5 This invention relates to the formation of toner images which are a combination of previously formed toner images.

BACKGROUND ART

10 Present commercial apparatus has the capability of combining images in copying or printing. For example, a textural image can be combined with suitable graphics or pictorials to form a single image having both text and graphics and/or pictorials. Similarly, a single color original can
15 be reproduced with certain portions highlighted by reproduction in a different color from the rest of the reproduction. A related capability breaks down a multicolor original into its component colors and reproduces that original.

20 In attaining all of the above results using electrostatic imaging, the most common commercial approach is to create two or more toner images on a single image member and then to transfer them in registration to a receiving sheet to form a combined
25 toner image.

 In apparatus that function primarily as a single color, office copier or printer, the most common way of presenting a receiving sheet to a plurality of toner images is to feed the sheet back
30 to the image member along a path normally used for duplex. One inversion is added or subtracted to the duplex path to present the side of the sheet already holding an image to receive a second image. With this system, registration of combined images is
35 dependent upon accurate cross track, in-track and

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skew registration of the receiving sheet
recirculation mechanism. Very high quality
registration has not been obtainable with this
system. Acceptable registration generally requires a
5 more sophisticated receiving sheet handling mechanism
then is used in an ordinary duplex path. Results are
also adversely affected by repeated passes of the
receiving sheet through a fuser.

The most commonly used approach for
10 combining three or more single color images to make a
high quality multicolor image is to attach the
receiving sheet to a transfer drum and rotate it
repeatedly through transfer relation with the image
member to superpose the images on the receiving
15 sheet. The transfer drum and its sheet attaching
mechanism are quite expensive and represent difficult
technology to accomplish. When successfully
implemented, they provide high-quality registration
of the images being combined. The results are
20 sufficiently good that the expense of a transfer drum
is sometimes undertaken to obtain highest quality in
highlight color applications.

A number of references suggest that images
can be combined by transferring them in registration
25 to an intermediate transfer member, for example, a
drum or a web from which they are transferred to a
receiving sheet. See, for example, U.S. Patent
4,712,906, Bothner et al, issued December 15, 1987,
which describes a multicolor imaging approach in
30 which ledger-size images are transferred to an
intermediate drum or web having a circumference large
enough to handle a ledger-size image with its long
dimension in the in-track direction. Letter-size
images are positioned with their short dimension in
35 the in-track direction transferring two letter-size

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images in the same space as a single ledger-size image.

U.S. Patent 4,714,939, Ahern et al, issued December 22, 1987, is representative of a number of
5 references which show a method of making duplex copies in which a first image is transferred to an intermediate and a receiving sheet is fed between the intermediate and the original image member while images are transferred from the intermediate and the
10 image member to opposite sides of the single sheet. See also, U.S. Patent 4,688,925, Randall, issued August 25, 1987.

STATEMENT OF THE INVENTION

It is an object of the invention to provide
15 a method and apparatus for combining toner images which has good registration but without the expense and technical problems of a transfer drum with a sheet holding mechanism.

These and other objects are accomplished by
20 forming a plurality of toner images on an image member, transferring one or more of those toner images to an intermediate member and then transferring the one or more images back to the image member in registration with another toner image to
25 form a combined toner image on the original image member. The combined toner image may then be transferred in one step to a receiving sheet, or otherwise utilized.

This approach provides registration
30 comparable to that of tacking a receiver sheet to a rotating transfer drum. It is considerably less expensive than the rotating transfer drum. It permits the utilization of the ordinary transfer mechanism of a copier or printer in transferring
35 images to a receiving sheet. That is, the receiving

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sheet need not be capable of being attached to a transfer drum. It lends itself to any duplexing system, including single pass duplexing of several types.

5 Any two or more toner images that can be formed on an image member can be combined in this manner. For example, two images of the same color from different originals can be combined into a single combined toner image. Two images from the
10 same or different originals can be made in different colors and combined to make a two or more color combined toner image. Toner images formed by different means, for example, electronic and optical means can be combined into a single image. Two
15 images of the same color, but of different characteristics, for example, magnetic and non-magnetic, can also be combined.

 In this invention, the intermediate member performs the function of an image buffer which
20 positions the image back on the image member but at a different location. The intermediate member can be either an endless web or a drum. Preferably, it should be equal in length to the pitch of the images. However, modern copiers and printers produce
25 a variety of sizes of outputs, including both letter-size and ledger-size outputs. In such environments, according to a preferred embodiment, the intermediate member can have a circumference equal to the pitch of ledger-size images with the
30 long dimension in the in-track direction. Letter-size images can then be formed with the short dimension in the in-track direction, forming two letter-size combined images in the same space that one ledger-size image is formed.

35 BRIEF DESCRIPTION OF THE DRAWINGS

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In the detailed description of the preferred embodiment of the invention presented below, reference is made to the accompanying drawings, in which:

5 Fig. 1 is a side schematic of an electrophotographic apparatus for carrying out the invention.

10 Fig. 2 is a side schematic of a portion of an electrophotographic apparatus comparable to that shown in Fig. 1 but illustrating an alternative embodiment of the invention.

15 Fig. 3 is a side schematic similar to Fig. 1, but illustrating a different duplexing scheme in combination with the invention than that shown in Fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows an electrophotographic apparatus for making copies or prints either optically or electronically. According to Fig. 1, an image member, for example, an endless photoconductive belt 1, is trained about a series of rollers 2, 3, 4, 5, 6 and 7. One of the rollers is driven to drive the image member 1 past a series of electrophotographic stations, most of which are conventional.

25 In normal, conventional operation, image member 1 is uniformly charged by a primary charging station 10 and imagewise exposed at an exposure station 11 to create an electrostatic image. The electrostatic image is toned by a black (or other color) toner station 12 to create a toner image and the toner image is transferred to a receiving sheet at a simplex transfer station 15. The receiving sheet is fed from a receiving sheet supply 19 to transfer station 15. It is separated from image

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member 1 as image member 1 goes around small roller 6 and is transported by a belt transport 16 to a fuser 17 where the image is fused to the receiving sheet. The receiving sheet is finally deposited in an output tray 18. The image member is cleaned by a conventional cleaning device 20 for reuse.

In conventional single pass duplex operation, the receiving sheet is fed to a duplex transfer station 14 to receive a first toner image. It is turned over at a turnover station 30 and refed to simplex transfer station 15 to receive a second toner image on the opposite side. After separation at roller 6, a known duplex transport 16 transports the sheet to duplex fuser 17 without disturbing either unfixed toner image. Both toner images are fused simultaneously by duplex fuser 17, and the duplex copy is deposited in tray 18. Depending on the order of the images, the sheet may be turned over before depositing in the tray. This duplex method is known as "single pass" duplexing. It is characterized by a short receiving sheet path and a single fusing step for both images. However, it is difficult to adapt to conventional image combining systems.

To combine toner images according to the invention, a toner image buffer 40 is provided along the path of image member 1 between toning station 12 and transfer stations 14 and 15. Toner image buffer 40 is shown in Fig. 1 as an endless belt intermediate member 41 entrained about rollers 42, 43 and 44. Rollers 43 and 44 are directly opposite rollers 47 and 48 respectively backing image member 1 and assuring a close transfer relationship between intermediate member 41 and image member 1. An electrically reversible corona charger 45 backs a

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portion of intermediate member 41 which faces and is in transfer relationship with image member 1. A conditioning corona 46 is positioned adjacent intermediate member 41 at a position remote from
5 image member 1.

In operation, consecutive electrostatic images to be combined are formed by primary charger 10 and exposure station 11. Both electrostatic images can be toned by toning station 12 if a
10 single-color combined image is desired. However, for images combining two different toners, for example, magnetic and non-magnetic toners or to make two-color images, for example, in making highlight color reproductions, one image is toned by toner station 12
15 and a second image is toned by a toner station 13. Toner station 13 contains magnetic toner or highlight color toner.

The first toner image thus formed is transferred by reversible charger 45 to intermediate
20 member 41 as both intermediate member 41 and image member 1 are driven at equal speeds and in transfer relation. The first toner image is held by electrostatic forces created by the combination of charge on the toner image and charge from charger
25 45. This attraction is loosened by conditioning charger 46 which sprays a charge of polarity opposite that of the toner onto the image. Charger 46 can also be an AC charger appropriately biased to neutralize the forces holding the toner to
30 intermediate member 41. The first toner image approaches the image member 1 as the second toner image approaches intermediate member 41. The polarity on reversible charger 45 is reversed at a voltage source 50. The first toner image is
35 transferred back to image member 1 in registration

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with the second toner image to provide a combined toner image.

In simplex operation, the combined toner image is transferred to a receiving sheet at simplex transfer station 15 and the image is fused by fuser 17. In duplex operation, four toner images can be created on image member 1. The first toner image is transferred to intermediate member 41 and then transferred back in registration with the second toner image on primary image member 1. The third toner image, similar to the first toner image is transferred to the intermediate member 41 and then transferred back to primary image member 1 in registration with the fourth toner image. The combined first and second toner images are then transferred to the first side of a receiving sheet at duplex transfer station 14. The receiving sheet is turned over at turnover station 30 and the combined toner image made up of the third and fourth toner images is transferred to the other side of the receiving sheet at simplex transfer station 15. All four toner images, i.e., both combined toner images, are fused by duplex fuser 17 simultaneously. Thus, the advantages of single pass duplexing are realized with combined or multicolor images.

Images can be combined from different originals placed in the original plane (not shown), of exposure station 11. Images may be combined from the same original with different portions of the electrostatic image erased in the two images. To accomplish this, an LED printhead 31 is positioned opposite roller 2 and is connected to suitable electronics which are not shown, but are known, per se, to erase a portion of the image frame approaching exposure station 11, which portion of the frame is

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not to be imaged in one particular color. The rest of the frame would be erased in the next image to provide complementary charged image frames to exposure station 11. The two electrostatic images
5 formed by exposure station 11 would then be toned by stations 12 and 13 and combined at buffer 40 to form a combination image whose colors are defined by the charge erasing done at erasing printhead 31. Printhead 31 can also be used to electronically form
10 images. Thus, an image formed electronically by printhead 31 can be combined with an image formed optically by exposure station 11 again using image buffer 40. This approach can be used to electronically print letterheads or forms while
15 optically forming a varying text, graphics or other image. Another application could be to print text electronically and add pictorial or graphic information optically. Alternatively, optical exposure station 11 can be eliminated and all images
20 formed by printhead 31 converting the apparatus entirely to an electronic printer.

Three images may be combined by first transferring two images in registration to intermediate member 41 to create a combined image
25 which is a combination of those two images. The combined image is then transferred back to image member 1 in registration with another image to form a three-image combination. This approach can be used to form three-color images using a third toning
30 station, not shown, or to combine graphics and text from different originals and make portions of one of the other into two colors. Obviously, four or more images may also be combined.

Fig. 2 shows an alternative embodiment of
35 the image buffer 40. According to Fig. 2,

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intermediate belt 41 has been replaced by an intermediate drum 54 whose circumference is equal to the length of belt 41. As with image member 41, images are transferred from image member 1 to the
5 periphery of drum 54 and then transferred back to image member 1 in registration with subsequent images. Transfer is accomplished by biasing drum 54 with reversible voltage source 50. Image member 1 is backed by a grounded backing roller 55 opposite drum
10 54.

Intermediate image members 41 and 54 preferably have an in-track dimension equal to the pitch of the images formed on image member 1. However, modern copiers and printers image on a
15 variety of sizes of receiving sheets, including both ledger-size and letter-size sheets. To accommodate both sizes with greatest efficiency, intermediate members 41 and 54 can be equal in in-track dimension to the pitch of ledger-size images with their long
20 dimension positioned in the in-track direction. If letter-size images are then positioned with their shorter dimension in the in-track direction, two letter-sized images can be transferred to a single intermediate member 41 or 54 at a time. In this
25 approach, two letter-size images to be combined would be separated by another letter-size image area which may or may not be used.

Fig. 3 shows the image buffer 40 of Fig. 1 in apparatus having a different duplexing approach.
30 This approach is similar to that shown in U.S. 4,714,939 referred to above.

According to Fig. 3, consecutive combined or not combined images are formed on image member 1 as in Fig. 1. The first image passes under simplex
35 charger 15, which is turned off. It is transferred

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to a duplex intermediate member 100 using a transfer corona 117 or a transfer roller or bar opposite separation roller 6.

5 A receiving sheet is fed from supply 19 to
simplex transfer station 15 to receive the second
image on its bottomside. A separation or detack
charger 116 can be used to loosen the sheet for
separation from image member 1. The receiving sheet
separates from image member 1 as image member 1
10 passes around roller 6. It is electrostatically held
by duplex intermediate member 100. Transfer corona
117 can be turned off at this point. The first image
is transferred to the top side of the sheet by duplex
transfer charger 118. This transfer does not affect
15 the image on the bottom of the sheet, because the
image member 1 no longer contacts it and the image
has no where to go. The sheet can be
electrostatically loosened by separation corona 119
and is separated from member 100 as member 100 passes
20 around a small roller 121. If the location of duplex
fuser 17 permits, duplex intermediate member 100 can
be used to transport the sheet to the fuser 17,
eliminating an expensive duplex transport shown in
Fig. 1.

25 Note that if intermediate member 100 is a
single frame in circumference, it will have to make
an extra non-transferring rotation or cycle between
images if the next image is a combined one. This is
because there will be a frame from which an image has
30 been combined to the following frame between
transferrable toner images. If the second image is
not combined, no such extra cycle is necessary. If
member 100 is two frames in circumference,
appropriate skip frames will have to be made in
35 exposure when doing uncombined images, but no such

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extra cycle of member 100 will be necessary even though the image transferred to the bottom of the receiving sheet is a combination of two images. Most flexibility is obtained if both buffer intermediate member 41 and duplex intermediate 100 are a single frame in length.

The Fig. 3 apparatus has the substantial advantage of a reliable, straight paper path in doing duplex. With the buffer 40, it adds a high registration combined image capability.

Although image member 1 is shown as an endless belt, it could also be in the form of a drum and work with a buffer intermediate member or duplex intermediate member which is either a belt or a drum.

Note that this approach combines images without altering the receiving sheet handling approach of the apparatus. Typically, a high volume copier or printer is operated a very high percentage of its time in a single color simplex or duplex mode. The receiving sheet path has not been altered from the optimum design. In Fig. 1, single pass duplexing is used, which is a system that has not been used with conventional image combining systems.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

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I Claim:

1. A method of forming combined toner images comprising:
 - 5 forming first and second toner images on an image member(1),
transferring said first image to an intermediate member(41, 54), and
transferring said first image back to said
10 image member(1) in registration with said second image to form a combined toner image on said image member.
2. The method according to claim 1
15 including the additional step of transferring the combined toner image to a receiving sheet.
3. The method according to claim 1
including the further step of transferring one or
20 more additional toner images to said intermediate member in registration with the first toner image and transferring said first and additional images back to said image member in registration with said second toner image.
25
4. The method according to claim 1 wherein said first and second toner images are formed by toning first and second electrostatic images with toners of different color.
30
5. Toner image-forming apparatus comprising:
an image member(1) movable through an endless path past a series of stations,
an intermediate member(41; 54) movable
35 through an endless path, a portion of said path

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bringing it into transfer relation with said image member,

means(10,11,31) for forming first and second electrostatic images on said image member,

5 means(12,13) for toning said electrostatic images to form first and second toner images,

means(45;55) for transferring said first toner image from said image member to said intermediate member,

10 means(45;55) for transferring said first toner image from said intermediate member back to said image member in registration with said second toner image to form a combined toner image of said first and second images on said image member.

15

6. Apparatus according to claim 5 further including means(14;15;118) for transferring said combined toner image to a receiving sheet.

20 7. Apparatus according to claim 5 further including means for forming an additional electrostatic image before forming said second electrostatic image and means for toning said additional electrostatic image to create an
25 additional toner image and means for transferring said additional toner image to said intermediate member in registration with said first toner image, said first and additional toner images being
transferred back to said image member in registration
30 with said second toner image in a single step.

8. Apparatus according to claim 5 wherein one of said electrostatic images is formed by optical exposure of said image member and the other
35 electrostatic image is formed by electronic exposure

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of said image member.

9. Apparatus according to claim 5 wherein
said intermediate member is an endless belt(41)
5 entrained about a plurality of rollers.

10. Apparatus according to claim 5 wherein
said intermediate member is a drum(54).

10 11. Apparatus according to claim 5
including a reversible field creating means(45; 55)
for first transferring a toner image from said image
member to said intermediate member and then
transferring said toner image back to said image
15 member.

12. Apparatus according to claim 5 wherein
said toning means includes a first toning means(12)
for applying a toner of a first color to said first
20 image and a second toning means(13) for applying a
toner of a second color to said second image.

13. A duplex imaging apparatus comprising:
an image member(1),
25 a duplex intermediate member(100),
means(10,11,31) for forming first and second
electrostatic images on said image member(1),
means(12,13) for toning said electrostatic
images to form first and second toner images on said
30 image member,
means(117) for transferring said first toner
image to said duplex intermediate member(100),
means for feeding a receiving sheet through
a path in which one side of said receiving sheet
35 passes through transfer relation with said image

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member(1) and the other side passes through transfer relation with said duplex intermediate member(100), and

means(15) for transferring said second toner
5 image from said image member to one side of a receiving sheet fed along said path and means(118) for transferring said first toner image from said duplex intermediate member to the other side of said receiving sheet, characterized in that said duplex
10 intermediate member(100) extends away from said image member(1) to transport a receiving sheet away from said image member and wherein said means(118) for transferring said first toner image to said receiving sheet is positioned to effect such transfer at a
15 position where said receiving sheet is not backed by said image member(1).

14. Apparatus according to claim 13 wherein said means(15) for transferring said second toner
20 image to said receiving sheet is positioned to transfer said second toner image where said receiving sheet is not backed by said duplex intermediate member(100).

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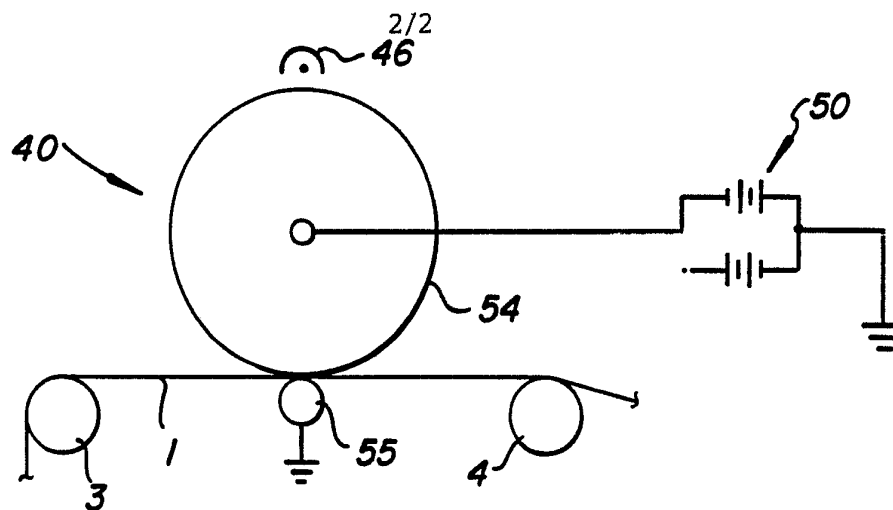


Fig. 2

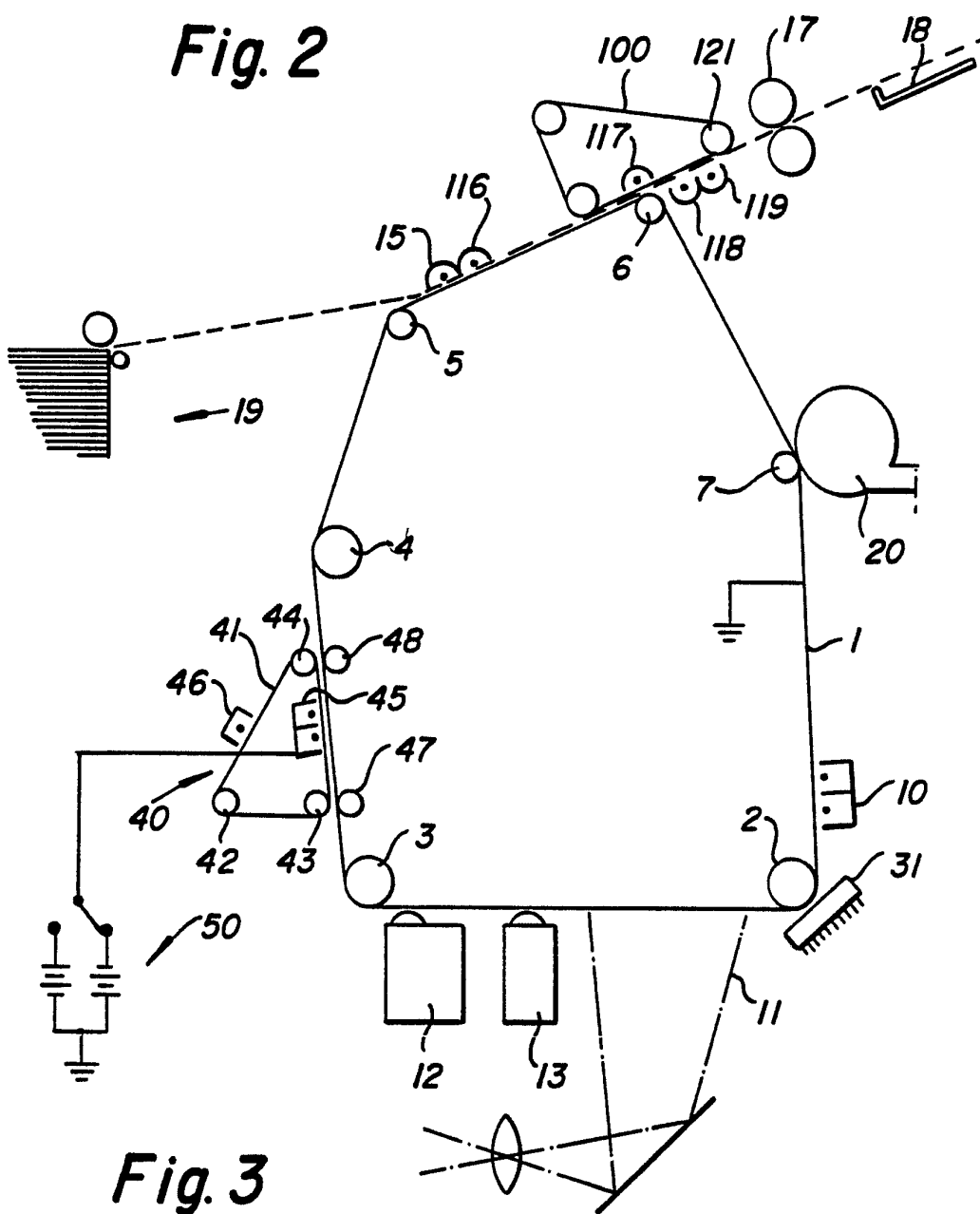


Fig. 3