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B6C
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(54) Electrophotographic apparatus

(57) An electrophotographic apparatus in which two images are formed on the same recording material in respectively designated areas, such that a blank margin is obtained at the boundary of these two images. The blank margin may be achieved by adopting different magnifications for the first and second images or by erasing any image at the boundary between the two images.

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FIG. 1

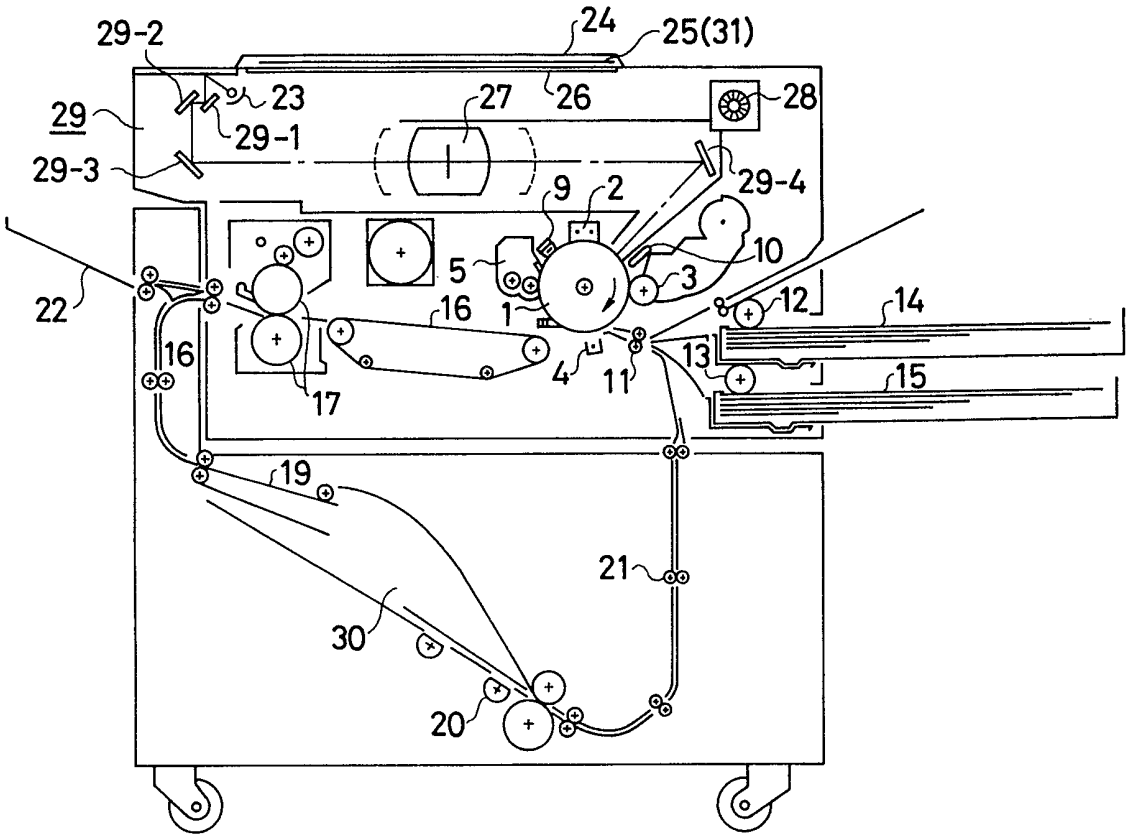


FIG. 2

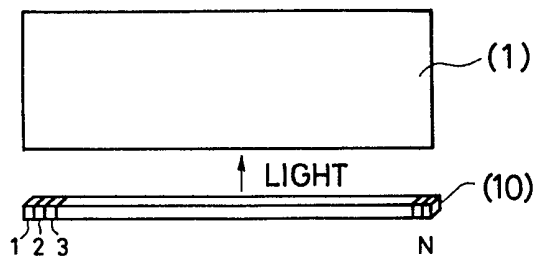


FIG. 3

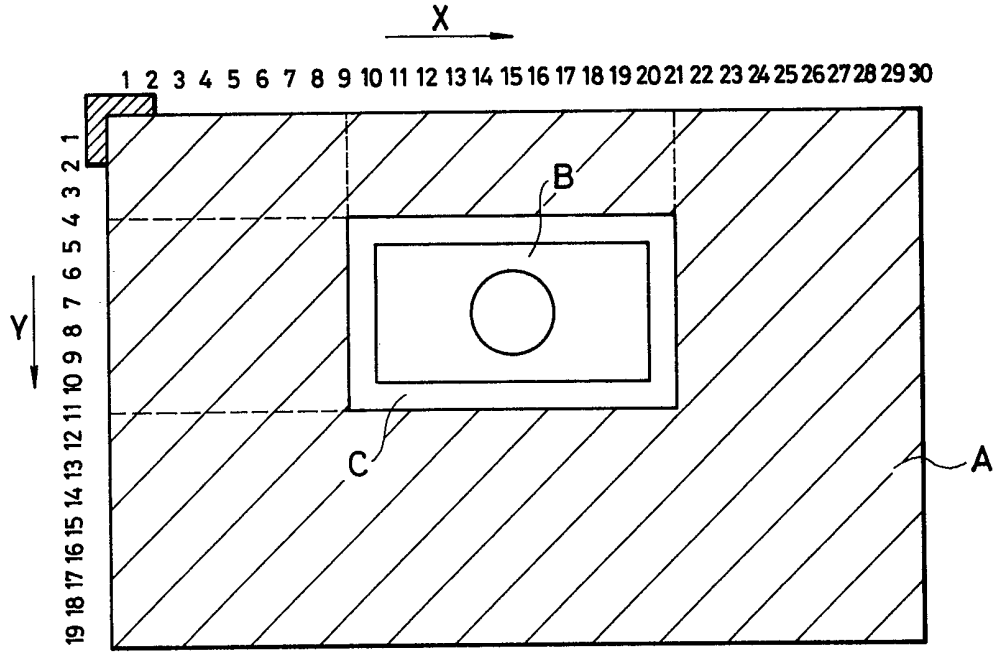

X
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Y
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
B
C
A

FIG. 4

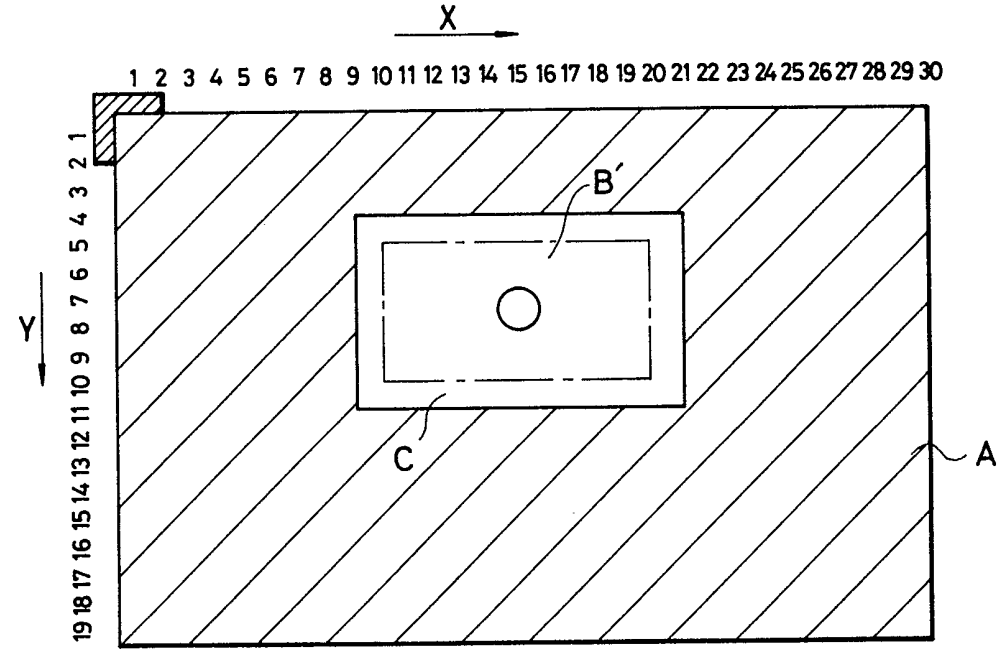

X
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Y
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
B'
C
A

FIG. 5

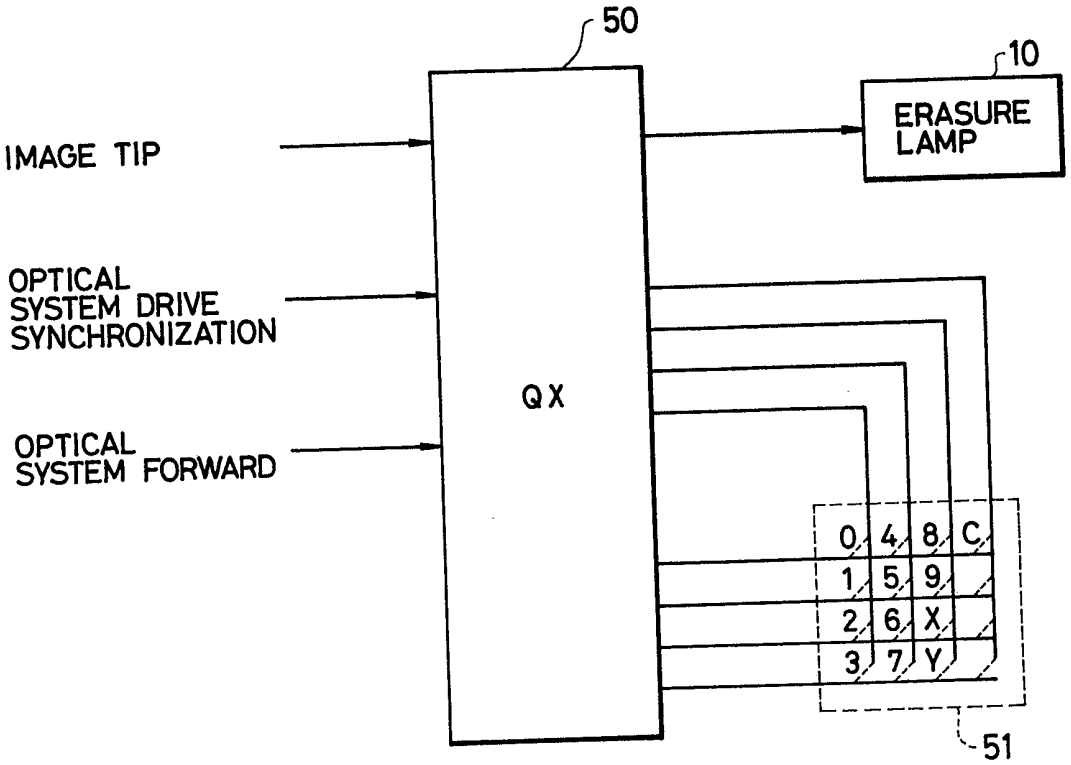

50
10
ERASURE LAMP
IMAGE TIP
OPTICAL SYSTEM DRIVE SYNCHRONIZATION
OPTICAL SYSTEM FORWARD
QX
0 4 8 C
1 5 9
2 6 X
3 7 Y
51

FIG. 7

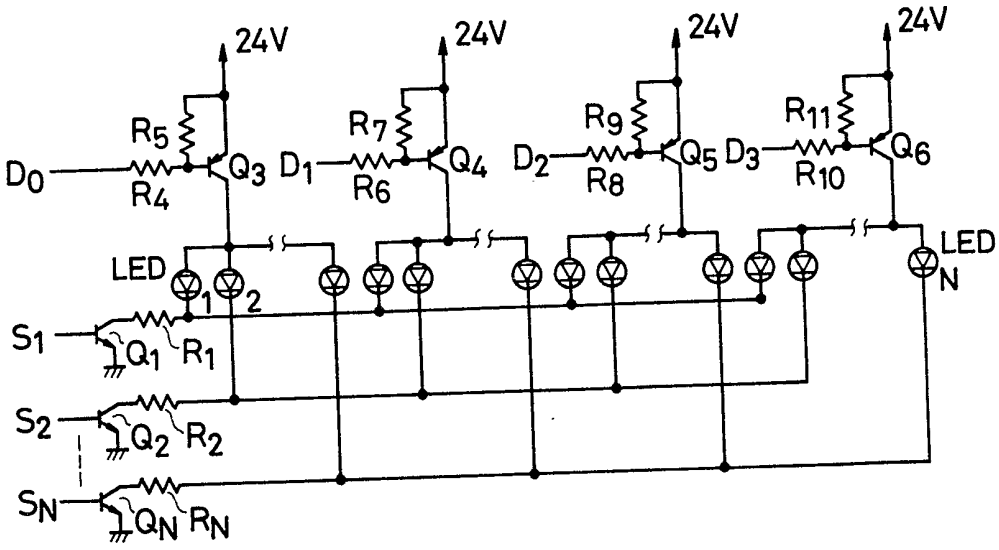

24V
24V
24V
24V
R5
R7
R9
R11
D0
R4
Q3
D1
R6
Q4
D2
R8
Q5
D3
R10
Q6
LED 1
2
LED N
S1
Q1
R1
S2
Q2
R2
SN
QN
RN

FIG. 6

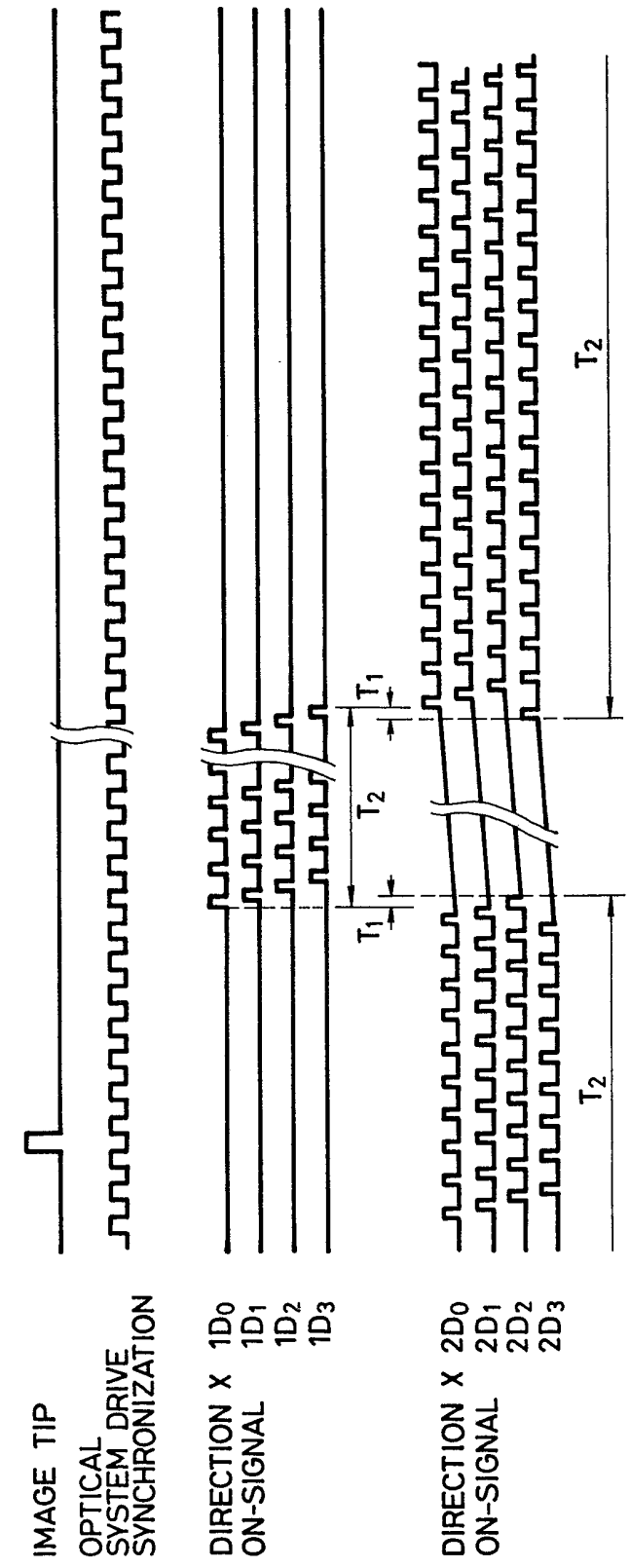


IMAGE TIP
OPTICAL SYSTEM DRIVE SYNCHRONIZATION
DIRECTION X ON-SIGNAL
1D0
1D1
1D2
1D3
DIRECTION X ON-SIGNAL
2D0
2D1
2D2
2D3
T1
T2
T1
T2
T2

FIG. 8-1

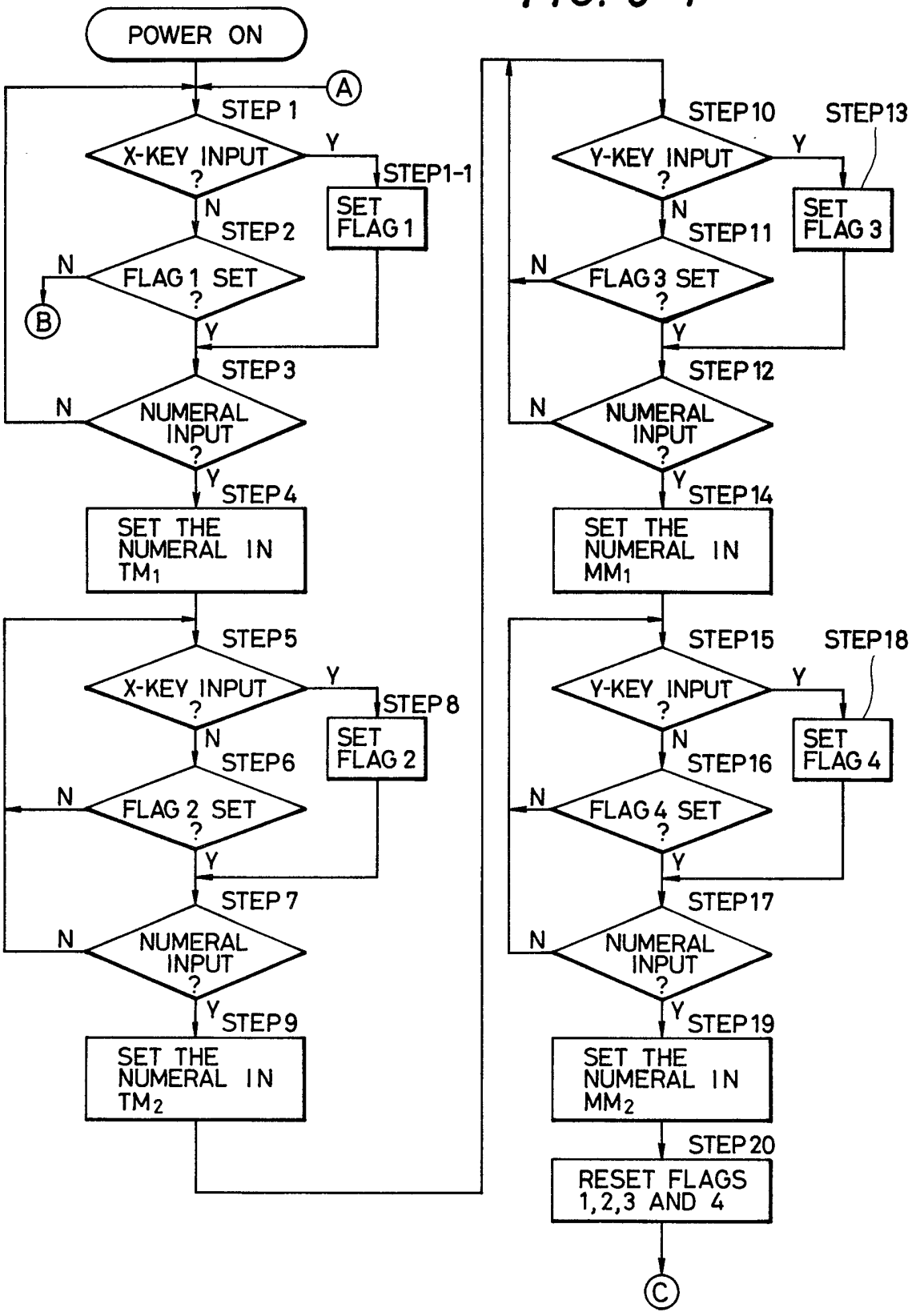

POWER ON
A
STEP 1
X-KEY INPUT ?
Y
STEP1-1
SET FLAG 1
N
STEP 2
FLAG 1 SET ?
N
B
Y
STEP 3
NUMERAL INPUT ?
N
Y
STEP 4
SET THE NUMERAL IN TM1
STEP 5
X-KEY INPUT ?
Y
STEP 8
SET FLAG 2
N
STEP 6
FLAG 2 SET ?
N
Y
STEP 7
NUMERAL INPUT ?
N
Y
STEP 9
SET THE NUMERAL IN TM2
STEP 10
Y-KEY INPUT ?
Y
STEP 13
SET FLAG 3
N
STEP 11
FLAG 3 SET ?
N
Y
STEP 12
NUMERAL INPUT ?
N
Y
STEP 14
SET THE NUMERAL IN MM1
STEP 15
Y-KEY INPUT ?
Y
STEP 18
SET FLAG 4
N
STEP 16
FLAG 4 SET ?
N
Y
STEP 17
NUMERAL INPUT ?
N
Y
STEP 19
SET THE NUMERAL IN MM2
STEP 20
RESET FLAGS 1, 2, 3 AND 4
C

FIG. 8-2

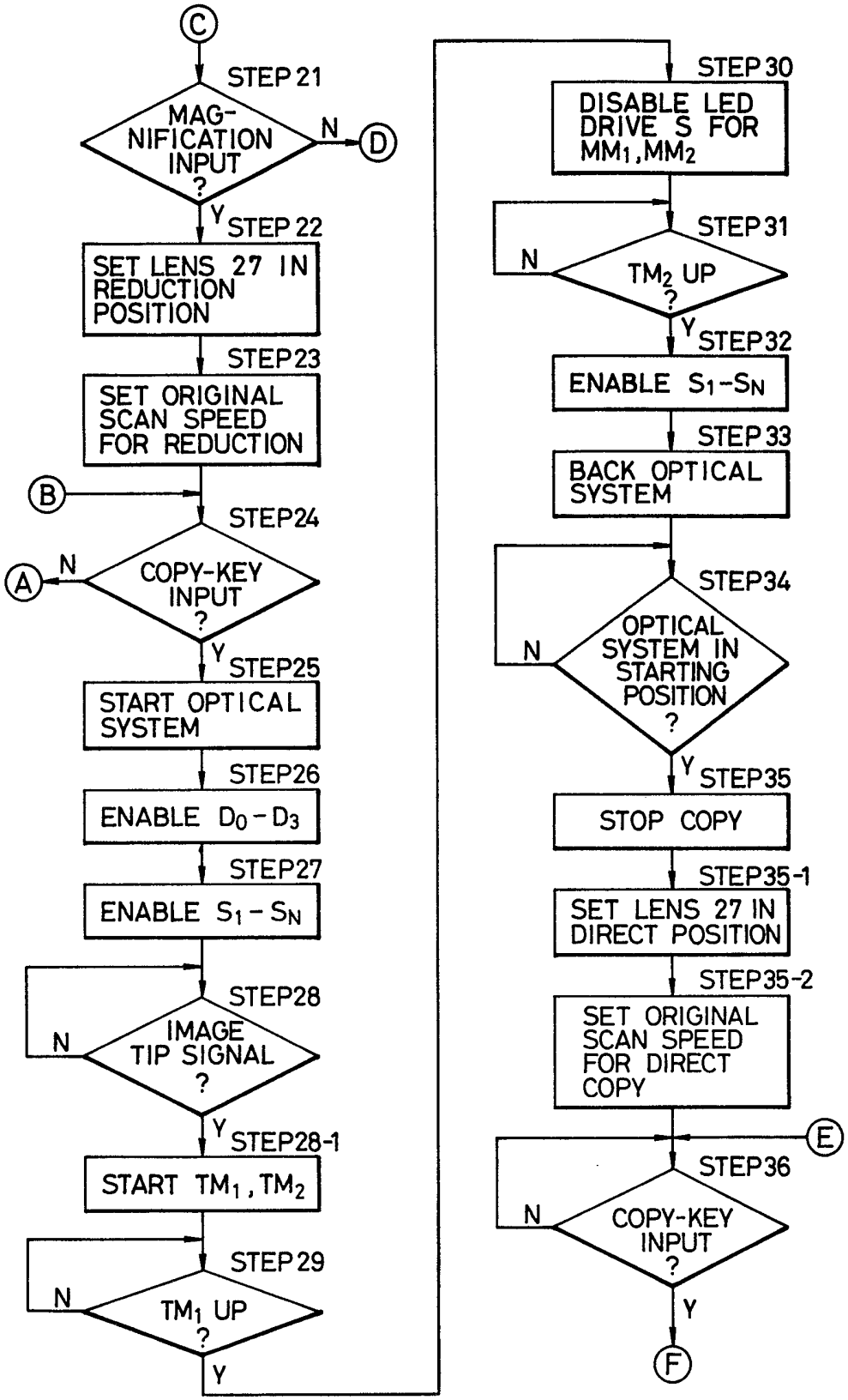

C
STEP 21
MAG-NIFICATION INPUT ?
N
D
Y
STEP 22
SET LENS 27 IN REDUCTION POSITION
STEP23
SET ORIGINAL SCAN SPEED FOR REDUCTION
B
STEP24
A
N
COPY-KEY INPUT ?
Y
STEP25
START OPTICAL SYSTEM
STEP26
ENABLE $D_0 - D_3$
STEP27
ENABLE $S_1 - S_N$
STEP28
N
IMAGE TIP SIGNAL ?
Y
STEP28-1
START TM_1, TM_2
STEP29
N
TM_1 UP ?
Y
STEP30
DISABLE LED DRIVE S FOR MM_1, MM_2
STEP31
N
TM_2 UP ?
Y
STEP32
ENABLE $S_1 - S_N$
STEP33
BACK OPTICAL SYSTEM
STEP34
N
OPTICAL SYSTEM IN STARTING POSITION ?
Y
STEP35
STOP COPY
STEP35-1
SET LENS 27 IN DIRECT POSITION
STEP35-2
SET ORIGINAL SCAN SPEED FOR DIRECT COPY
E
STEP36
N
COPY-KEY INPUT ?
Y
F

FIG. 8-3

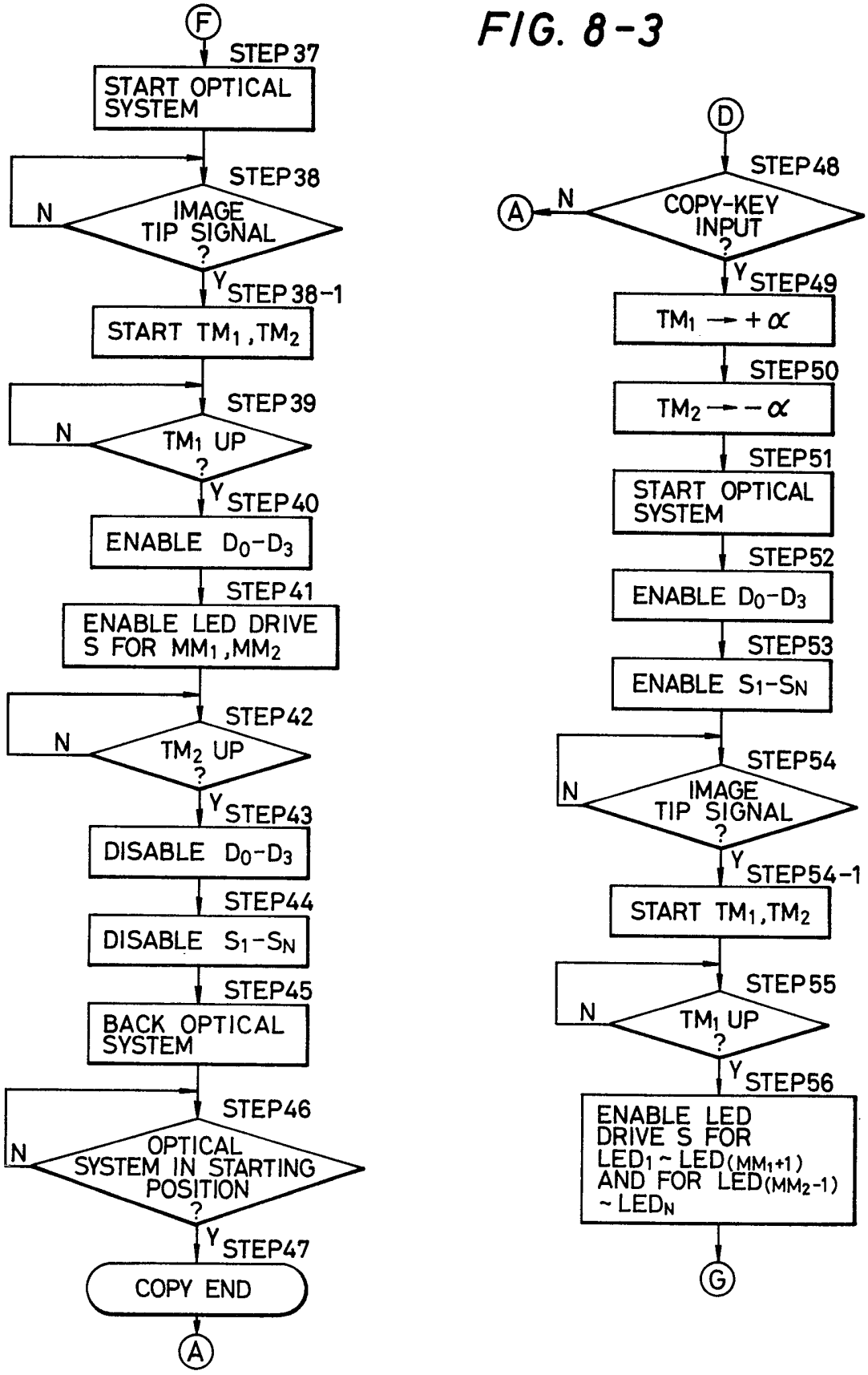
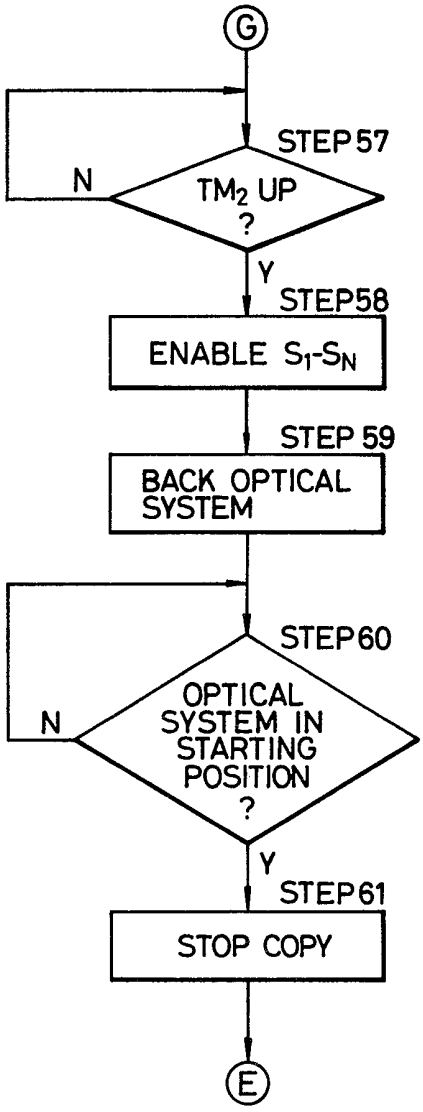

F
STEP37
START OPTICAL SYSTEM
STEP38
N
IMAGE TIP SIGNAL ?
Y
STEP38-1
START TM1, TM2
STEP39
N
TM1 UP ?
Y
STEP40
ENABLE D0-D3
STEP41
ENABLE LED DRIVE S FOR MM1, MM2
STEP42
N
TM2 UP ?
Y
STEP43
DISABLE D0-D3
STEP44
DISABLE S1-SN
STEP45
BACK OPTICAL SYSTEM
STEP46
N
OPTICAL SYSTEM IN STARTING POSITION ?
Y
STEP47
COPY END
A
D
STEP48
A
N
COPY-KEY INPUT ?
Y
STEP49
TM1 → +α
STEP50
TM2 → −α
STEP51
START OPTICAL SYSTEM
STEP52
ENABLE D0-D3
STEP53
ENABLE S1-SN
STEP54
N
IMAGE TIP SIGNAL ?
Y
STEP54-1
START TM1, TM2
STEP55
N
TM1 UP ?
Y
STEP56
ENABLE LED DRIVE S FOR LED1 ~ LED(MM1+1) AND FOR LED(MM2-1) ~ LEDN
G

FIG. 8-4


G
STEP57
N
TM2 UP
?
Y
STEP58
ENABLE S1-SN
STEP 59
BACK OPTICAL SYSTEM
STEP60
N
OPTICAL SYSTEM IN STARTING POSITION
?
Y
STEP61
STOP COPY
E

SPECIFICATION

Electrophotographic apparatus

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an electrophotographic apparatus capable of superposed image recording.

Description of the Prior Art

Image synthesis in copying has for example been achieved by synthesizing images on an original document and copying thus synthesized original on a copying machine. There is however involved a cumbersome procedure of adhering an original to be synthesized to another original with a transparent adhesive tape, and the obtained original document is often smeared by the use of such adhesive tape.

Apart from such manual image synthesis, automatic image synthesis has been proposed with a copying machine with intelligent functions, but such apparatus is inevitably complex and expensive. It is also possible to effect such image synthesis by forming an electrostatic latent image of a first original image on a photosensitive member, then erasing an unnecessary part of said latent image by selective on-off control of erasing lamps consisting for example of an LED array, then developing and transferring said image through a known electrophotographic process to obtain a partially lacking copy image, then forming another latent image with inverted on-off control of the erasing lamps so that it can be fitted into the lacking portion of the above-mentioned image, and rendering said latent image visible to obtain a synthesized copy image.

However, in the transfer of the developed image from the photosensitive member to the copy sheet, there may result an error in the registration between the front end of the image and that of the copy sheet, and there may also result a shrinkage or elongation of the copy sheet by heat and pressure when it passes the fixing device.

Consequently the above-mentioned image synthesis with inverted on-off control of the erasing lamps frequently results in overlapping boundaries of two images, thus giving rise to unesthetic synthesized images.

SUMMARY OF THE INVENTION

An object of the present invention is to alleviate the above-mentioned drawbacks.

Another object of the present invention is to provide an improved image forming apparatus.

In one aspect the present invention provides an image forming apparatus capable of forming a blank margin area in the boundaries of the synthesized images, thus avoiding smears in the images caused by an error in registration or a shrinkage or elongation of the copy sheet and providing a clean image.

In another aspect the present invention provides an image forming apparatus capable, in image formations in first and second areas, of varying the sizes of said first and second areas to form a blank margin area at the boundaries, thus preventing the image overlapping at the boundaries of image synthesis and providing a clean copy.

In a further aspect the present invention provides an image forming apparatus capable of forming a blank margin area at the boundaries of first and second image areas by adopting different image magnifications in said two areas, thereby preventing the image overlapping at said boundaries and providing a clean copy.

In yet another aspect the present invention provides an image forming apparatus capable of controlling the amount of a blank margin area on the copy sheet by controlling means for forming first and second images corresponding to first and second image information.

The foregoing and still other objects of the present invention, and the advantages thereof, will become fully apparent from the following description, which is to be taken in conjunction with the attached drawings, as well as from the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of a copying machine in which the present invention is applicable;

Fig. 2 is a schematic view showing the combination of a photosensitive member and an erasing lamp;

Figs. 3 and 4 are schematic views showing examples of image output according to the present invention;

Fig. 5 is a block diagram of a circuit for forming a blank margin;

Fig. 6 is a timing chart showing signals of said block diagram shown in Fig. 5;

Fig. 7 is a circuit diagram for driving erasing lamp; and

Fig. 8 is a flow chart showing the control sequence according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now the present invention will be clarified in detail by an embodiment shown in the attached drawings.

Figs. 1 to 8 illustrate an embodiment of the present invention, in which Fig. 1 is a cross-sectional view of a copying machine in which the present invention is applicable. In Fig. 1 there are provided a photosensitive drum 1; a primary charger 2; a developing unit 3; a transfer charger 4; a cleaner 5; a pre-exposure lamp 9; an erasing lamp 10; a registration roller 11; sheet feed rollers 12, 13; copy sheets 14, 15; a conveyor belt 16; and a

fixing roller 17 to effect a known electrophotographic process to form a transferred image on said copy sheets 14, 15.

The image synthesis is conducted in the following manner. A first original document 25 is set on an original support glass 26, and unrepresented image synthesis key and copy start key are actuated whereby said first original document 25, maintained in position by a pressure plate 24, is illuminated by an illuminating lamp 23. The reflected light is projected through a mirror system 29 (29-1, 29-2, 29-3, 29-4) and a lens 27 onto said photosensitive member 1 to form a latent image of said first original document 25 thereon. At the same time an erasing lamp 10 is on-off controlled to erase the latent image in an area designated by an unrepresented area designating key. The latent image is erased in the area illuminated by said lamp but remains in the unirradiated area. The remaining latent image is rendered visible by the developing unit 3. The registration roller is driven at such timing that the leading end of the image on the photosensitive member coincides with the front end of the copy sheet, and the image is transferred by means of the transfer charger 4. Then the sheet is guided to the fixing unit 17 by the conveyor belt 16. In case of an image synthesis, a guide 18 is activated to direct the sheet path toward an intermediate tray 30, into which the copy sheet is stored. Then the aforementioned original document 25 is replaced by a second original document 31 to be synthesized, and said second original document is again illuminated by the illuminating lamp 23. The reflected light is projected through the mirrors 29 and lens 27 onto the photosensitive member 1 to form a latent image of said second original document. For said second original 31, the erasing lamp 10 is so controlled as to erase the latent image outside the area designated for the first original document and slightly inside the boundary of said area. Then the remaining latent image is rendered visible by the developing unit 3, and the copy sheet stored in the intermediate tray is supplied, by means of an intermediate tray feed roller 20 and a transport roller 21, toward the registration roller 11. Said registration roller is driven at such timing that the leading end of the image coincides with the leading end of the copy sheet, and the image is transferred by the transfer charger 4. The copy sheet is then guided by the conveyor belt 16 to the fixing unit 17, and is finally discharged through the guide 18 to a tray 22.

As an alternative method, it is also possible to form a blank margin at the boundary of images to be synthesized, by adopting mutually different image magnifications for the first and second original documents. As an example, the position of the lens 27 and the scanning speed of the illuminating lamp 23 are so controlled that the first original document 25 is copied in actual size, while the second original document 31 is copied with a predetermined image magnification, for example an image reduction to 95%.

It is also possible to erase the latent image of the first original document outside a designated area, and to erase the latent image of the second original document inside said designated area.

It is furthermore possible to effect an image synthesis by a plural-page continuous copying mode, in which two originals on the original support glass, or a right-hand half and a left-hand half of an original, are separately subjected to scanning operations.

It is furthermore rendered possible to change the color in a part of the image of a same original, by combining the above-described technology with different developers in the developing unit. For example it is possible, in a copying machine equipped with two developing untis, to copy the outside of a designated area with black color, and then to copy the inside thereof with red color.

Fig. 2 shows a combination of the photosensitive member 1 and the erasing lamp 10, which is composed of finely divided light-emitting elements, for example an array of light-emitting diodes (LED).

Figs. 3 and 4 illustrate examples of image synthesis. In the following there will be explained a case of synthesizing an image into a part of another image, as shown in Fig. 3. It is assumed that an area is designated by the diagonal coordinates (9, 4) and (21, 11). At first, in the copying of an area A, the latent image is erased in an area defined by 9 to 21 in the X-direction and 4 to 11 in the Y-direction by lighting the erasing lamp in the corresponding range, and, in the copying of an area B, the latent image is erased outside area slightly inside said designated area, i.e. an area defined by 10 to 20 in the X-direction and 5 to 10 in the Y-direction, by lighting the erasing lamp 10 in the corresponding range. According to the present invention, there is formed a blank margin area C which is not subjected to image formation in the copying of area A or B.

In the image synthesis shown in Fig. 4, the image in an area B' is copied with a predetermined reduction rate. In this case, the erasing lamp 10 is so controlled as to erase the latent image outside an area defined by the coordinates (9, 4) and (21, 11), and the image in said area is copied with a predetermined reduction rate to form a blank margin area at the boundary.

In a block diagram shown in Fig. 5, a microcomputer 50 (Qx) designates the area of image synthesis through an input key matrix 51, and controls the on-off timing of the erasing lamp 10, according to data inputs X, Y shown in Fig. 3. Now reference is made to Fig. 6 for explaining the timing in the Xdirection. Optical

system drive synchronization signals are counted from an image front end signal, supplied from an unrepresented sensor and indicating the front end of the image, and the erasing lamp 10 is controlled, for the first original document, with the timing of signals $1D_0$—$1D_3$ to erase the latent image in the designated area, while it is controlled, for the second original document, with the timing of signals $2D_0$—$2D_3$ for erasing the latent image outside the designated area. T2 indicates the lighting period of the erasing lamp, which is lighted in both copying operations for overlapping periods T1.

Fig. 7 shows a driving circuit for the erasing lamp 10, wherein provided are transistors Q1—QN, resistors R1—R11 and light-emitting diodes LED1 LEDN. In the present embodiment, the erasing lamp 10 is composed of an array of light-emitting diodes, which are used in dynamic lighting mode. Signals D0—D3 and S1—SN are mutually combined to light the LED's at a desired timing, thereby erasing the latent image for effecting image synthesis. The lamp lighting may also be effected in static lighting mode instead of dynamic lighting.

Now reference is made to Fig. 8 for explaining the control by the microcomputer Qx. The present flow chart determines the lighting time of the erasing lamp, wherein steps 1—9 identify whether a number is set for the X-direction after the power supply is turned on. At first a step 1 identifies whether an X-key, indicating the image synthesis area in the X-direction, has been actuated, and, if actuated, a flag 1 is set in a step 1-1. In the absence of such actuation, a step 2 identifies whether the flag 1 is already set.

If the flag 1 is already set, or after the execution of the step 1-1, a step 3 identifies whether a number for designating an area, has been entered. In the absence of such number setting, the program returns to the step 1. In the presence of said number setting, the set number is set in a timer TMI (step 4). Then, in a similar manner as explained above, steps 5 to 9 sets, in a timer TM2, a set number indicating the end of the image synthesis area in the X-direction. In this manner the control in the X-direction is achieved by time in relation to the scanning of the optical system or the rotation of the photosensitive drum, and the start and end of lamp function in the X-direction are defined by the numbers set in the timers TM1, TM2. The image synthesis area in the Y-direction is also designated through a similar procedure in steps 10 to 19, by setting numbers in memories MM1, MM2 and resetting flats 1—4. In this manner the numbers in the Y-directions correspond to the elements S1—SN of the erasing lamp or LED array. Thus the image synthesis area is designated in the original document placed on the original support glass, as shown in Figs. 3 and 4, by input of the numbers in the X- and Y-directions.

Then a step 21 identifies whether the image magnification has been selected for the second copy image. If it has been entered, a step 22 moves the lens 27 to a position corresponding to the selected reduction ratio, then a step 23 selects a scanning speed corresponding to the selected image magnification, and a step 24 awaits the actuation of the copy start key. If the image magnification has not been entered in the step 21, a step 48 awaits the actuation of the copy start key. In the presence of such selection of image magnification, the optical system is started at the selected speed in a step 25 or 51. On the other hand, in the absence of such selection of image magnification, setps 49, 50 and $+\alpha$ and $-\alpha$ respectively to the contents of the timers TM1, TM2 previously set in the steps 4 and 9, in order to form a blank margin area.

Subsequently steps 26, 27, 52 and 53 turn on the LED drive signals D0—D3 and S1—SN, in order to light the erasing lamp. Then, in response to the image front end signal supplied from the unrepresented image front end sensor, steps 28, 28-1 or 54, 54-1 start the timers TM1, TM2, and steps 29 and 55 await the expiration of the timer TM1.

Upon expiration of said timer, a step 30 turns off the LED drive signal S corresponding to a range designated by input values MM1, MM2 in the Y-direction, thereby turning off the LED in said range. However, in the absence of selection of image magnification in the step 21, there are lighted LED's from LED1 to an LED corresponding to a memory value MM1 + 1 and from an LED corresponding to a memory value MM2 − 1 to LED_N by turning on the corresponding LED drive signals S alone (step 56). In this manner the latent image is erased to a position slightly inside the designated area, as represented by B in Fig. 3. Then a step 31 or 57 awaits the expiration of the timer TM2, and upon expiration thereof all the LED drive signals S1—SN are turned on to light all the erasing lamps (step 32 or 58). Then the optical system is reversed upon arrival at a reversing position (step 33 or 59), and is stopped at the start position (step 34 and 35, or 60 and 61). On the other hand, in the presence of selection of an image magnification in the step 21, the lens 27 is positioned for equal size imaging (step 35-1), and the scanning speed is set at the equal size imaging (step 35-2).

Then, after the second original document is set, a step 36 awaits the actuation of the copy start key again, and, upon said actuation, a step 37 starts the optical system. Then, in response to an image front end signal (step 38), timers TM1, TM2 are activated in synchronization (step 38-1). Upon expiration of the timer TM1 (step 39), the LED drive signals D0—D3 are turned on (step 40), thereby lighting the LED's corresponding to a

range designated by the input values MM1, MM2 in the Y-direction alone (step 41). In this manner the LED's are controlled inversely to the case in the step 30, thereby copying the area A shown in Fig. 3 or 4, thus obtaining a synthesized image. Upon expiration of the timer TM2 (step 42), the LED drive signals D0—D3 and S1—SN are all turned off, in order to turn off all the erasing lamps (steps 43, 44). Then the optical system is reversed upon arrival at the reversing position and the blank exposure lamps are all turned off (step 45), and, upon arrival of the optical system at the start position, the copying operation is terminated (steps 46,47) and the program returns to the step 1.

As explained in the foregoing, the blank margin area C in the image synthesis shown in Fig. 3 is formed by increasing the number of lighted LED's, while the blank margin area C shown in Fig. 4 is obtained by reducing the size of the image B'.

In the foregoing embodiment the image B or B' is formed at first, but it is also possible to form the image A at first.

Also the blank margin area may be formed by erasing the latent image just outside the boundary of the image A.

Furthermore, it is also possible to change the image magnification of the area A.

Furthermore, the first and second original documents may have areas which are separately designated.

Furthermore the present invention is applicable also to image data stored in a memory or the like.

Naturally the present invention is not limited to the foregoing embodiment but is subject to various modifications within the scope and spirit of the appended claims.

CLAIMS

1. An image forming apparatus comprising:
area designating means for designating a desired image area;
first image forming means for forming an image of a first area designated by said area designating means;
second image forming means for forming an image of a second area designated by said area designating means;
synthesizing means for recording the images formed by said first and second image forming means, on a same recording material; and
blank margin forming means for forming a blank margin at the boundary of the synthesized images formed by said synthesizing means.

2. An image forming apparatus according to Claim 1, wherein areas of image formation by said first and second image forming means are mutually different.

3. An image forming apparatus according to Claim 2, wherein said blank margin forming means is adapted to reduce the size of the area of image formation by said first image forming means.

4. An image forming apparatus according to Claim 2, wherein said blank margin forming means is adapted to increase the size of said designated area for image formation by said second image forming means.

5. An image forming apparatus according to Claim 1, wherein said blank margin forming means is adapted to adopt mutually different image magnifications for said first and second image forming means.

6. An image forming apparatus according to Claim 5, wherein the image magnification at image formation of said first image forming means is selected smaller than that of said second image forming means.

7. An image forming apparatus according to Claim 1, wherein said first and second image forming means are adapted to erase unnecessary image areas by blank exposure means.

8. An image forming apparatus comprising:
area designating means for designating a desired area of an original image;
first image forming means for forming the image of a first area designated by said area designating means;
second image forming means for forming the image of a second area designated by said area designating means; and
synthesizing means for recording the images, formed by said first and second image forming means, on a same recording material;
wherein said first and second image forming means are adapted, at the formation of images of said first and second areas, to vary the size of said first or second area.

9. An image forming apparatus according to Claim 8, wherein said first area is obtained by extracting a designated area of said original image.

10. An image forming apparatus according to Claim 8, wherein said second area is obtained by erasing a designated area of said original image.

11. An image forming apparatus according to Claim 9, wherein said first image forming means is adapted, at the formation of image of said first area, to reduce the size of said extracted area.

12. An image forming apparatus according to Claim 10, wherein said second image forming means is adapted, at the formation of image of said second area, to increase the size of said erased area.

13. An image forming apparatus according to Claim 8, wherein said first and second area are contained in a same original image.

14. An image forming apparatus according to Claim 8, wherein said first and second area are contained in mutually different original images.

15. An image forming apparatus comprising:
area designating means for designating a desired area of an original image;

first image forming means for forming the image of a first area designated by said area designating means;

second image forming means for forming the image of a second area designated by said area designating means; and

synthesizing means for recording the images formed by said first and second image forming means on a same recording material;

wherein said first and second image forming means adopt mutually different image magnifications for the formation of images in said first and second areas.

16. An image forming apparatus according to Claim 15, wherein said first area is obtained by extracting a designated area of said original image.

17. An image forming apparatus according to Claim 15, wherein said second area is obtained by erasing a designated area of said original image.

18. An image forming apparatus according to Claim 16, wherein the image magnification of said first area is smaller than that of said second area.

19. An image forming apparatus according to Claim 17, wherein the image magnification of said first area is smaller than that of said second area.

20. An image forming apparatus comprising:

first image forming means for forming the image of first image information;

second image forming means for forming the image of second image information;

synthesizing means for recording the images formed by said first and second image forming means on a same recording material; and

control means for controlling said first or second image forming means to control the amount of blank margin to be formed on said recording material.

21. An image forming apparatus according to Claim 20, wherein said control means is adapted to control the image magnification of said first or second image forming means.

22. An image forming apparatus according to Claim 20, wherein said control means is adapted to control the image forming area of said first or second image information.

23. An image forming apparatus for forming on a recording medium an image comprising first and second substantially complementary portions corresponding to respective parts of first and second originals, means being provided for causing said portions to be formed with a boundary portion, formed at the boundary between said portions and separating them.

24. A copying machine operable to perform a copying process in which substantially complementary parts of respective first and second originals are copied onto a common recording medium to form a composite copy image, so that the portions of said composite image corresponding to said parts of the originals are separated by a narrow boundary portion. 25. An image forming apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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