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Description

BACKGROUND OF THE INVENTION

1) Field of the Invention

The present invention generally relates to an electrophotographic printer including a toner image carrying body such as a photosensitve drum, a dielectric drum or the like to which a toner image obtained from a toner development of an electrostatic latent image is electrostatically adhered and held, and in particular, relates to a toner image transferring device incorporated therein for electrostatically transferring the toner image from the toner image carrying body to a sheet or paper.

2) Description of the Related Art

As is well known, the electrophotographic printer typically carries out the processes of: producing a uniform distribution of electrical charges on a surface of a rotary photosensitive drum; forming an electostatic latent image on the electrically charged surface of the photosensitive drum by optically writing an image thereon with a laser beam scanner, an LED (light emitting diode) array, an LCS (liquid crystal shutter) array or the like; visually developing the electrostatic latent image with a developer, *i.e.* toner, which is electrically charged to be electrostatically adhered to the electostatic latent image zone; electrostatically transferring the developed visible image or toner image from the drum to a sheet or paper; and fixing the transferred image on the sheet or paper.

In the transferring process, the transfer of the toner image to the paper is carried out by using a transfer charger to feed an electric charge to the paper Namely, the transfer charger is disposed in the vicinity of the photosensitive drum, the paper is introduced into a clearance therebetween, and the transfer charger gives the paper an electric charge having a polarity opposite to that of the electric charge of the toner image, whereby the toner image is electrostatically transferred from the drum to the sheet or paper. Note, the transfer charger may be a corona discharger.

To increase the efficiency of the transfer of the toner image, the paper must be given an amount of electric charge on the order of about 320 $\mu C/m^2$, and thus the transfer charger is provided with a capacity needed to give the paper such an amount of electric charge. Nevertheless, in practice, leading and trailing edge portions of the paper have a large amount of electric charge of much more than 320 $\mu C/m^2$ because, when the paper is not intervened between the transfer charger and the photosensitive drum, the charge is given to the drum as a body to be charged. In particular, the photosensitive drum has an electric capacity of about 5 $\mu F/m^2$, which is larger than that (about 0.5 $\mu F/m^2$) of the paper, so that an amount of electric charge fed from the transfer charger to the drum is relatively large when the paper is not intervened therebetween. As a result, when the leading edge of the paper is introduced into the clearance between the transfer charger and the drum, or when the trailing edge thereof leaves therefrom, a portion of the electric charge to be fed to the drum is added to the leading or trailing edge portion of the paper.

When the leading edge portion of the paper is given a large amount of electric charge, it will be strongly adhered to the photosensitive drum due to an electrostatic attraction acting therebetween, and thus the paper is often entangled with the drum. Therefore, conventionally, for example, a pair of nail members are engaged with a surface of the photosensitive drum at the side edges thereof, to separate the leading edge of the paper therefrom and prevent the entanglement of the paper with the drum. Nevertheless, the entanglement of the paper may frequently occur because the pair of nail members are merely applied to the side edges of the paper, and thus the separation of the paper from the photosensitive drum is not effectively carried out in practice. When the nail members are engaged with the photosensitive drum surface at the middle position thereof, to carry out an effective separation of the paper from the drum, they are applied to a middle area of the paper on which the toner image has been transferred, and thus the transferred toner image can be damage by the nail members.

It is also known that an AC charger eliminator, which may be a corona discharger, is disposed adjacent to the transfer charger, to partially eliminate the electric charge from the paper to which the toner image has been transferred, whereby the electrostatic attraction between the paper and the photosensitive drum can be weakened. Nevertheless, the leading edge of the paper cannot be effectively separated from the photosensitive drum due to the excessive charge thereof. Of course, an AC charge eliminator may be arranged so that the electric charge can be eliminated from the leading edge of the paper, but in this case, the toner image may be returned from the paper to the photosensitive drum.

US-A-4728991 describes an image forming apparatus which includes a separation charge eliminator which applies a high voltage to a non-image zone and a low voltage in an image zone.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a toner image transferring device for electrostatically transferring a charged toner image, which is electrostatically held by a toner image carrying body, therefrom to a sheet or paper, wherein only a leading

edge of the sheet or paper can be effectively prevented from being excessively charged, so that a separation of the leading edge of the sheet or paper from said toner image carrying body can be facilitated.

In accordance with a first aspect of the present invention, there is provided to a toner image transferring device for electrostatically transferring a charged toner image electrostatically held by a toner image carrying body, to a sheet or paper, which comprises: transfer charger means disposed in the vicinity of said toner image carrying body to form a clearance therebetween for feeding an electric charge to the sheet or paper while the sheet or paper is passed therethrough; electric source means for supplying an electric energy to the transfer charger means to thereby give the sheet or paper an electric charge having a polarity opposite to that of the charge of the toner image; and means for controlling the electric energy output from the electric source means to said transfer charger means in such a manner that the transfer charger means gives the sheet or paper an amount of electric charge necessary for the transfer of the toner image when the sheet or paper is completely intervened between said toner image carrying body and the transfer charger means characterised in that the electric source means comprises first electric source means whose electrical energy output to said transfer charger means gives the sheet or paper a first amount of electric charge necessary for the transfer of the toner image only when the sheet or paper is completely intervened between said toner image carrying body and said transfer charger means during the passage of the sheet or paper through the clearance therebetween, and that said transfer charger means gives the sheet or paper a second amount of electric charge less than the first amount of electric charge when the leading edge of the sheet or paper is intervened between said toner image carrying body and said transfer charger means during the passage of the sheet or paper through said clearance therebetween, so that a leading edge zone of the sheet or paper has a charge value, resulting from said second amount of electric charge, which is substantially equal to that of the sheet or paper resulting from said first amount of electric charge.

In accordance with a second aspect of the present invention, a printer comprises a toner image carrying body having a charged toner image electrostatically held thereby;

transfer charger means disposed in a vicinity of said toner image carrying body to form a clearance therebetween for feeding an electric charge to the sheet or paper while the sheet or paper is passed therethrough;

electric source means for supplying an electric energy to said transfer charger means to give the sheet or paper an electric charge having a polarity opposite to that of the charge of the toner image;

means for controlling an electric energy output from said electric source means to said transfer charger means in such a manner that said transfer charger means gives the sheet or paper the first amount of electric charge necessary for the transfer of the toner image when the sheet or paper is completely intervened between said toner image carrying body characterized in that the printer further comprises alternate current charger eliminator means disposed adjacent to an outlet of said clearance from which the sheet or paper is discharged, for eliminating a first amount of electric charge from the sheet or paper when the sheet or paper leaves said clearance; wherein the electric source means comprises first electric source means whose electrical energy output to said transfer charger means gives the sheet or paper a first amount of electric charge necessary for the transfer of the toner image only when the sheet or paper is completely intervened between said toner image carrying body and said transfer charger means during the passage of the sheet or paper through the clearance therebetween, and that said transfer charger means gives the sheet or paper a second amount of electric charge less than the first amount of electric charge when the leading edge of the sheet or paper is intervened between said toner image carrying body and said transfer charger means during the passage of the sheet or paper through said clearance therebetween, so that a leading edge zone of the sheet or paper has a charge value, resulting from said second amount of electric charge, which is substantially equal to that of the sheet or paper resulting from said first amount of electric charge.

The electric source means may be a direct current source or a direct current voltage source. The toner image carrying body may be formed as a photosensitive drum which is rotated to bring the toner image to the transfer charger means. In this case, the toner image transferring device according to the present invention further comprises means for synchronizing the movement of the sheet or paper with the rotation of the photosensitive drum so that the toner image can be transferred from the photosensitive drum to the sheet or paper at a proper position thereon.

The device may further comprise alternate current charger eliminator means disposed adjacent an outlet of the clearance from which the sheet or paper is discharged; and second electric source means for supplying an electric energy to the alternate current charger eliminator means to eliminate a given amount of electric charge from the sheet or paper, when leaving the clearance, in such a manner that a return of the transferred toner image from the sheet or paper to the toner image carrying body is prevented.

Also, when the toner image carrying body is formed as a photosensitive drum which is rotated to bring the toner image to the transfer charger means, the toner image transferring device further comprises

means for synchronizing the movement of the sheet or paper with the rotation of the photosensitive drum so that the toner image can be transferred from the photosensitive drum to the sheet or paper at a proper position thereon.

Furthermore, the means for controlling the electric energy output from the second electric source means to the alternate current charger eliminator means utilizes at least one of a peak-to-peak voltage and an offset voltage as a control parameter.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will be better understood from the following description, with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of an electrophotographic printer to which a toner image transferring device according to the present invention be applied;

Figure 2 is a block diagram of a comparative example of a toner image transferring device;

Figure 3 is a flow chart for explaining an operation of the toner image transferring device of Fig. 2;

Figure 4 is a time chart in relation to the flow chart of Fig. 3;

Figures 5(a), 5(b), and 5(c) are views showing steps of the operation of the toner image transferring device of Fig. 2;

Figure 6 is a graph showing a distribution of charge of a sheet or paper when using the toner image transferring device of Fig. 2;

Figure 7 is a graph showing a distribution of charge of a sheet or paper when using a prior toner image transferring device;

Figure 8 is a partial block diagram showing the toner image transferring device of Fig. 2 modified in accordance with an example of the present invention;

Figure 9 is a flow chart for explaining an operation of the toner image transferring device of Fig. 8;

Figure 10 is a time chart in relation to the flow chart of Fig. 9;

Figure 11 is a graph showing a distribution of charge of a sheet or paper when using the prior toner image transferring device of Fig. 8;

Figure 12(a) is a block diagram of another type toner image transferring device according to the present invention, which is applied to the electrophotographic printer of Fig. 1;

Figure 12(b) is a view explaining an offset voltage and peak-to-peak voltage of an alternate current;

Figure 13 is a flow chart for explaining an operation of the toner image transferring device of Fig. 12;

Figure 14 is a time chart in relation to the flow chart of Fig. 13;

Figures 15(a), 15(b), and 15(c) are views showing steps of the operation of the toner image transferring device of Fig. 12;

Figure 16 is a graph showing a distribution of charge of a sheet or paper when using the toner image transferring device of Fig. 12;

Figure 17 is a block diagram of a modification of the toner image transferring device of Fig. 12(a), which is applied to another type electrophotographic printer;

Figure 18 is a flow chart for explaining an operation of the toner image transferring device of Fig. 17;

Figure 19 is a time chart in relation to the flow chart of Fig. 18;

Figures 20(a), 20(b), and 20(c) are views showing steps of the operation of the toner image transferring device of Fig. 17; and

Figures 21(a), 21(b), 21(c), 21(d), 21(e), and 21(f) are time charts showing various control parameters selected for the operation of the toner image transferring device of Fig. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows an electrophotographic printer to which a toner image transferring device according to the present invention is applied. The electrophotographic printer includes a rotary photosensitive drum 10, as a toner image carrying body, which may be formed of an aluminum cylindrical hollow element and a photoconductive insulating film such as an amorphous silicone film (a-Si) bonded thereto. During operation, the drum 10 is rotated in a direction as indicated by an arrow A. The printer also includes a charger 12, a toner developing device 14, a transfer charger 16, and a cleaner 18, which are successively disposed around the photosensitive drum 10 in the direction of rotation thereof. A sheet or paper P is introduced into a clearance between the drum 10 and the transfer charger 16, in a direction as shown by an arrow B. The printer further includes a toner image fixing device 20 disposed downstream of the transfer charger 16 in the direction of travel of the paper P.

The charger 12 may comprise a corona discharger, which is arranged to give the positive charges (+) to the photoconductive insulating film of the photosensitive drum 10, so that a uniform distribution of the positive charges (+) is produced on the drum surface, as shown in Fig. 1. The electrophotographic printer is provided with an optical writing means such as a laser beam scanner, an LED (light emitting diode) array, an LCS (liquid crystal shutter) array, or the like for forming an electrostatic latent image on the charged area of the photosensitive drum 10. As shown in Fig. 1, the charged area of the drum 10 is illuminated with a light beam 22 emitted from the optical writing means, and

the charges are released from the illuminated zone, indicated by reference numeral 24, so that a potential difference between the illuminated zone and the remaining zone forms an electrostatic latent image (*i.e.*, the illuminated zone 24) on the drum surface.

The toner developing device 14 comprises a vessel 14a for holding a developer or toner, and a developing roller 14b provided within the vessel 14a in such a manner that a portion of the developing roller is exposed therefrom and faces the surface of the photosensitive drum 10. For example, when a two-component developer composed of a toner component (colored fine synthetic resin particles) and a magnetic component (magnetic fine carrier) is used, the developing roller 14b is formed as a magnetic roller so that the magnetic carriers with toner particles are magnetically adhered to the magnetic roller surface to form a magnetic brush therearound, and by rotating the magnetic roller 14b carrying the magnetic brush, the toner particles are brought to the surface of the photosensitive drum 10 for development of the electrostatic latent image formed thereon. Since the uniform distribution of the positive charges (+) is produced on the drum surface as mentioned above, a two-component developer is prepared so that the toner particles are positively charged by a triboelectrification to the magnetic carriers. During the development process, the toner particles having the positive charges are electrostically adhered to the electrostatic latent image zone, as if the latent image zone or low potential zone is charged with the positive toner particles, whereby the developed image or toner image can be obtained as a visible image. Note, in Fig. 1, the positive toner particles are indicated by a symbol ⊕.

The transfer charger 16, which may also comprise a corona discharger, forms a part of the toner image transferring device according to the present invention. The transfer charger 16 is arranged to give a negative charge (-) to the paper P introduced into the clearance between the photosensitive drum 10 and the transfer charger 16, as shown in Fig. 1, whereby when the paper P is given a negative charge, the positive toner particles forming the toner image are electrostatically transferred to the paper. The paper P carrying the transferred toner image is then passed through the toner image fixing device 20, which comprises a heat roller 20a and a backup roller 20b. In particular, when the paper P is passed through the rollers 20a and 20b, the transferred toner particles are heat-fused by the heat roller 20a so that the transferred toner image is heat-fixed to the paper P. Note, in Fig. 1, the fixed toner particles are indicated by reference numeral 26. The residual toner particles not transferred to the paper P are removed from the surface of the photosensitive drum 10 by the cleaner 18, which may comprise a fur brush element 18a. The cleaned surface of the drum is illuminated by a lamp (not shown), so as to eliminate the charges therefrom, and is then given a positive charge (+) by the charger 12.

Referring to Figure 2, although the electrophotographic printer of Fig. 1 is only partially shown, the toner image transferring device of a comparative example is incorporated therein. As shown in this drawing, the printer includes a pair of nail members 28 (only one illustrated in Fig. 2) which engage with the surface of the photosensitive drum 10 at the side edges thereof to separate the leading edge of the paper therefrom and prevent an entanglement of the paper P with the drum 10. The nail member 28, which may be formed of a suitable hard rubber material, is pivotally mounted to a pin element 28a. The nail member 28 is provided with a torsion spring 28b which acts on the nail member 28 and the pin element 28a so that a nail edge 28c of the nail member 28 is resiliently biased against the drum surface.

As shown in Fig. 2, the electrophotographic printer also includes a pair of feed rollers 30 driven by an electric motor 30a such as a stepping motor, a servomotor or the like, whereby the paper P is introduced into the clearance between the photosensitive drum 10 and the transfer charger 16. While the paper P is conveyed from a paper supply station (not shown) toward the feed rollers 30, the motor 30a is driven, and when the leading edge portion of the paper P enters between the feed rollers 30, the electric motor 30a is once stopped so that the paper P is stood. This standby condition is detected by a suitable photosensor 30b disposed in the vicinity of the feed rollers 30. Namely, the photosensor 30b generates a standby-signal when the paper P is stood. Note, in Fig. 2, reference numeral 32 indicates a pair of guide plate elements by which the paper P is guided when introduced into the clearance between the drum 10 and the charger 16, and reference 34 indicates a guide plate element by which the paper P is guided while passing therethrough.

As shown in Fig. 2, the optical writing means for writing an electrostatic latent image on the surface of the electrophotographic drum 10 is formed as a laser beam scanner 36, which includes a laser beam generator 36a such as a semiconductor laser device for emitting a laser beam LB, and a polygon mirror 36b for deflecting the laser beam LB from a left position indicated by L to a right position indicated by R, to scan the drum surface with the deflected laser beam. During the scanning operation, the laser beam LB is intermittently emitted on the basis of video data or image data obtained from a word processor, a microcomputer or the like, whereby the electrostatic latent image is formed as a dot image on the drum surface. Note, the dot image is formed from a plurality of dot lines formed in parallel to each other in the scaning direction. The laser beam scanner 36 also includes a reflector element 36c for receiving and reflecting the laser beam deflected to the left position L, and a

beam sensor 36d for detecting the laser beam reflected by the reflector element 36c. Namely, the beam sensor 36d generates a beam detecting signal when the laser beam LB is deflected to the left position L by the polygon mirror 36b.

The toner image transfer device includes an electric source 38 for applying a direct current to a corona wire 16a of the transfer charger 16, and a control circuit 40 for carrying out an ON/OFF control of the electric source 38. Note, the control circuit 40 forms a part of the electrophotographic printer mentioned above, and commands the overall operation thereof. The printer control circuit 40 may be constructed by a microcomputer, as shown in Fig. 2, which comprises a central processing unit (CPU) 40a, a read-only memory (ROM) 40b for storing routines, constants, etc., a random access memory (RAM) 40c for storing temporary data, and an input/output interface (I/O) 40d.

As shown in Fig. 2, the photodetector 30b is connected to the I/O 40d through an analog-to-digital (A/D) converter 42, so that the standby-signal generated by the photodetector 30b is fetched as digital datum by the printer control circuit 40. A driver circuit 44 for driving the electric motor 30a is also connected to the I/O 40d, so that the electric motor 30a is commanded by the printer control circuit 40. Furthermore, the beam sensor 36d is connected to the I/O 40d through an amplifier circuit 46 and an analog-to-digital (A/D) converter 48, so that the beam detecting signal generated by the beam detector 36d is fetched as digital datum by the printer control circuit 40.

As shown in Fig. 2, the printer control circuit 40 is connected to a host control circuit 50, which may be incorporated into a word processor, a microcomputer or the like, and which comprises a central processing unit (CPU) 50a, first and second input/output interfaces (I/O) 50b and 50c connected to the I/O 40d of the printer control circuit 40, a code buffer 50d for temporarily storing character code data successively read from a memory means such as a floppy disk, a character generator 50e for converting the character code data into image data, and an image memory 50f for temporarily storing the data.

When the printer control circuit 40 fetches the standby-signal generated by the photosensor 30b, or when the paper P is standing for the transfer of the toner image thereto, a signal demanding image data to be recorded on the paper P (one page) is output from the printer control circuit 40 to the host control circuit 50. When the host control circuit 50 receives the image data demanding signal, the character code data stored in the buffer 50d is converted into the image data by the character generator 50e, and is then stored in the image memory 50f. When the image data to be recorded on the paper P (one page) is stored in the image memory 50f, a signal allowing a writing of the image data on, the photosensitive drum 10 is output from the host control circuit 50 to the printer control circuit 40. Whenever the beam detecting signal is generated by the beam sensor 36d after the printer control circuit 40 receives the writing-allowing signal from the host control circuit 50, a horizontal synchronizing signal is output from the printer control circuit 40 to the host control circuit 50, and accordingly, the image data corresponding to one dot line of the dot image is output from the image memory 50f to the printer control circuit 40, whereby the dot image (electrostatic latent image) can be properly formed on the photosensitive drum 10 in such a way that the dot lines are aligned with each other in the direction perpendicular to the scanning direction. On the other hand, when the beam detecting signal is first generated by the beam sensor 36d after the writing-allowing signal is received by the printer control circuit 50, a timing signal is output by the printer control circuit 40 and the electric motor 44 is driven to release the paper P from the standby-condition, whereby the toner image is transferred from the photosensitive drum 10 to the paper at a proper position thereon.

The operation of the toner image transferring device of Fig. 2 will be now explained with reference to Figures 3, 4 and 5. The operation may be carried out, for example, under the following conditions:

(1) The photosensitive drum 10 with the amorphous silicone film (a-Si) has a diameter of 120 mm, and is rotated at a peripheral speed of 240 mm/s.

(2) The uniform distribution of positive charges having a potential of +700 V is formed on the photosensitive drum 10, and the electrostatic latent image 24 formed thereon has a potential of about +100 V.

(3) The latent image 24 is developed with the two-component developer, and a developing bias voltage of +450 V is applied to the developing roller 14b.

(4) The electric source 38 outputs a direct current of -200 μA to the transfer charger 16, when made ON.

(5) A time of 532 ms passes while the paper P is moved from the standby-position to a position at which the leading edge thereof reaches an inlet of the clearance between the photosensitive drum 10 and the transfer charger 16.

(6) The printer control circuit 40 is arranged so that the electric source 38 is made ON when 172 ms have elapsed from the time at which the leading edge of the paper P reaches the clearance inlet. Namely, when 704 ms have elapsed from the time at which the paper P is released from the standby-condition, the electric source 38 is made ON for the transfer of the toner image to the paper P.

Figure 3 shows a routine for the ON/OFF control of the electric source 38 which is executed by interruptions output at intervals of 4 ms, Fig. 4 shows a

time chart with relation to the routine of Fig. 3, and Figs. 5(a), 5(b) and 5(c) are views showing the steps of the operation.

At step 301, it is determined whether the timing signal is high or low; *i.e,* it is determined whether or not the paper P has been released from the standby-condition. If the timing signal rises, as shown in Fig. 4, *i.e.*, the paper P has been released from the standby-condition, the control proceeds to step 302 in which a counter C_H is incremented by 1. Then, at step 303, it is determined whether or not the counter C_H has counted up 176 (704 ms). If C_H < 176 (704 ms), the control jumps from step 303 to step 304, in which a counter C_L is reset, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C_H is only incremented by 1 until the count number thereof reaches 176 (704 ms).

As apparent from the above, when the counter C_H has a count number of 133 (532 ms), the leading edge of the paper P has reached only the inlet of the clearance between the photosensitive drum 10 and the transfer charger 16. Accordingly, when a count number of the counter C is less than 133 (532 ms), the paper P cannot enter the clearance between the drum 10 and the transfer charger 16, as shown in Fig. 5(a). At this time, the electric source 38 is made OFF, as shown in Fig. 4. When a count number of the counter C_H exceeds 133 (532 ms), the leading edge portion of the paper P is introduced into the clearance between the drum 10 and the transfer charger 16, to be partially entered therebetween, as shown in Fig. 5(b). The electric source 38, however, is still made OFF until the counter C_H has a count number of 176 (704 ms), as shown in Fig 4.

When the count number of the counter C_H reaches 176 (704 ms) at step 303, the paper P is completely intervened between the photosensitive drum 10 and the transfer charger 16, as shown 5(c), and thus the control proceeds from step 303 to step 304, in which the electric source 38 is made ON. Namely, a power ON/OFF signal, which is output from the printer countrol circuit 40 to the electric source 38, rises as shown in Fig. 4, so that a direct current of -200 μA is applied to the transfer charger 16, whereby the toner image is transferred from the photosensitive drum 10 to the paper P.

When the writing of the electrostatic latent image to be recorded on the paper P (one page) on the photosensitive drum 10 is completed, the timing signal falls as shown in Fig. 4, and when the timing signal becomes low, the control proceeds from step 301 to step 306 in which the counter C_L is incremented by 1. Then, at step 307, it is determined whether or not the counter C_L has a count number of 176 (704 ms). If C_L < 176 (704 ms), the control jumps from step 307 to step 309 in which the counter C_H is reset. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C_L is only incremented by 1 until the count number thereof reaches 176 (704 ms).

When the count number of the counter C_L reaches 173 (704 ms), the transfer of the toner image to the paper P can be completed, and thus the control proceeds from step 307 to step 308 in which the power ON/OFF signal falls as shown in Fig. 4, so that the electric source 38 is made OFF.

In the operation as mentioned above, after the leading edge portion (*i.e.*, margin zone) of the paper P is introduced into the clearance between the photosensitive drum 10 and the transfer charger 16, the electric source 38 for the transfer charger 16 is energized so that the leading edge portion of the paper P is not excessively charged by the transfer charger 16. Accordingly, the electrostatic attraction between the paper P and the photosensitive drum 10 can be greatly reduced, and thus the leading edge portion of the paper P can be easily separated from the drum 10 without becoming entangled therewith.

When using the toner image transferring device as shown in Fig. 2, an actual measurement of the charge of the paper P was made. For this measurement, a potentiometer was disposed in the vicinity of an outlet of the clearance between the photosensitive drum 10 and the transfer charger 16, whereby a potential of the paper P was measured while the paper P passed through the clearance between the drum 10 and the transfer charger 16. The results are shown in Figure 6, in which the origin of the abscissa scale and the 1250 ms division thereof correspond to the leading and trailing edges of the paper P, respectively. As apparent from the distribution of charges shown in Fig. 6, an amount of charge held by the leading edge portion of the paper P was very small.

On the contrary, Figure 7 shows a distribution of charges obtained when using a prior toner image transferring device, wherein the transfer charger is energized before the paper arrives thereat. As apparent from this drawing, a volume of charge held by the leading edge portion of the paper is very large. This is because, as stated hereinbefore, an amount of electric charge fed from the transfer charger to the photosensitive drum is very large when the paper is not intervened therebetween so that, when the leading edge of the paper is introduced into the clearance between the drum and the transfer charger, a portion of the electric charge to be fed to the drum is added to the charge at the leading edge portion of the paper.

Figure 8 shows the comparative example of Fig. 2, modified in accordance with an example of the present invention, in that another type electric source 38′ is substituted for the electric source 38. The electric source 38′ is arranged so as to supply two different levels of electric energy to the transfer charger 16, by a power change signal generated in the printer control circuit 40.

The operation of the toner image transferring de-

vice of Fig. 8 will be now explained with reference to Figures 9 and 10. The operation may be carried out under the same conditions as in in Fig. 2 except that the electric source 38′ supplies a direct current of -100 μA or -200 μA to the transfer charger 16.

Figure 9 shows a routine for the output control of the electric source 38′ which is executed by interruptions output at intervals of 4 ms, and Fig. 10 shows a time chart with relation to the routine of Fig. 9.

At step 901, it is determined whether the timing signal is high or low; *i.e.*, it is determined whether or not the paper P has been released from the standby-condition. If the timing signal rises, as shown in Fig. 10, *i.e.*, that the paper P has been released from the standby-condition, at step 902 it is determined whether or not the power change signal is low or high. if the power change signal is low, the control proceeds to step 903, in which it is determined whether a flag F_1 is "1" or "0". If $F_1 = 1$, a counter C_H is incremented by 1 at step 904. Then, at step 905, it is determined whether or not the count number of the counter C_H has reached 133 (532 ms). If $C_H < 133$ (532 ms), the control jumps from step 905 to step 914, in which a counter C_L is reset, and then the routine is once completed. The routine is repeatedly executed at intervals of 4 ms, but the counter C_H is only incremented by 1 until the count number thereof reaches 133 (532 ms).

At step 905, when a count number of the counter C_H is 133 (532 ms), *i.e.*, when the leading edge of the paper P has reached the inlet of the clearance between the photosensitive drum 10 and the transfer charger 16, the control proceeds to step 906 in which the flag F_1 is made "0". Then, at step 907, the power ON/OFF signal rises, as shown in Fig. 10, so that the electric source 38′ for the transfer charger 16 is made ON, whereby a direct current of -100 μA is applied from the electric source 38′ to the transfer charger 16, because the power change signal is low.

When the electric source 38′ is made ON, the control proceeds to step 908 in which the counter C_H is cleared. At step 909, the counter C_H is incremented by 1, and then the control proceeds to step 910 in which it is determined whether or not the count number of the counter C_H is 43 (172 ms). If $C_H < 43$ (172 ms), the control jumps from step 910 to step 914 in which the counter C_L is cleared, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C_H is only incremented by 1 until the count number thereof reaches 43 (172 ms), because the control merely jumps from step 903 to step 909. Note, the flag F_1 is "0".

When a count number of the counter C_H reaches 43 (172 ms), *i.e.*, when the paper P is completely intervened between the photosensitive drum 10 and the transfer charger 16, the control proceeds from step 910 to step 911, in which the power change signal becomes high, as shown in Fig. 10, so that the direct current applied from the electric source 38′ to the transfer charger 16 is changed from -100 μA to -200 μA. Then, at step 912, the flag F_1 is made "1", and at step 913, a flag F_2 is made "1". After the counter C_L is cleared at step 914, the routine is once completed, and thereafter, the routine is repeatedly executed at intervals of 4 ms but the status is maintained as is as long as the timing signal is high, because the control merely jumps from step 902 to 914. Note, the power change signal is high.

When the writing of the electrostatic latent image to be recorded on the paper P (one page) on the photosensitive drum 10 is completed, the timing signal falls as shown in Fig. 10. When the timing signal becomes low, the control proceeds from step 901 to step 915 in which it is determined whether or not the power change signal is high or low. At this time, since the power change signal is high, the control proceeds to step 916 in which the counter C_L is incremented by 1. Then, at step 917, it is determined whether or not the count number of the counter C_L has reached 176 (704 ms). If $C_L < 176$ (704 ms), the control jumps from step 917 to step 924, in which a counter C_H is reset, and then the routine is once completed. The routine is repeatedly executed at intervals of 4 ms, but the counter C_L is only incremented by 1 until the count number of the counter C_L reaches 176 (704 ms).

When the count number of the counter C_L reaches 173 (704 ms), the transfer of the toner image to the paper P can be completed, and thus the control proceeds from step 917 to step 918 in which the power change signal falls, as shown in Fig. 10, so that the direct current applied from the electric source 38′ to the transfer charger 16 is changed from -200 μA to -100 μA.

Then, at step 919, the counter C_L is reset, and the control proceeds to step 920 in which the counter C_L is imcremented by 1. At step 921, it is determined whether or not the count number of the counter C_L has reached 55 (220 ms). If $C_L < 55$ (220 ms), the control jumps from step 921 to step 924, in which the counter C_H is cleared, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C_L is only incremented by 1 until the count number thereof reaches 55 (220 ms), because the control merely jumps from step 915 to step 920 through step 925. Note, the power change signal is low, and the flag F_2 is "1".

If the timing signal again becomes high until the count number of the counter C_L reaches 55 (220 ms), *i.e.*, if the timing signal rises after 172 ms has elapsed from a time when the power change signal falls, as shown in Fig. 10, the operation as mentioned above is repeated so that the transfer of the toner image to the next paper is carried out. On the other hand, if the timing signal does not become high until a count number of the counter C_L reaches 55 (220 ms), the control proceeds from step 921 to step 922, in which the pow-

er ON/OFF signal falls, as shown in Fig. 10 (left side), and then at step 923, the flag F_2 is made "0". After the counter C_H is cleared, the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the status is maintained as is as long as the timing signal is low, because the control proceeds from step 901 to step 915, and then jumps from step 925 to step 924. Namely, the transfer charger 16 cannot be energized until the timing signal rises.

In the operation as mentioned above, after the leading edge portion (namely, margin zone) of the paper P enters the clearance between the photosensitive drum 10 and the transfer charger 16, the electric source 38 for the transfer charger 16 is energized at the high level (-200 μA) so that the leading edge portion of the paper P is not excessively charged by the transfer charger 16. Accordingly, the electrostatic attraction between the paper P and the photosensitive drum 10 can be greatly reduced, and thus the leading edge portion of the paper P can be easily separated from the drum 10 without becoming entangled therewith.

When using the toner image transferring device as shown in Fig. 8, an actual measurement of the charge held by the paper P was made. The measurement was carried out in the same manner as in the embodiment of Fig. 2, and the results are shown in Figure 11. As apparent from the distribution of charges shown in Fig. 11, the leading edge portion of the paper P was not excessively charged.

In the embodiment shown in Fig. 8, although the electric source 38′ comprises a direct current source, a direct current voltage source may be substituted therefor. Also, although the nail members 28 are used to separate the leading edge of the paper P from the photosensitive drum 10, they may be omitted, if desired, since the separation can be properly carried out only by preventing an excessive charging of the leading edge portion of the paper P.

Figure 12(a) shows another embodiment of the toner image transferring device according to the present invention. This embodiment modifies the comparative example of Fig. 2, in that a transfer charger assembly 52 is substituted for the transfer charger 38, and that a DC source 54 and an AC source 56 are used for the transfer charger assembly 52. The transfer charger assembly 52 includes a transfer charger 52a and an AC charge eliminator 52b integrated as one body, and the DC source 54 and the AC source 56 supply electric energy to the transfer charger 52a and the AC charge eliminator 52b, respectively. The DC source 54 is the same type as the electric source 38′; *i.e.*, the DC source 54 is arranged so as to supply the electric energy at two different levels to the transfer charger 52a, by a DC power change signal generated in the printer control circuit 40. The AC source 56 is also arranged so as to supply the electric energy at two different levels to the AC charge eliminator 52b, by an AC power change signal generated in the printer control circuit 40.

The operation of the toner image transferring device of Fig. 12(a) will be now explained with reference to Figures 13, 14, and 15. The operation may be carried out under the same conditions as in Fig. 2, except for the following conditions:

(1) The DC source 54 supplies a direct current of -100 μA or -200 μA to the transfer charger 52a.

(2) The AC source 56 supplies an alternate current voltage (peak-to-peak) of 12 biased with an offset voltage of 100 V or an alternate current voltage (peak-to-peak) of 12 KV biased with an offset voltage of 750 V. Note, as shown in Fig. 12(b), the peak-to-peak voltage is defined as an amplitude width of the AC voltage, and the offset voltage is defined as a voltage for shifting the AC voltage along the potential axis.

(3) A time of 532 ms elapses while the paper P is moved from the standby-position to a position at which the leading edge thereof reaches an inlet of the clearance between the photosensitive drum 10 and the transfer charger 16, and a time of 172 ms elapses while the leading edge of the paper P is moved from the clearance inlet to an outlet thereof.

Figure 13 shows a routine for the power change control of the DC and AC sources 54 and 56 which is executed by interruptions output at intervals of 4 ms, Fig. 14 shows a time chart with relation to the routine of Fig. 13, and Figs. 15(a), 15(b) and 15(c) are views showing the steps of the operation.

At step 1301, it is determined whether the timing signal is high or low; *i.e.* it is detemined whether or not the paper P has been released from the standby-condition. If the timing signal rises, as shown in Fig. 14, showing that the paper P has been released from the standby-condition, the control proceeds to step 1302 in which it is determined whether a flag F_1 is "1" or "0". If F_1 = "1", the control proceeds to step 1303, in which it is determined whether a flag F_2 is "1" or "0". If F_2 = "1", the control proceeds to step 1304 in which a counter C is incremented by 1, and then at step 1305, it is determined whether or not the count number of the counter C has reached 133 (532 ms). If C < 133 (532 ms), the control jumps from step 1305 to step 1316, in which a counter SC is reset, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 133 (532 ms).

At step 1305, when the count number of the counter C reaches 133 (532 ms), *i.e.*, when the leading edge of the paper P has reached the inlet of the clearance between the photosensitive drum 10 and the transfer charger assembly 52 as shown in Fig. 15(a), the control proceeds to step 1306 in which the flag F_1 is made "0". Then, at step 1307, the DC and AC power

ON/OFF signals rise to make the DC and AC sources 54 and 56 ON, and at step 1308, the DC and AC power change signals rise, so that the direct current of -100 μA and the alternate current voltage of 12 KV (offset voltage of 750 V) are applied by the DC and AC sources 54 and 56 to the transfer charger 52a and the AC charge eliminator 52b, respectively, as shown in Fig. 14.

At step 1309, the counter C is reset, and then the control proceeds to step 1310 in which the counter C is incremented by 1. At step 1311, it is determined whether or not the count number of the counter C has reached 43 (172 ms). If C < 43 (172 ms), the control jumps from step 1311 to step 1316 in which the counter SC is reset, and then the routine is once completed. Thereafter, the routine is repeatedly executed at a time of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 43 (172 ms).

When the count number of the counter C reaches 43 (172 ms), *i.e.*, when the leading edge of the paper P has reached the outlet of the clearance between the photosensitive drum 10 and the transfer charger assembly 52, as shown 15(c), the control proceeds from step 1311 to step 1312, in which the DC and AC power change signals fall so that the direct current of -100 μA and the alternate current voltage of 12 KV (offset voltage of 750 V) applied to the transfer charger 52a and the AC charge eliminator 52b are changed to the direct current of -200 μA and the alternate current voltage of 12 KV (offset voltage of 100 V), respectively, as shown in Fig. 14, whereby the transfer of the toner image to the paper P is started. When a count number of the counter C is less than 43 (172 ms), the paper P is only partially intervened between the photosensitive drum 10 and the transfer charger assembly 52, as shown in Fig. 15(b). In this case, the DC and AC power change signals are kept high so that the leading edge portion of the paper is not excessively charged.

Then, at step 1313, the flag F_1 is made "1", and at step 1314, the flag F_2 is made "0". Then successively, at step 1315 the counter C is reset, and at step 1316 the counter SC is cleared, whereby the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the status is maintained as is as long as the timing is high, because the control merely jumps from step 1303 to 1316.

Note, the flag F_1 is "1", and the flag F_2 is "0".

When the writing of the electrostatic latent image to be recorded on the paper P (one page) is completed, the timing signal falls as shown in Fig. 14.

When the timing signal becomes low, the control proceeds to step 1301 to step 1317, in which the flag F_2 is made "1". At step 1318, the counter SC is incremeted by 1, and then at step 1319, it is determined whether or not the count number of the counter SC has reached 188 (752 ms). If SC < 188 (752 ms), the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 188 (752 ms).

If the timing signal again becomes high until the count number of the counter SC reaches 188 (752 ms), as shown in Fig. 14, the operation as mentioned above is repeated so that the transfer of the toner image to the next paper is carried out. On the other hand, if the timing signal does not become high until the count number of the counter C_L reaches 188 (752 ms), the control proceeds from step 1318 to step 1320, in which the DC and AC power ON/OFF signals fall, as shown in Fig. 14 (left side), and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the status is maintained as is as long as the timing signal is low. Namely, the transfer charger 52a and the AC charge eliminator 52b cannot be energized until the timing signal becomes high.

When using the toner image transferring device as shown in Fig. 12(a), an actual measurement of the charqe of the paper P was made. The measurement was carried out in the same manner as in the comparative example of Fig. 2, and the results are shown in Figure 16. As apparent from the distribution of charges shown in Fig. 11, the leading edge portion of the paper P was not excessively charged.

Figure 17 shows a modification of the embodiment as shown in Fig. 12(a), but the toner image transferring device of Fig. 17 is incroporated into another type electrophotographic printer. The electrophotographic printer as shown in Fig. 17 features an air suction endless belt conveyer assembly 58 including a pair of pulleys 58a and 58b, an endless belt element 58c entrained over the pulleys 58a and 58b, and a suction box member 58d associated with the endless belt element 58c. The pulley 58a is driven by an electric motor (not shown) in the clockwise direction in Fig. 17, and the pulley 58b acts as a driven pulley. The endless belt element 58c has a plurality of perforations formed therein, which are disposed in the running direction of the endless belt element 58c. The suction box member 58d is provided with a fan element 58e for drawing a vacuum therefrom, and an air suction port member 58d having an elongated suction port, which is in slidable contact with an inner surface of the endless belt element 58c, whereby the paper leaving the clearance between the photosensitive drum 10 and the transfer charger assembly 52 is sucked up against the endless belt element 58c, and it then conveyed to the toner image fixing station (not shown).

In Fig. 17, a location on the photosensitive drum 10 at which an electrostatic latent image is written by the scanning laser beam LB emitted from the laser beam scanner 36 is indicated by an arrow C. By rota-

tion of the drum 10, the location is moved via the toner developing device (not shown) toward the transfer charger assembly 52. In the printer of Fig. 17, a time of 532 ms elapses while the location indicated by the arrow C is moved from the position at which the latent image is written to a first position at which the location is 15 mm short of an inlet of the clearance between the drum 10 and the transfer charger assembly 52. Also, a time of 108 ms elapses while the location is moved from the first position to a second position defined by a boundary between the transfer charger 52a and the AC charger eliminator 52b. Furthermore, a time of 64 ms elapses while the location is moved from the second position to a third position defined by an outlet of the clearance between the drum 10 and the transfer charger assembly 52.

In the embodiment of the toner image transferring device shown in Fig. 17, the transfer charger 52a and the AC charger eliminator 52b are energized by a DC source 54′ and an AC source 56′ which are substantially identical to the transfer charger 54 and the AC charger eliminator 56 in that they are arranged so as to supply electric energy at two different levels to the transfer charger 52a and the AC charger eliminator 52b.

The operation of the toner image transferring device of Fig. 17 will be now explained with reference to Figures 18, 19 and 20. The operation may be carried out under the same conditions as in Fig. 12(a), except for the following:

(1) The DC source 54′ supplies a direct current of -100 μA or -200 μA to the transfer charger 54′.

(2) The AC source 56′ supplies an alternate current voltage (peak-to-peak) of 12 KV biased with an offset voltage of 110 V or an alternate current voltage (peak-to-peak) of 14 KV biased with an offset voltage of 750 V.

(3) A time of 532 ms passes while the paper P is moved from the standby-position to a position at which the leading edge thereof is 15 mm short of the inlet of the clearance between the drum 10 and the assembly 52. Then, while the paper is moved to a position at which the leading edge thereof reaches the boundary between the transfer charger 52a and the AC charger eliminator 52b, a time of 108 ms passes. Then successively, while the paper P is moved to the outlet of the clearance between the drum 10 and the assembly 52, a time of 64 ms passes. Namely, the movement of the paper P is synchronized with the rotation of the drum 10.

Figure 18 shows a routine for the power change control of the DC and AC sources 54′ and 56′ which is executed by interruptions output at intervals of 4 ms, Fig. 19 shows a time chart with relation to the routine of Fig. 18, and Figs. 20(a), 20(b) and 20(c) are views showing the steps of the operation.

At step 1801, it is determined whether the timing signal is high or low; *i.e.*, it is detemined whether or not the paper P has been released from the standby-condition. If the timing signal rises, as shown in Fig. 14, showing that the paper has been released from the standby-condition, the control proceeds to step 1802 in which it is determined whether a flag F_1 is "1" or "0". If F_1 = "1", the control proceeds to step 1803, in which it is determined whether a flag F_2 is "1" or "0". If F_2 = "1", the control proceeds to step 1804 in which a counter C is imcremented by 1, and then at step 1805, it is determined whether or not the count number of the counter C has reached 133 (532 ms). If C < 133 (532 ms), the control jumps from step 1805 to step 1824, in which a counter SC is reset, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 133 (532 ms).

At step 1805, when the count number of the counter C reaches 133 (532 ms), *i.e.*, when the paper P has been moved from the standby-position to the position at which the leading edge thereof is 15 mm short of the inlet of the clearance between the photosensitive drum 10 and the transfer charger assembly 52 as shown in Fig. 19(a), the control proceeds to step 1806 in which the DC power ON/OFF signal rises to make the DC source 54′ ON, and at step 1807, the DC power change signals rise, so that the direct current of -100 μA is applied by the DC sources 54′ to the transfer charger 52a, as shown in Fig. 20.

At step 1808, the flag F_1 is made "0", and then at step 1809, the counter C is reset. The control proceeds to step 1810 in which the counter is incremented by 1, and then at step 1911, it is determined whether or not the count number of the counter C has reached 27 (108 ms). If C < 27 (108 ms), the control jumps from step 1811 to step 1824 in which the counter SC is reset, and then the routine is once completed. Thereafter, the routine is repeatedly executed at a time of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 27 (108 ms). Note, the flag F_1 is "0", and a flag F_3 is "1" at step 1825.

At step 1811, when the count number of the counter C reaches 27 (108 ms), *i.e.,* when the leading edge of the paper P has reached the boundary between the transfer charger 52a and the AC charger eliminator 52b as shown in Fig. 20(b), the control proceeds to step 1812 in which the DC power change signal falls as shown in Fig. 19, so that the direct current of -100 μA applied to the transfer charger 52a is changed to the direct current of -200 μA. Then, at step 1813, the AC power ON/OFF signal rises to make the AC source 56′ ON, and at step 1814, the AC power change signal rises as shown in Fig. 19, so that the alternate current voltage of 14 KV (offset voltage of 750 V) is applied to the AC charger eliminator 52b, as shown in Fig. 19.

At step 1815, the flag F_3 is made "0", and then at

step 1316, the counter C is reset. The control proceeds to step 1817 in which the counter is incremented by 1, and then at step 1818, it is determined whether or not the count number of the counter C has reached 16 (64 ms). If C < 16 (64 ms), the control jumps from step 1818 to step 1824 in which the counter SC is reset, and then the routine is once completed. Thereafter, the routine is repeatedly executed at a time of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 16 (64 ms). Note, the flags F_1 and F_3 are "0".

At step 1818, when the count number of the counts C reaches 16 (64 ms), *i.e,* when the leading edge of the paper P has reached the outlet of the clearance between the drum 10 and the transfer charger assembly 52 as shown in Fig. 20(c), the control proceeds to step 1819 in which the AC power change signal falls as shown in Fig. 19, so that the alternate current voltage of 14 KV (offset voltage of 750 V) applied to the AC charger eliminator 52b is changed to the alternate current voltage of 12 KV (offset voltage of 110 V).

Then, at step 1820 the flag F_1 is made "1", at step 1821 the flag F_2 is made "0", and at step 1822 the flag F_3 is made "1". Then successively, at step 1823 the counter C is reset, at step 1824 the counter SC is cleared, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the status is maintained as is as long as the timing is high, because the control merely jumps from step 1803 to 1824. Note, the flag F_1 is "1", and the flag F_2 is "0".

When the writing of the electrostatic latent image to be recorded on the paper P (one page) is completed, the timing signal falls as shown in Fig. 19. When the timing signal becomes low, the control proceeds to step 1801 to step 1826, in which the flag F_2 is made "1". At step 1827, the counter SC is incremeted by 1, and then at step 1828, it is determined whether or not the cont number of the counter SC has reached 188 (752 ms). If SC < 188 (752 ms), the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the counter C is only incremented by 1 until the count number thereof reaches 188 (752 ms).

If the timing signal again becomes high until the count number of the counter SC reaches 188 (752 ms), the operation as mentined above is repeated so that the transfer of the toner image to the next paper is carried out. On the other hand, if the timing signal does not become high until the count number of the counter C_L reaches 188 (752 ms), the control proceeds from step 1828 to step 1829, in which the DC and AC power ON/OFF signals fall, as shown in Fig. 19, and then the routine is once completed. Thereafter, the routine is repeatedly executed at intervals of 4 ms, but the status is maintained as is as long as the timing signal is low. Namely, the transfer charger 52a and the AC charge eliminator 52b cannot be energized until the timing signal becomes high.

When using the toner image transferring device as shown in Fig. 17, the leading edge portion of the paper P was not excessively charged, as the preceeding embodiments. Accordingly, it is possible to easily separate the paper P only by using the air suction endless belt conveyer assembly 58.

In the embodiment of Fig. 17, although all of the direct current, the peak-to-peak voltage, and the offset voltage are used as control parameters, it should be understood that the control can be carried out by using at least one of these control parameters, as shown in Figures 21(a) to 21(f).

In the embodiments of Figs. 12(a) and 17, although the DC sources 54 and 54′ comprise a direct current source, a direct current voltage source may be substituted therefor.

In all of the embodiments mentioned above, although the timing signal based on the beam detecting signal is used to synchronize the movement of the paper with the rotation of the drum, another signal may be utilized therefor.

Claims

1. A toner image transferring device for electrostatically transferring a charged toner image electrostatically held by a toner image carrying body (10) to a sheet or paper (P), said toner image transfer device comprising:

transfer charger means (16) disposed in the vicinity of said toner image carrying body (10) to form a clearance therebetween for feeding an electric charge to the sheet or paper (P) while said sheet or paper is passed therethrough; electric source means (38′) for supplying an electric energy to said transfer charger means (16) to thereby give the sheet or paper an electric charge having a polarity opposite to that of the charge of the toner image; and

means for controlling the electric energy output from said electric source means to said transfer charger means (16) in such a manner that said transfer charger means gives the sheet or paper (P) an amount of electric charge necessary for the transfer of the toner image when the sheet or paper is completely intervened between said toner image carrying body (10) and the transfer charger means characterised in that the electric source means comprises first electric source means (38′) whose electrical energy output to said transfer charger means gives the sheet or paper (P) a first amount of electric charge necessary for the transfer of the toner image only when the sheet or paper is completely intervened between said toner image carrying

body (10) and said transfer charger means (16) during the passage of the sheet or paper through the clearance therebetween, and that said transfer charger means (16) gives the sheet or paper a second amount of electric charge less than the first amount of electric charge when the leading edge of the sheet or paper is intervened between said toner image carrying body and said transfer charger means during the passage of the sheet or paper through said clearance therebetween, so that a leading edge zone of the sheet or paper has a charge value, resulting from said second amount of electric charge, which is substantially equal to that of the sheet or paper resulting from said first amount of electric charge.

2. A toner image transferring device as set forth in claim 1, further comprising:

alternate current charger eliminator means (52b) disposed adjacent to an outlet of said clearance from which the sheet or paper is discharged; and

second electric source means (56) for supplying an electric energy to said alternate current charger eliminator means (52b) to eliminate a given amount of electric charge from the sheet or paper (P) when leaving said clearance, in such a manner that a return of the transferred toner image from the sheet or paper to said toner image carrying body (10) is prevented.

3. A toner image transferring device as set forth in claim 1 or claim 2, wherein said toner image carrying body (10) comprises a photosensitive drum which is rotated to bring the toner image to said transfer charger means (16), and a means (40) is provided for synchronizing the movement of the sheet or paper (P) with the rotation of said photosensitive drum to transfer the toner image to the sheet or paper (P) at a proper position thereon.

4. A toner image transferring device as set forth in any of claims 1 to 3, wherein said electric source means (38′) comprises a direct current source.

5. A toner image transferring device as set forth in any of claims 1 to 3, wherein said electric source means (38′) comprises a direct current voltage source.

6. A toner image transferring device as set forth in claim 2, further comprising means for controlling the electric energy output from said second electric source means (56) to said alternate current charger eliminator means (52b) utilizes at least one of a peak-to-peak voltage or an offset voltage as a control parameter.

7. A printer comprising:

a toner image carrying body (10) having a charged toner image electrostatically held thereby;

transfer charger means (52a) disposed in a vicinity of said toner image carrying body to form a clearance therebetween for feeding an electric charge to the sheet or paper (P) while the sheet or paper is passed therethrough;

electric source means (54) for supplying an electric energy to said transfer charger means (52a) to give the sheet or paper an electric charge having a polarity opposite to that of the charge of the toner image;

means (40) for controlling an electric energy output from said electric source means (54) to said transfer charger means (52a) in such a manner that said transfer charger means gives the sheet or paper the first amount of electric charge necessary for the transfer of the toner image when the sheet or paper is completely intervened between said toner image carrying body (10) characterized in that the printer further comprises alternate current charger eliminator means (52b) disposed adjacent to an outlet of said clearance from which the sheet or paper is discharged, for eliminating a first amount of electric charge from the sheet or paper when the sheet or paper leaves said clearance; wherein the electric source means comprises first electric source means (38′) whose electrical energy output to said transfer charger means gives the sheet or paper (P) a first amount of electric charge necessary for the transfer of the toner image only when the sheet or paper is completely intervened between said toner image carrying body (10) and said transfer charger means (52a) during the passage of the sheet or paper through the clearance therebetween, and that said transfer charger means gives the sheet or paper a second amount of electric charge less than the first amount of electric charge when the leading edge of the sheet or paper is intervened between said toner image carrying body (10) and said transfer charger means (52a) during the passage of the sheet or paper through said clearance therebetween, so that a leading edge zone of the sheet or paper has a charge value, resulting from said second amount of electric charge, which is substantially equal to that of the sheet or paper resulting from said first amount of electric charge.

Patentansprüche

1. Tonerbildübertragungseinrichtung zum elektrostatischen Übertragen eines von einem Tonerbildträgerkörper (10) elektrostatisch gehaltenen

geladenen Tonerbildes auf ein Blatt oder Papier (P), welche Tonerbildübertragungseinrichtung umfaßt:

Übertragungsladermittel (16), welche in der Nähe dieses Tonerbildträgerkörpers (10) unter Bildung eines Zwischenraumes zwischen diesen angeordnet sind, um eine elektrische Ladung auf das Blatt oder Papier (P) aufzubringen, während dieses Blatt oder Papier (P) durch diesen hindurch geführt wird;

elektrische Quellenmittel (38′) zum Liefern von elektrischer Energie an diese Übertragungsladermittel (16), um dadurch dem Blatt oder Papier eine elektrische Ladung zu erteilen, die eine Polarität hat, welche der der Ladung des Tonerbildes entgegengesetzt ist; und

Mittel zum Steuern der elektrischen Energieabgabe von diesen elektrischen Quellenmitteln an die Übertragungsladermittel (16) in solch einer Weise, daß diese Übertragungsladermittel an das Blatt oder Papier (P) eine elektrische Ladungsmenge abgeben, die für die Übertragung des Tonerbildes erforderlich ist, wenn das Blatt oder Papier vollständig zwischen diesen das Tonerbildträgerkörper (10) und die Übertragungsladermittel getreten ist, dadurch **gekennzeichnet,** daß die elektrischen Quellenmittel erste elektrische Quellenmittel (38′) umfassen, durch deren elektrische Energieabgabe an diese Übertragungsladermittel an das Blatt oder Papier (P) eine erste, für die Übertragung des Tonerbildes erforderliche elektrische Ladungsmenge nur abgegeben wird, wenn das Blatt oder Papier vollständig zwischen diesen Tonerbildträgerkörper (10) und diese Übertragungsladermittel (16) während des Durchtrittes des Blattes oder Papiers durch den zwischen diesen bestehenden Zwischenraum getreten ist, und daß durch diese Übertragungsladermittel (16) an das Blatt oder Papier eine zweite elektrische Ladungsmenge abgegeben wird, welche geringer als die erste elektrische Ladungsmenge ist, wenn die Vorderkante des Blattes oder Papiers zwischen diesen Tonerbildträgerkörper und diese Übertragungsladermittel während des Durchtrittes des Blattes oder Papiers durch diesen dazwischen bestehenden Zwischenraum getreten ist, so daß eine Vorderkantenzone des Blattes oder Papiers einen aus dieser zweiten elektrischen Ladungsmenge resultierenden Ladungswert hat, welcher im wesentlichen gleich dem des Blattes oder Papiers ist, der aus dieser ersten elektrischen Ladungsmenge resultiert.

2. Tonerbildübertragungseinrichtung wie im Anspruch 1 dargelegt, die ferner umfaßt:

Wechselstrom-Ladeentfernermittel (52b), welche in der Nähe eines Ausganges dieses Zwischenraumes angeordnet sind, aus welchem das Blatt oder Papier ausgegeben wird; und

zweite elektrische Quellenmittel (56) zum Liefern einer elektrischen Energie an diese Wechselstrom-Ladeentfernermittel (52b), um einen vorgegebenen Betrag an elektrischer Ladung von dem Blatt oder Papier (P) zu entfernen, wenn dieses diesen Zwischenraum verläßt, derart, daß eine Rückübertragung des übertragenen Tonerbildes von dem Blatt oder Papier auf diesen Tonerbildträgerkörper (10) verhindert wird.

3. Tonerbildübertragungseinrichtung, wie in Anspruch 1 oder 2 dargelegt, bei welchem dieser Tonerbildträgerkörper (10) eine lichtempfindliche Trommel umfaßt, welche drehangetrieben wird, um das Tonerbild zu diesen Übertragungsladermitteln (16) zu bringen, und bei welchem Mittel (40) zum Synchronisieren der Bewegung des Blattes oder Papiers (P) mit der Drehung dieser lichtempfindlichen Trommel vorgesehen sind, um das Tonerbild auf das Blatt oder Papier (P) an einer korrekten Position auf demselben zu übertragen.

4. Tonerbildübertragungseinrichtung, wie in einem der Ansprüche 1 bis 3 dargelegt, bei welcher diese elektrischen Quellenmittel (38′) eine Gleichstromquelle umfassen.

5. Tonerbildübertragungseinrichtung, wie in einem der Ansprüche 1 bis 3 dargelegt, bei welcher diese elektrischen Quellenmittel (38′) eine Gleichspannungsquelle umfassen.

6. Tonerbildübertragungseinrichtung, wie in Anspruch 2 dargelegt, welche ferner Mittel zum Steuern der elektrischen Energieabgabe von diesen zweiten elektrischen Quellenmitteln (56) an diese Wechselstrom-Ladungsentfernermittel (52b) aufweist, welche zumindest eine der Größen, nämlich eine Scheitel-zu-Scheitel-Spannung oder eine Offsetspannung, als Steuerparameter verwendet.

7. Drucker, umfassend,

einen Tonerbildträgerkörper (10) mit einem auf diesem elektrostatisch gehaltenen geladenen Tonerbild;

Übertragungsladermittel (52a), welche in der Nähe dieses Tonerbildträgerkörpers unter Bildung eines Zwischenraumes zwischen diesen angeordnet ist, um eine elektrische Ladung auf das Blatt oder Papier (P) zu liefern, während das Blatt oder Papier durch diesen Zwischenraum hindurch geführt wird;

elektrische Quellenmittel (54) zum Liefern

einer elektrischen Energie an diese Übertragungsladermittel (52a), um an das Blatt oder Papier eine elektrische Ladung mit einer Polarität abzugeben, die der der Ladung des Tonerbildes entgegengesetzt ist;

Mittel (40) zum Steuern einer elektrischen Energieabgabe von diesen elektrischen Quellenmitteln (54) an diese Übertragungsladermittel (52a) in einer solchen Weise, daß diese Übertragungsladermittel an das Blatt oder Papier die erste elektrische Ladungsmenge abgeben, die für die Übertragung des Tonerbildes erforderlich ist, wenn das Blatt oder Papier vollständig zwischen diesen Tonerbildträgerkörper (10) getreten ist, dadurch **gekennzeichnet,** daß der Drucker ferner Wechselstrom-Ladungsentfernermittel (52b) umfaßt, die in der Nähe eines Ausganges dieses Zwischenraumes angeordnet sind, aus welchem das Blatt oder Papier ausgegeben wird, um eine erste elektrische Ladungsmenge von dem Blatt oder Papier zu entfernen, wenn das Blatt oder Papier diesen Zwischenraum verläßt;

bei welchem die elektrischen Quellenmittel erste elektrische Quellenmittel (38′) umfassen, durch deren elektrische Energieabgabe an diese Übertragungsladermittel an das Blatt oder Papier (P) eine erste elektrische Ladungsmenge, die für die Übertragung des Tonerbildes erforderlich ist, nur abgegeben wird, wenn das Blatt oder Papier vollständig zwischen diesen Tonerbildträgerkörper (10) und diese Übertragungsladermittel (52a) während des Durchlaufs des Blattes oder Papiers durch den dazwischen angeordneten Zwischenraum getreten ist, und daß durch diese Übertragungsladermittel an das Blatt oder Papier eine zweite elektrische Ladungsmenge abgegeben wird, die geringer als die erste elektrische Ladungsmenge ist, wenn die Vorderkante des Blattes oder Papiers zwischen diesen Tonerbildträgerkörper (10) und diese Übertragungsladermittel (52a) während des Durchganges des Blattes oder Papiers durch diesen dazwischen angeordneten Zwischenraum getreten ist, so daß eine Vorderkantenzone des Blattes oder Papiers einen aus dieser zweiten elektrischen Ladungsmenge resultierenden Ladungswert hat, welcher im wesentlichen gleich dem des Blattes oder Papiers ist, welcher aus dieser ersten elektrischen Ladungsmenge resultiert.

Revendications

1. Dispositif de transfert d'image de toner pour transférer électrostatiquement une image de toner chargée électrostatiquement maintenue par un corps comportant une image de toner (10) sur une feuille ou un papier (P), ledit dispositif de transfert d'image de toner comprenant :

un dispositif chargeur de transfert (16) disposé au voisinage dudit corps comportant l'image de toner (10) pour former un espace entre eux pour fournir une charge électrique à la feuille ou au papier (P) pendant que ladite feuille ou papier passe entre eux ;

un dispositif de source électrique (38′) pour fournir une énergie électrique audit dispositif chargeur de transfert (16) pour donner ainsi à la feuille ou au papier une charge électrique ayant une polarité opposée à celle de la charge de l'image de toner ; et

un dispositif pour commander l'énergie électrique fournie par ledit dispositif de source électrique audit dispositif chargeur de transfert (16) de manière à ce que ledit dispositif chargeur de transfert donne à la feuille ou au papier (P) une quantité de charges électriques nécessaire au transfert de l'image de toner lorsque la feuille ou le papier est complètement interposé entre ledit corps comportant l'image de toner (10) et le dispositif de chargeurs de transfert caractérisé en ce que le dispositif de source électrique comprend un premier dispositif de source électrique (38′) dont l'énergie électrique fournie audit dispositif chargeur de transfert ne donne à la feuille ou au papier (P) une première quantité de charges électriques nécessaire au transfert de l'image de toner que lorsque la feuille ou le papier est complètement interposé entre ledit corps comportant l'image de toner (10) et ledit dispositif chargeur de transfert (16) pendant le passage de la feuille ou du papier via l'espace entre eux, et en ce que ledit dispositif chargeur de transfert (16) donne à la feuille ou au papier une seconde quantité de charges électriques inférieure à la première quantité de charges électriques lorsque le bord avant de la feuille ou du papier est interposé entre ledit corps comportant l'image de toner et ledit dispositif chargeur de transfert pendant le passage de la feuille ou du papier à travers ledit espace entre eux, de sorte qu'une zone de bord avant de la feuille ou du papier a une valeur de charges, résultant de ladite seconde quantité de charges électriques, qui est substantiellement égale à celle de la feuille ou du papier résultant de ladite première quantité de charges électriques.

2. Dispositif de transfert d'image de toner selon la revendication 1, comprenant en outre :

un dispositif éliminateur de charges à tension alternative (52b) disposé au voisinage d'une sortie dudit espace à partir duquel la feuille ou le papier est déchargé ; et

un second dispositif de source électrique (56) pour fournir une énergie électrique audit dis-

positif éliminateur de charges à tension alternative (52b) pour éliminer une quantité donnée de charges électriques de la feuille ou du papier (P) lorsqu'elle quitte ledit espace, de manière à empêcher un retour de l'image de toner transférée de la feuille ou du papier vers ledit corps comportant l'image de toner (10).

3. Dispositif de transfert d'image de toner selon la revendication 1 ou la revendication 2, dans lequel ledit corps portant l'image de toner (10) comprend un tambour photosensible qui est mis en rotation pour apporter l'image de toner audit dispositif chargeur de transfert (16), et un dispositif (40) est fourni pour synchroniser le déplacement de la feuille ou du papier (P) avec la rotation dudit tambour photosensible pour transférer l'image de toner à la feuille ou au papier (P) à une position appropriée sur celui-ci.

4. Dispositif de transfert d'image de toner selon l'une quelconque des revendications 1 à 3, dans lequel ledit dispositif de source électrique (38′) comprend une source de courant continu.

5. Dispositif de transfert d'image de toner selon l'une quelconque des revendications 1 à 3, dans lequel ledit dispositif de source électrique (38′) comprend une source de tension continue.

6. Dispositif de transfert d'image de toner selon la revendication 2, comprenant en outre un dispositif pour commander l'énergie électrique fournie par ledit second dispositif de source électrique (56) audit dispositif éliminateur de charges à tension alternative (52b), qui utilise au moins une tension crête à crête ou une tension de décalage comme paramètre de commande.

7. Imprimante comprenant :

un corps comportant une image de toner (10) ayant une image de toner chargée électrostatiquement maintenue sur celui-ci ;

un dispositif chargeur de transfert (52a) disposé au voisinage dudit corps comportant l'image de toner pour former un espace entre eux pour fournir une charge électrique à la feuille ou au papier (P) pendant que la feuille ou le papier passe à travers celui-ci ;

un dispositif de source électrique (54) pour fournir une énergie électrique audit dispositif chargeur de transfert (52a) pour donner à la feuille ou au papier une charge électrique ayant une polarité opposée à celle de la charge de l'image de toner ;

un dispositif (40) pour commander une énergie électrique fournie par ledit dispositif de source électrique (54) audit dispositif chargeur de transfert (52a) de manière à ce que ledit dispositif chargeur de transfert donne à la feuille ou au papier la première quantité de charges électriques nécessaire au transfert de l'image de toner lorsque la feuille ou le papier est complètement interposé entre ledit corps comportant l'image de toner (10) caractérisé en ce que l'imprimante comprend en outre un dispositif éliminateur de charges à tension alternative (52b) disposé au voisinage d'une sortie dudit espace à partir duquel la feuille ou le papier est déchargé, pour éliminer une première quantité de charges électriques de la feuille ou du papier lorsque la feuille ou le papier quitte ledit espace ; dans lequel le dispositif de source électrique comprend un premier dispositif de source électrique (38′) dont l'énergie électrique fournie audit dispositif chargeur de transfert ne donne à la feuille ou au papier (P) une première quantité de charges électriques nécessaire au transfert de l'image de toner que lorsque la feuille ou le papier est complètement interposé entre ledit corps comportant l'image de toner (10) et ledit dispositif de chargeurs de transfert (52a) pendant le passage de la feuille ou du papier à travers l'espace entre eux, et en ce que ledit dispositif chargeur de transfert donne à la feuille ou au papier une seconde quantité de charges électriques inférieure à ladite première quantité de charges électriques lorsque le bord avant de la feuille ou du papier est interposé entre ledit corps comportant l'image de toner (10) et ledit dispositif chargeur de transfert (52a) pendant le passage de la feuille ou du papier à travers ledit espace entre eux, de sorte qu'une zone de bord avant de la feuille ou du papier a une valeur de charges, résultant de ladite seconde quantité de charges électriques, qui est substantiellement égale à celle de la feuille ou du papier résultant de ladite première quantité de charges électriques.

Fig. 1

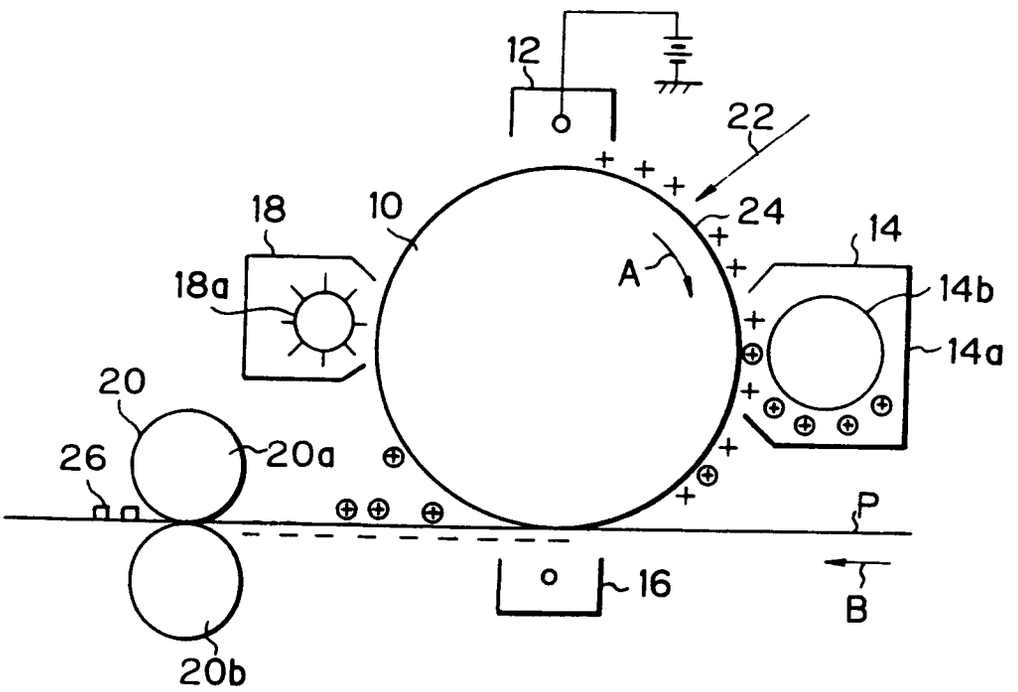


Fig. 2

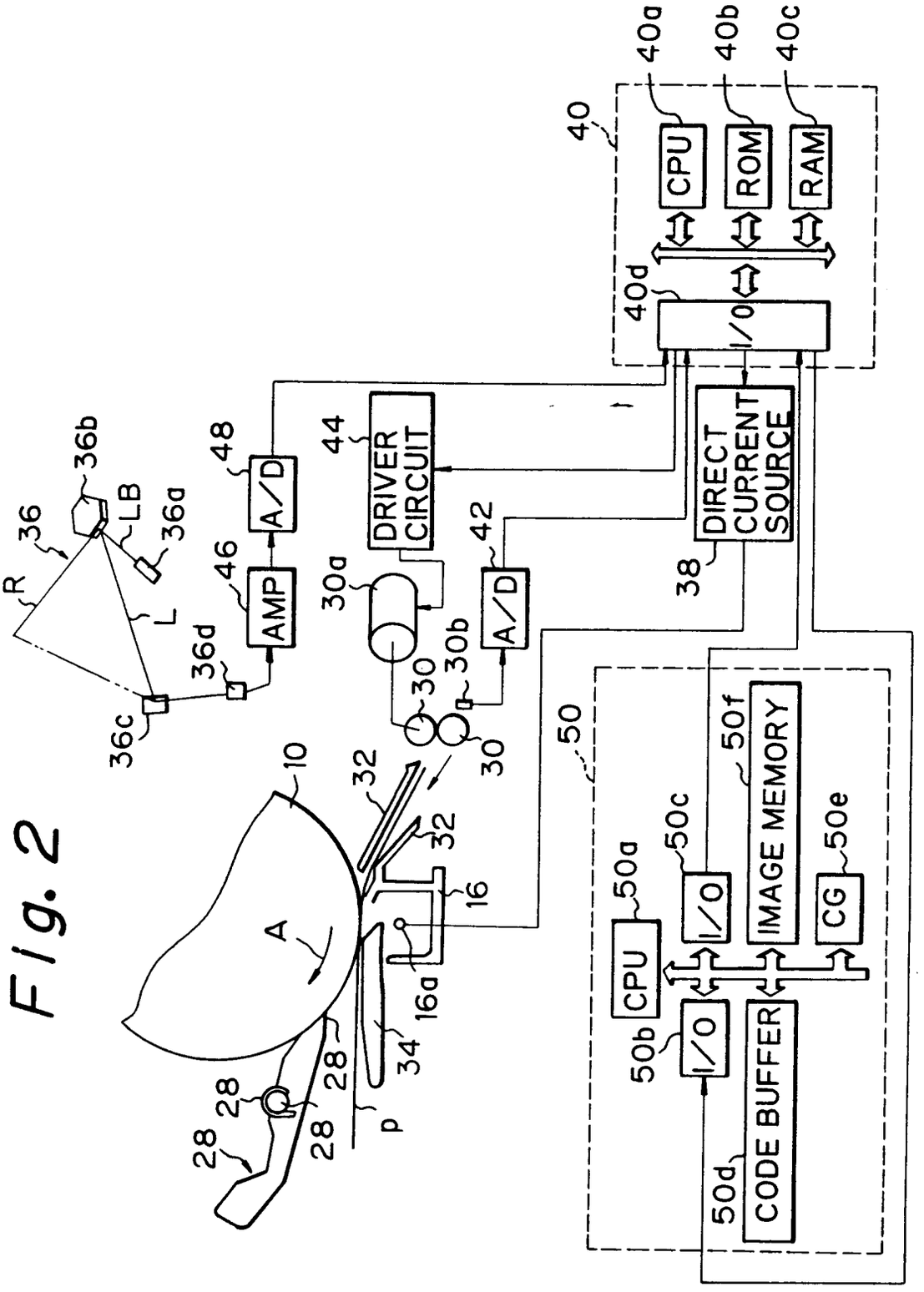

40
40a
40b
40c
CPU
ROM
RAM
40d
I/O
DIRECT CURRENT SOURCE
38
DRIVER CIRCUIT
44
A/D
48
AMP
46
A/D
42
36
36a
36b
36c
36d
LB
R
L
30a
30
30b
32
16
16a
34
10
A
28
p
50
50a
CPU
50b
I/O
50c
I/O
50d
CODE BUFFER
50e
CG
50f
IMAGE MEMORY

Fig. 3

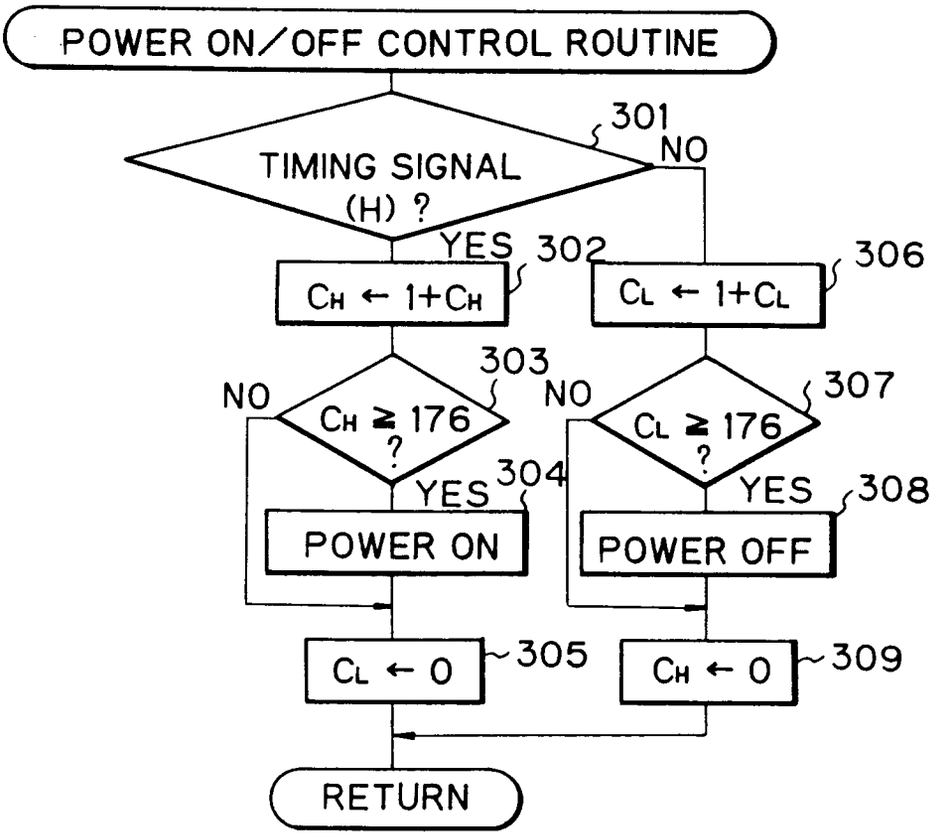

POWER ON/OFF CONTROL ROUTINE
TIMING SIGNAL (H) ?
301
NO
YES
302
CH ← 1+CH
306
CL ← 1+CL
303
NO
CH ≧ 176 ?
307
NO
CL ≧ 176 ?
YES
304
POWER ON
YES
308
POWER OFF
CL ← 0
305
CH ← 0
309
RETURN

Fig. 4

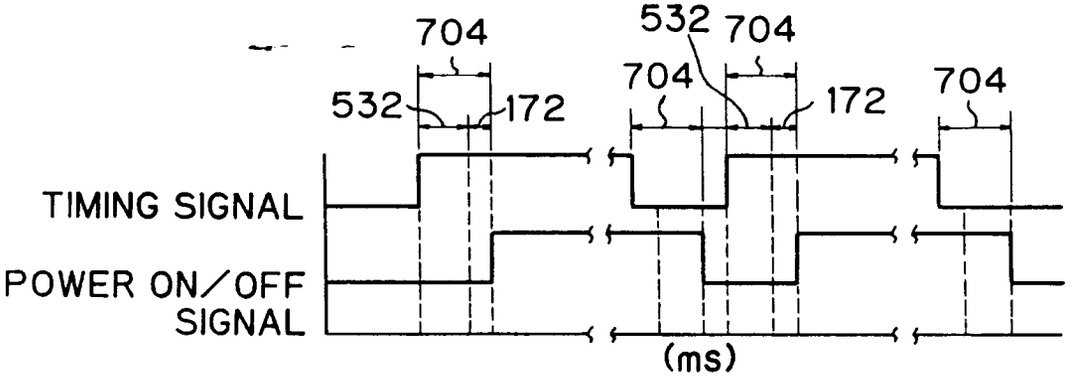

704
532
172
704
532
704
172
704
TIMING SIGNAL
POWER ON/OFF SIGNAL
(ms)

Fig. 5

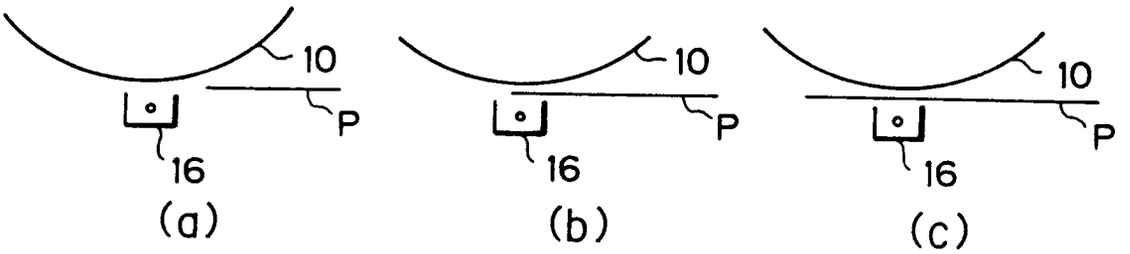

10
P
16
(a)
10
P
16
(b)
10
P
16
(c)

Fig. 6

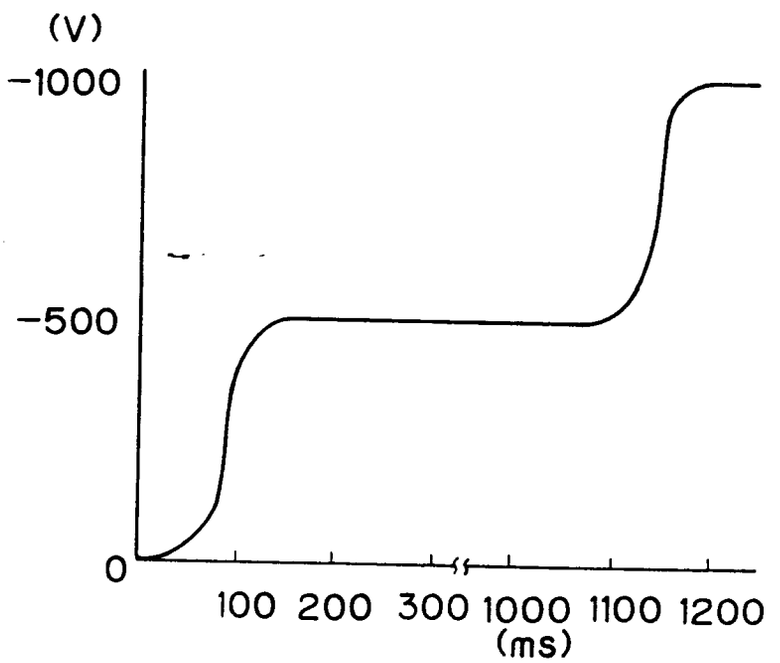

(V)
-1000
-500
0
100 200 300 1000 1100 1200
(ms)

Fig. 7

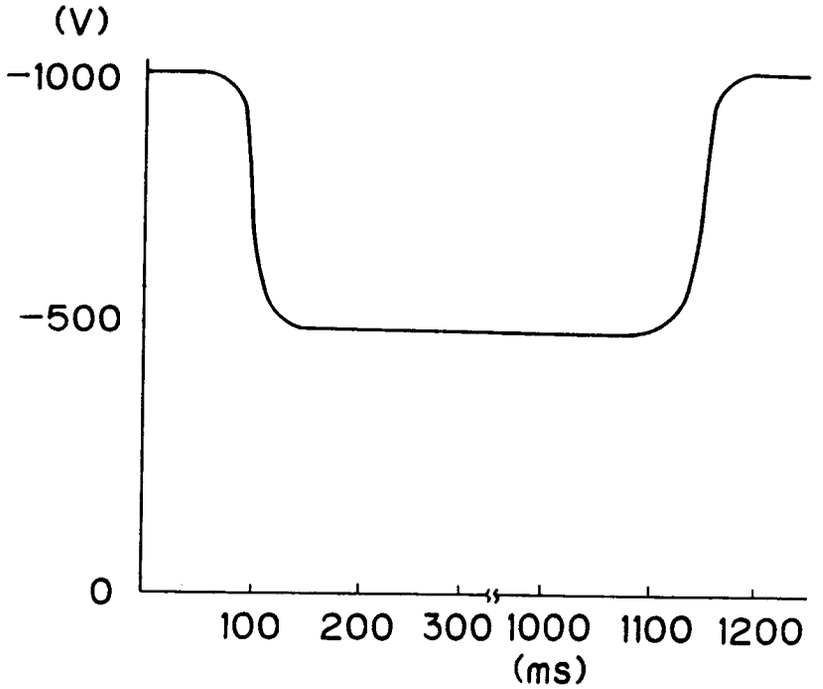

(V)
-1000
-500
0
100
200
300
1000
1100
1200
(ms)

Fig. 8

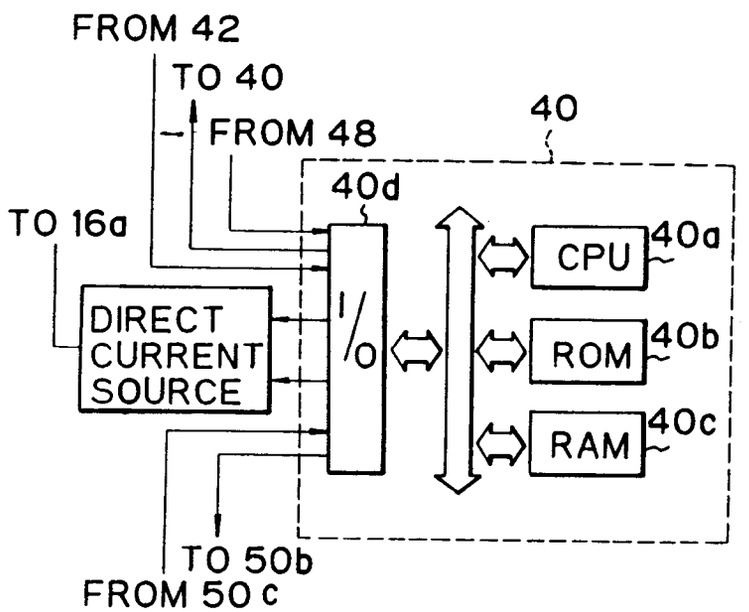

FROM 42
TO 40
FROM 48
40
40d
TO 16a
DIRECT CURRENT SOURCE
I/O
CPU
40a
ROM
40b
RAM
40c
TO 50b
FROM 50 c

Fig. 9

Fig. 9A

Fig. 9A | Fig. 9B

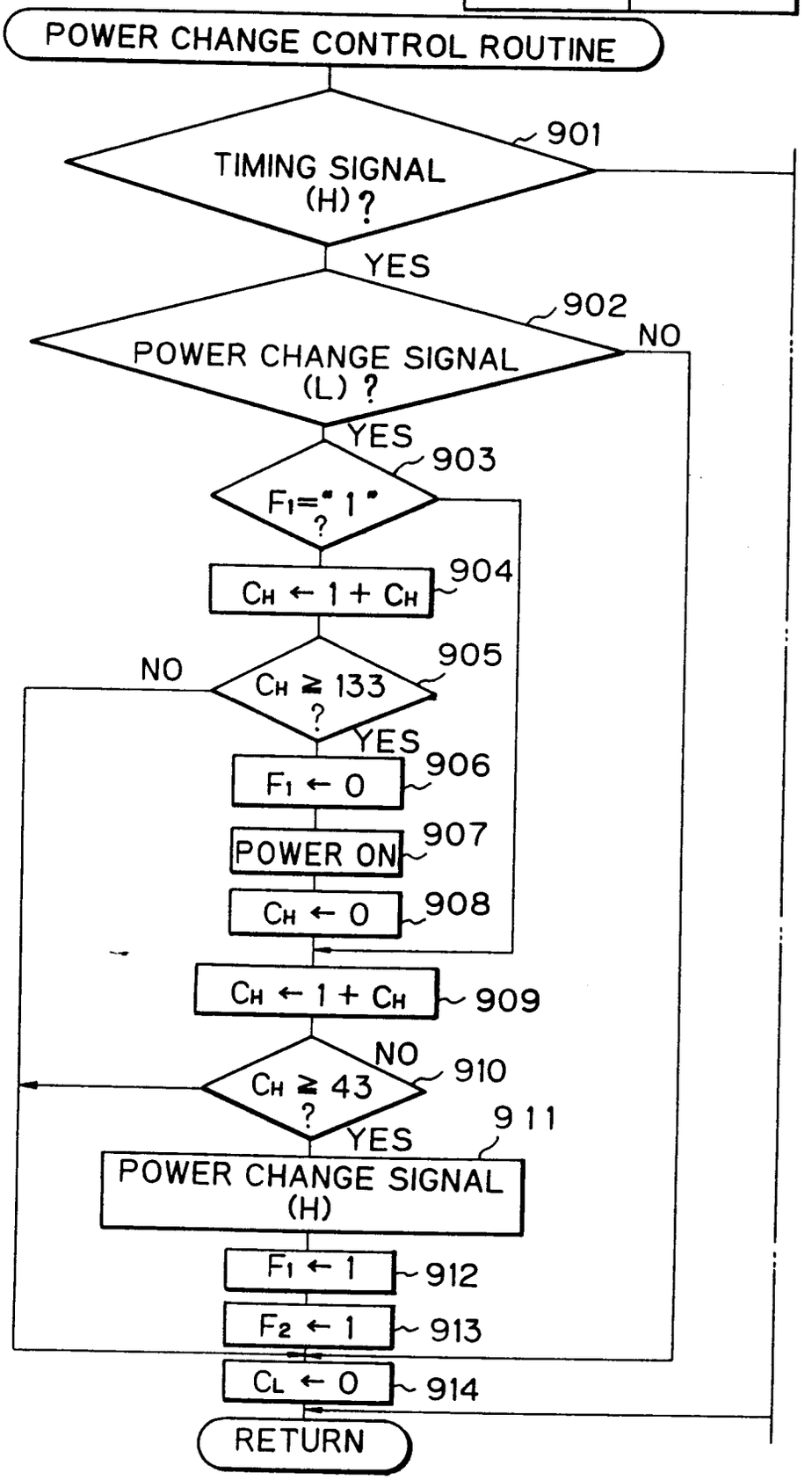


Fig. 9B

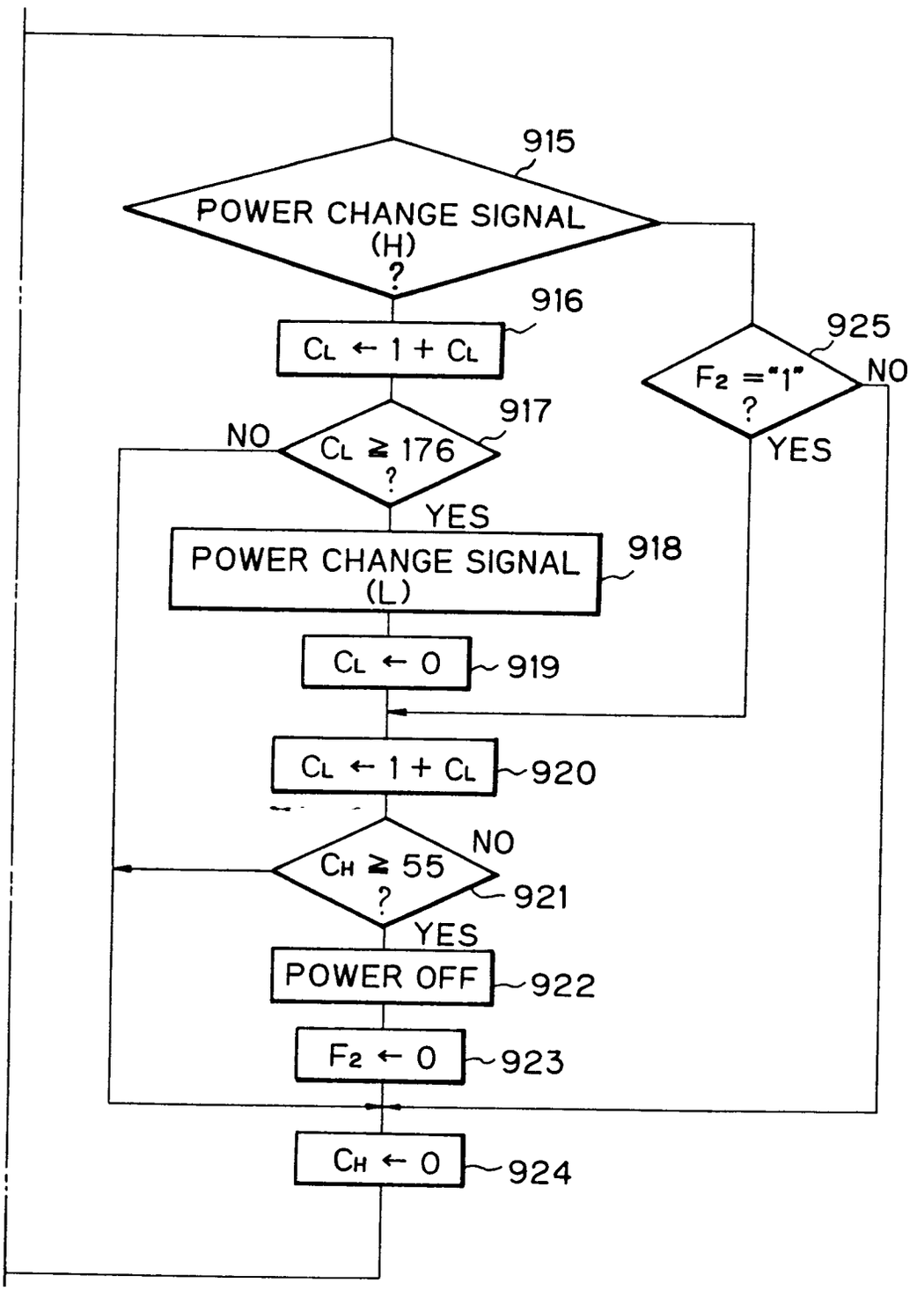

915
POWER CHANGE SIGNAL (H) ?
916
CL ← 1 + CL
917
CL ≧ 176 ?
NO
YES
925
F2 = "1" ?
NO
YES
POWER CHANGE SIGNAL (L)
918
CL ← 0
919
CL ← 1 + CL
920
CH ≧ 55 ?
NO
921
YES
POWER OFF
922
F2 ← 0
923
CH ← 0
924

Fig. 10

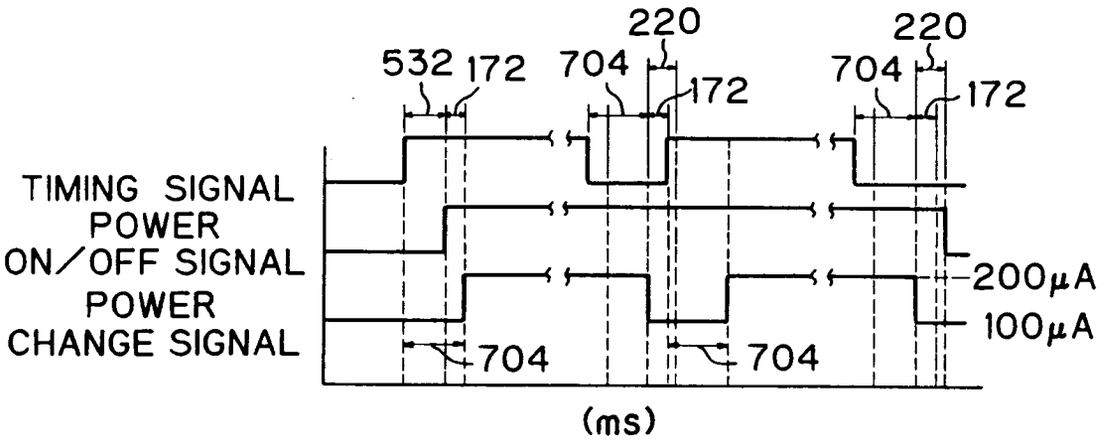
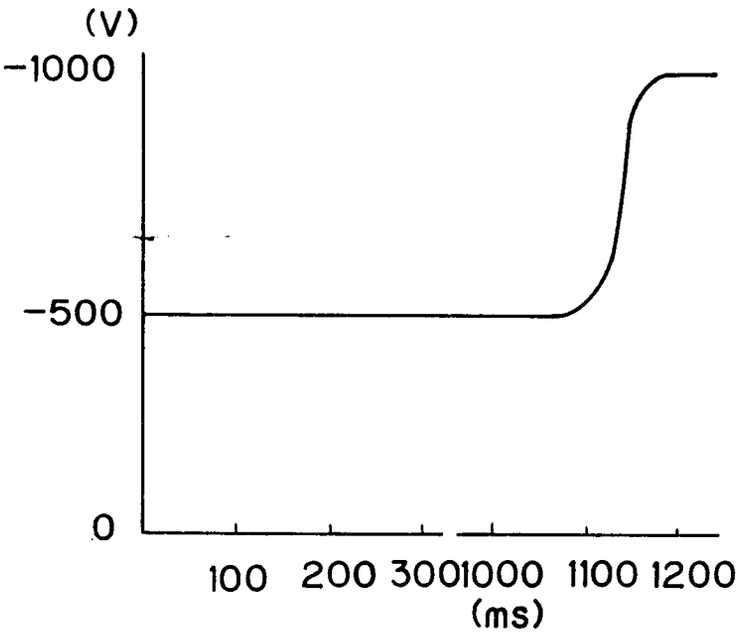

220
220
532
172
704
172
704
172
TIMING SIGNAL
POWER
ON/OFF SIGNAL
POWER
CHANGE SIGNAL
200μA
100μA
704
704
(ms)

Fig. 11


(V)
-1000
-500
0
100
200
300
1000
1100
1200
(ms)

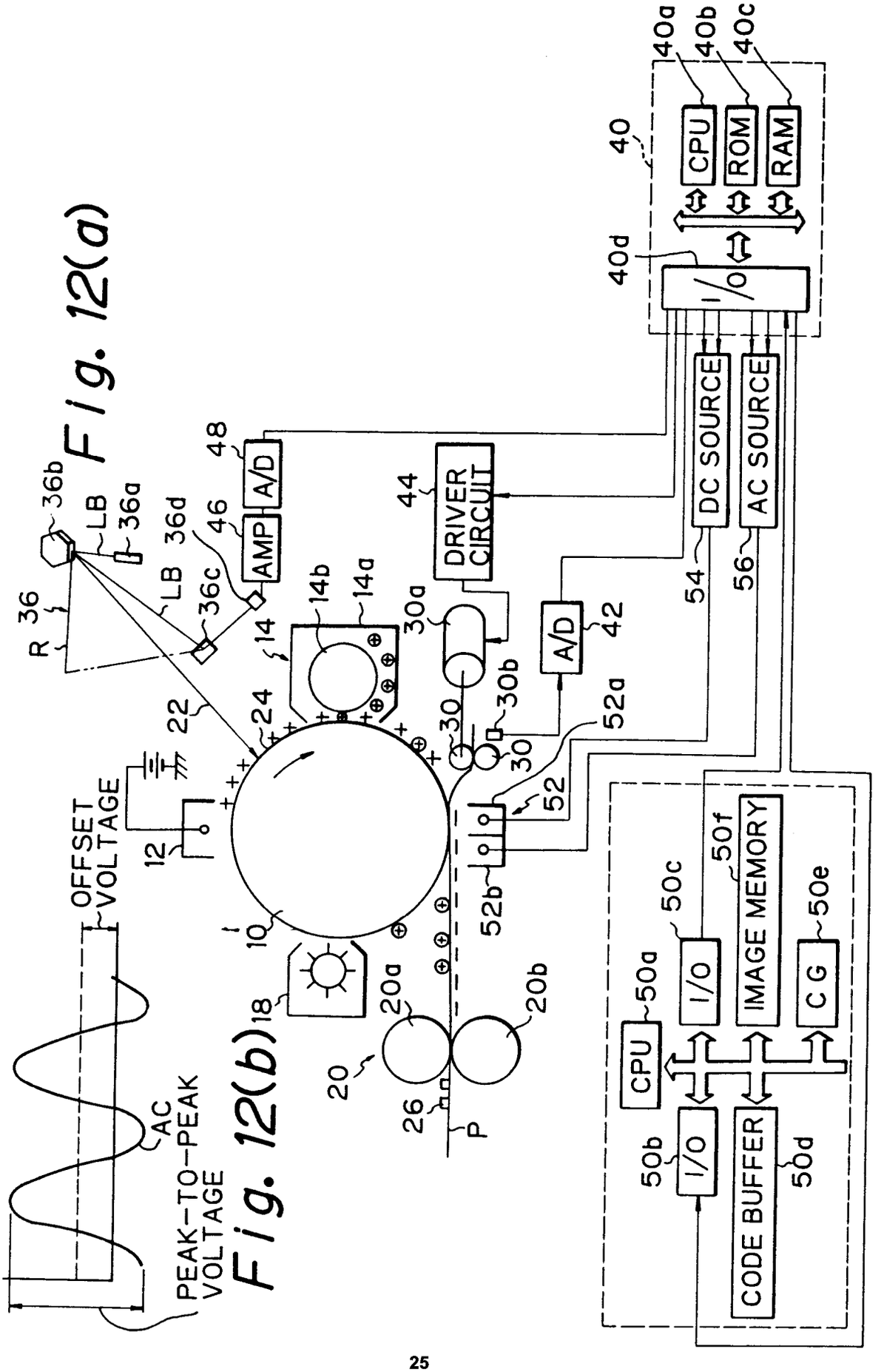


Fig. 12(b)

Fig. 12(a)

Fig. 13

Fig. 13A

Fig. 13A	Fig. 13B

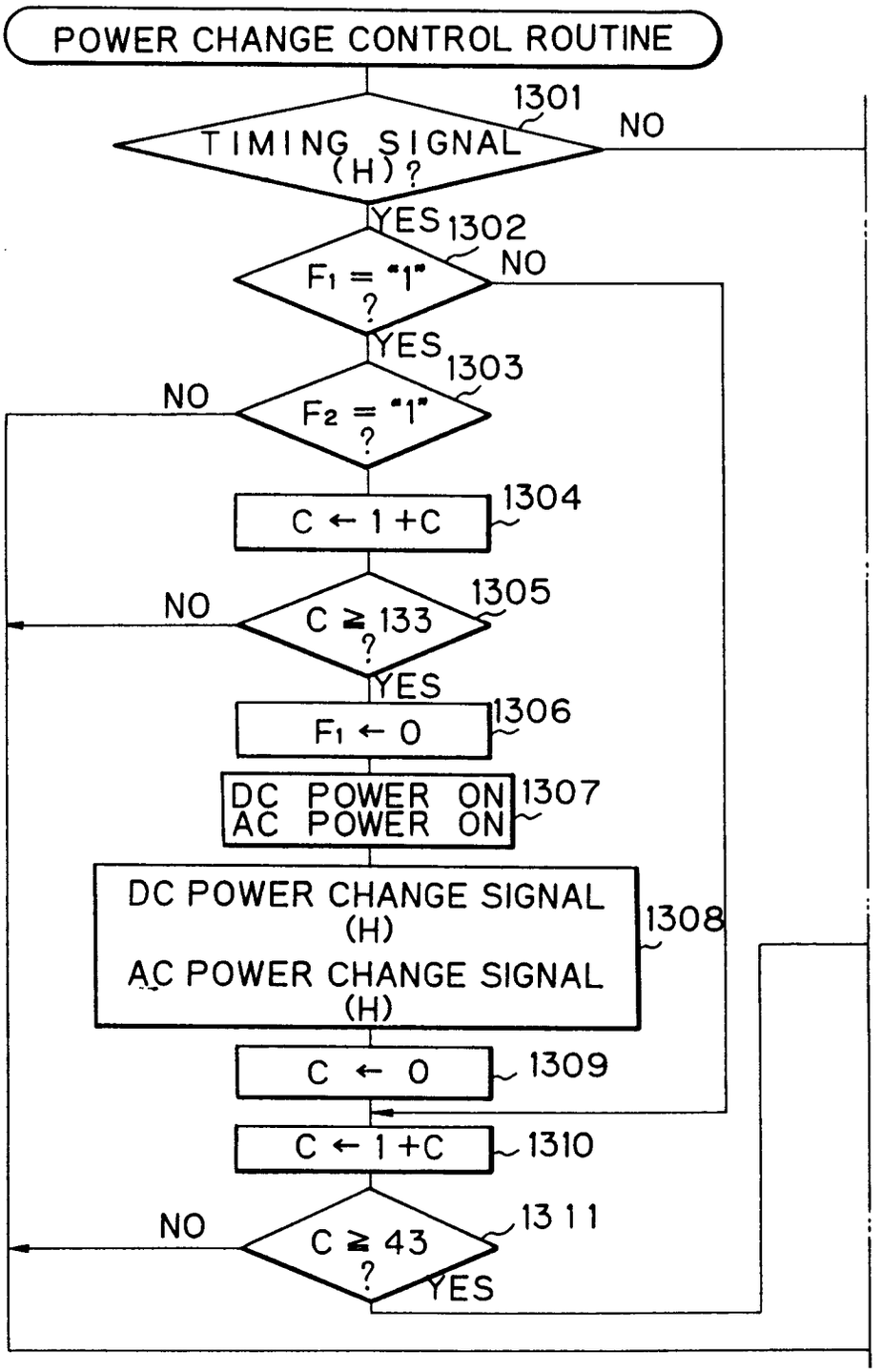


Fig. 13B

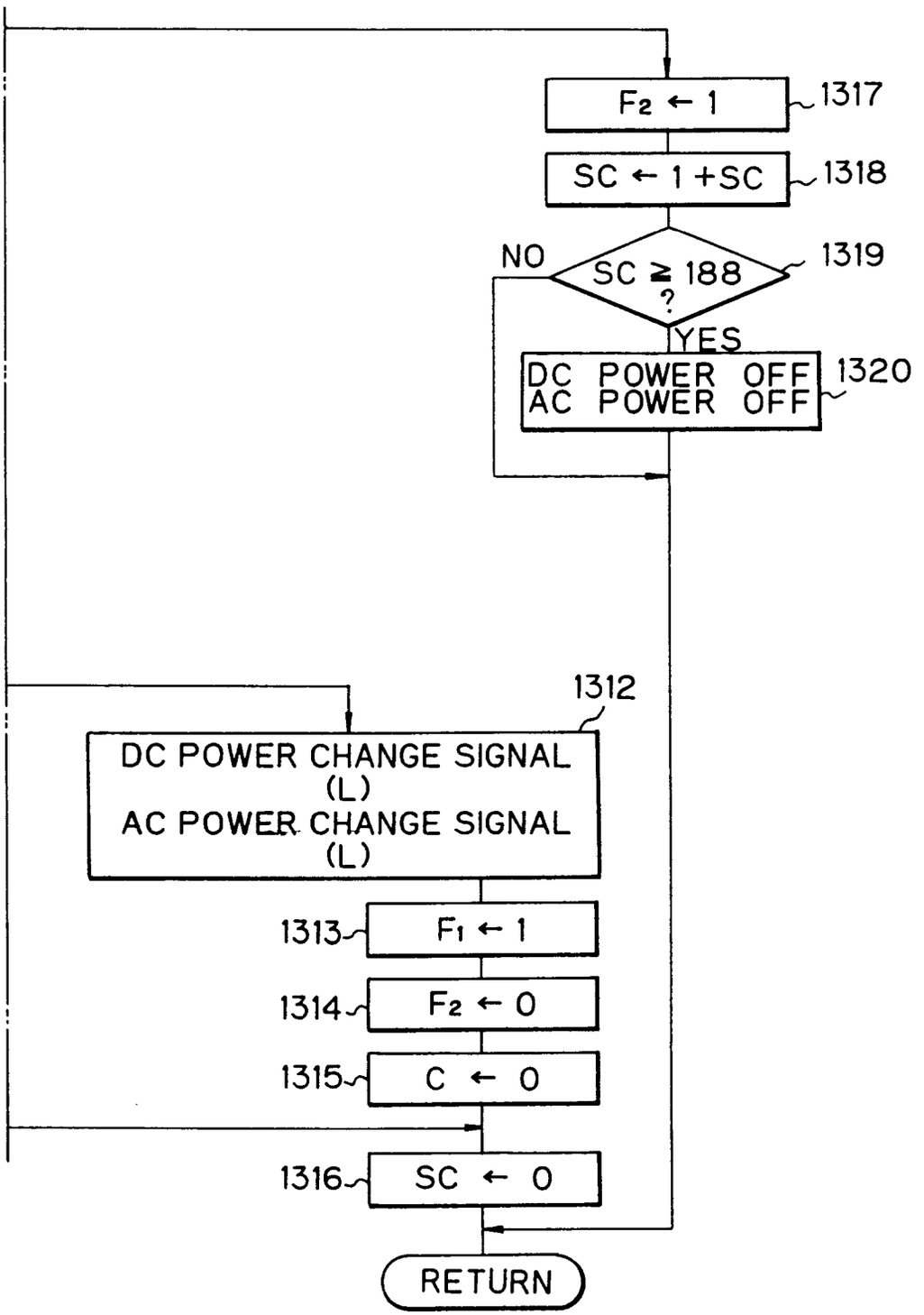

F2 ← 1
1317
SC ← 1 +SC
1318
NO
SC ≧ 188 ?
1319
YES
DC POWER OFF
AC POWER OFF
1320
1312
DC POWER CHANGE SIGNAL (L)
AC POWER CHANGE SIGNAL (L)
1313
F1 ← 1
1314
F2 ← 0
1315
C ← 0
1316
SC ← 0
RETURN

Fig. 14

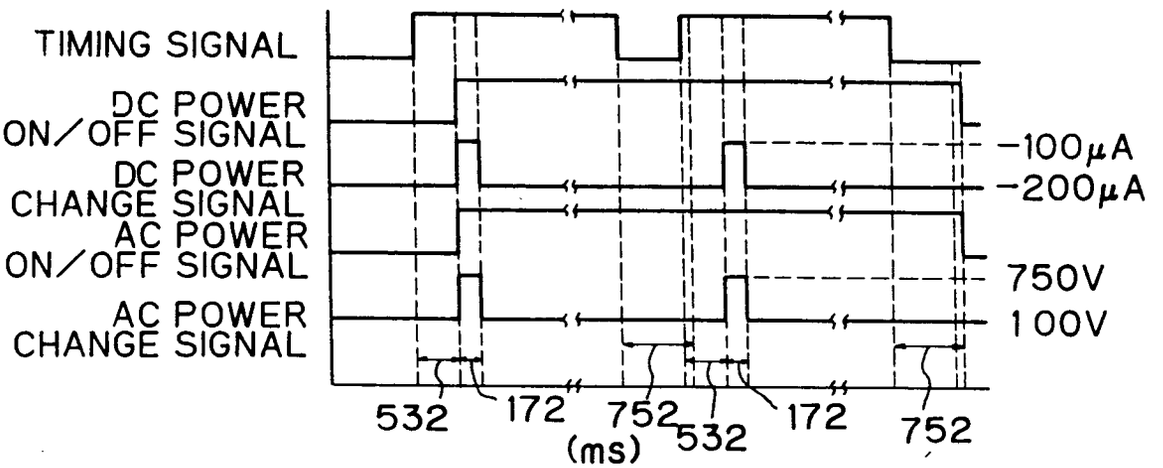


Fig. 15

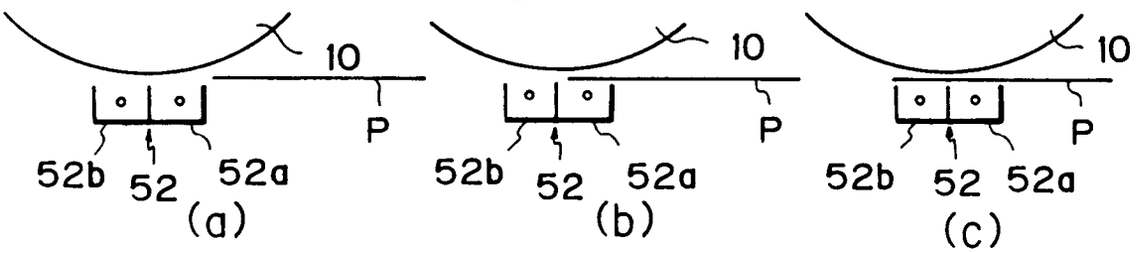


Fig. 16

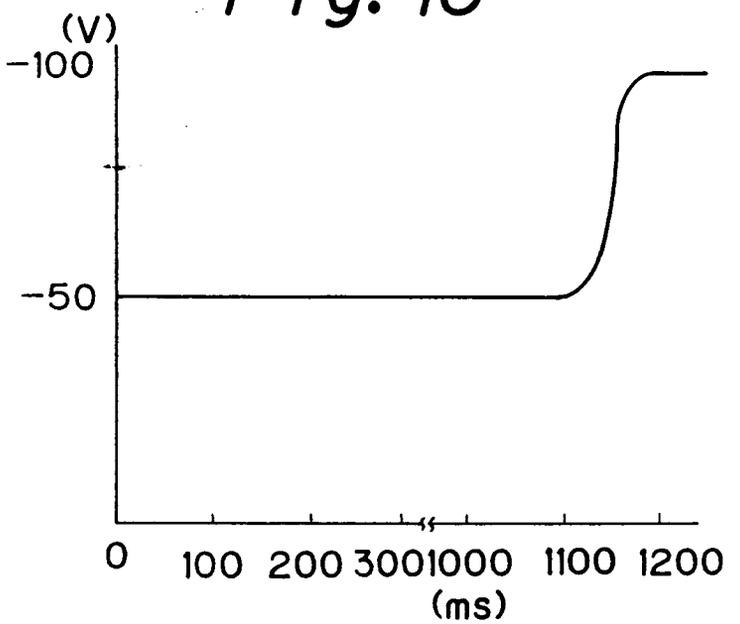


Fig. 17

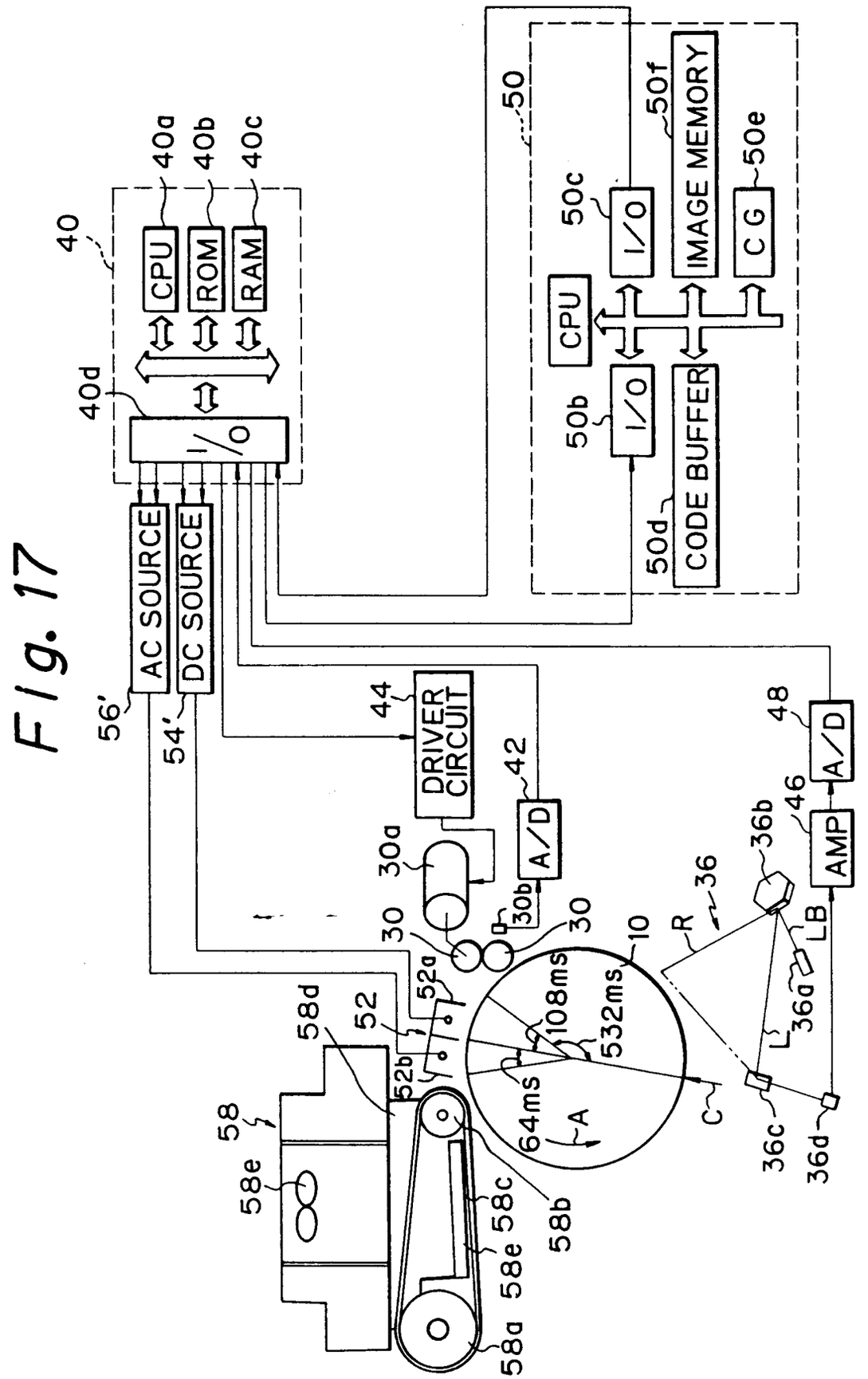

40
40a
40b
40c
CPU
ROM
RAM
40d
I/O
50
50c
I/O
50f
IMAGE MEMORY
50e
C G
CPU
50b
I/O
CODE BUFFER
50d
AC SOURCE
DC SOURCE
56'
54'
44
DRIVER CIRCUIT
42
A/D
48
A/D
46
AMP
36b
36
R
LB
36a
L
36c
36d
C
30a
30b
30
30
10
52a
52
52b
58d
58
58e
58e
58c
58b
58a
108ms
532ms
64ms
A

Fig. 18

Fig. 18A	Fig. 18B

Fig. 18A

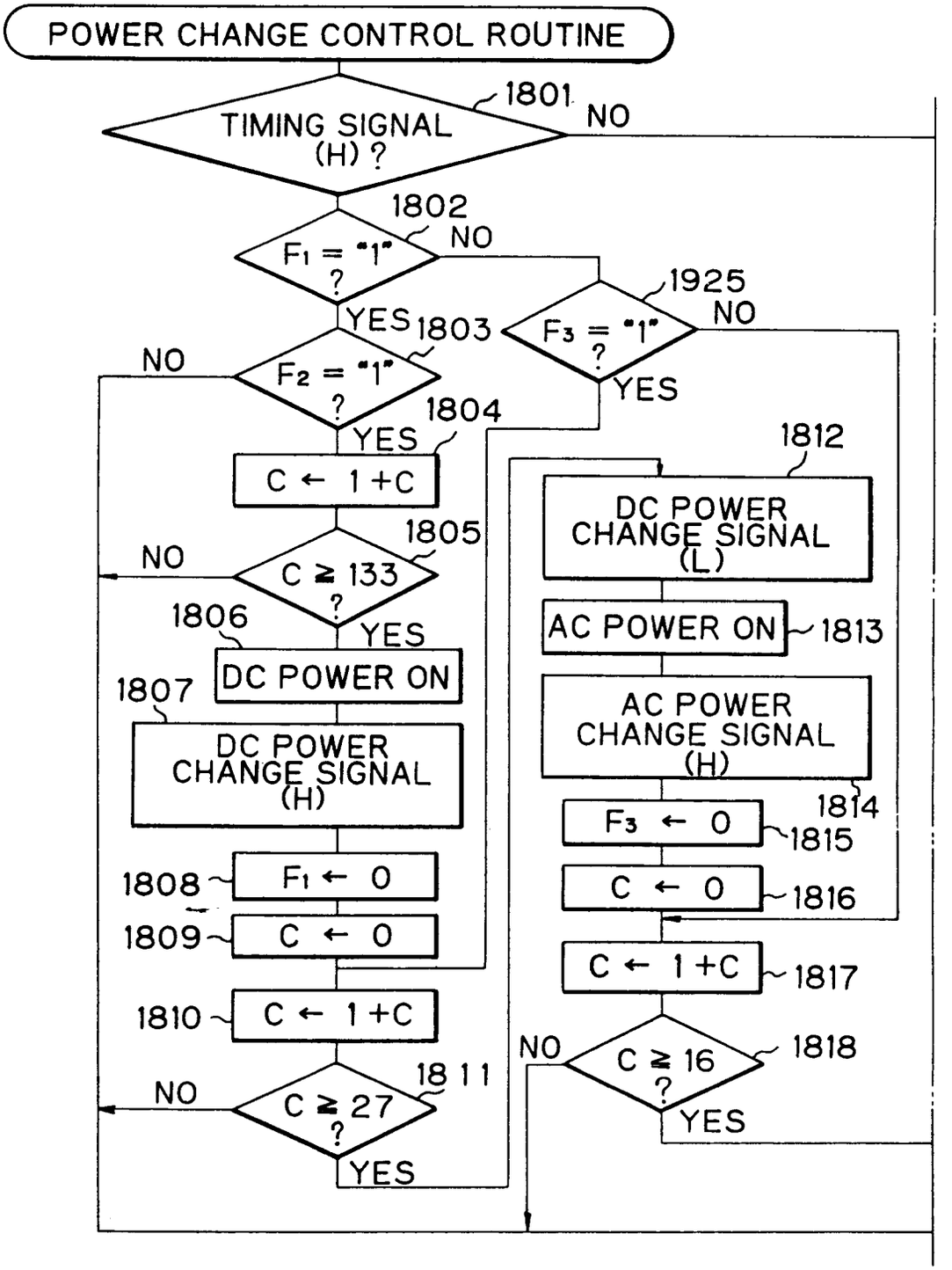


Fig. 18B

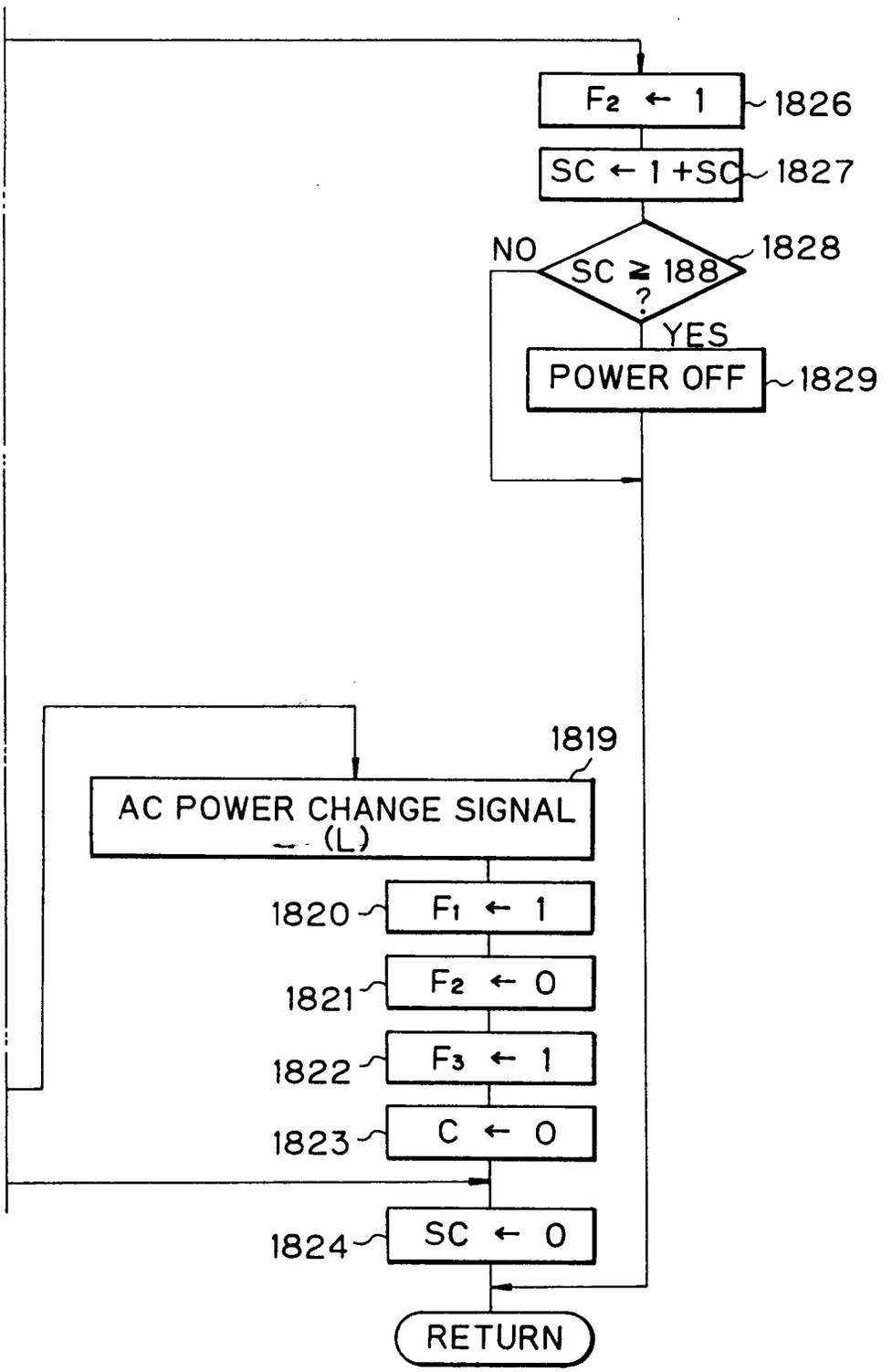

F2 ← 1
1826
SC ← 1 +SC
1827
NO
SC ≧ 188 ?
1828
YES
POWER OFF
1829
1819
AC POWER CHANGE SIGNAL (L)
1820
F1 ← 1
1821
F2 ← 0
1822
F3 ← 1
1823
C ← 0
1824
SC ← 0
RETURN

Fig. 19

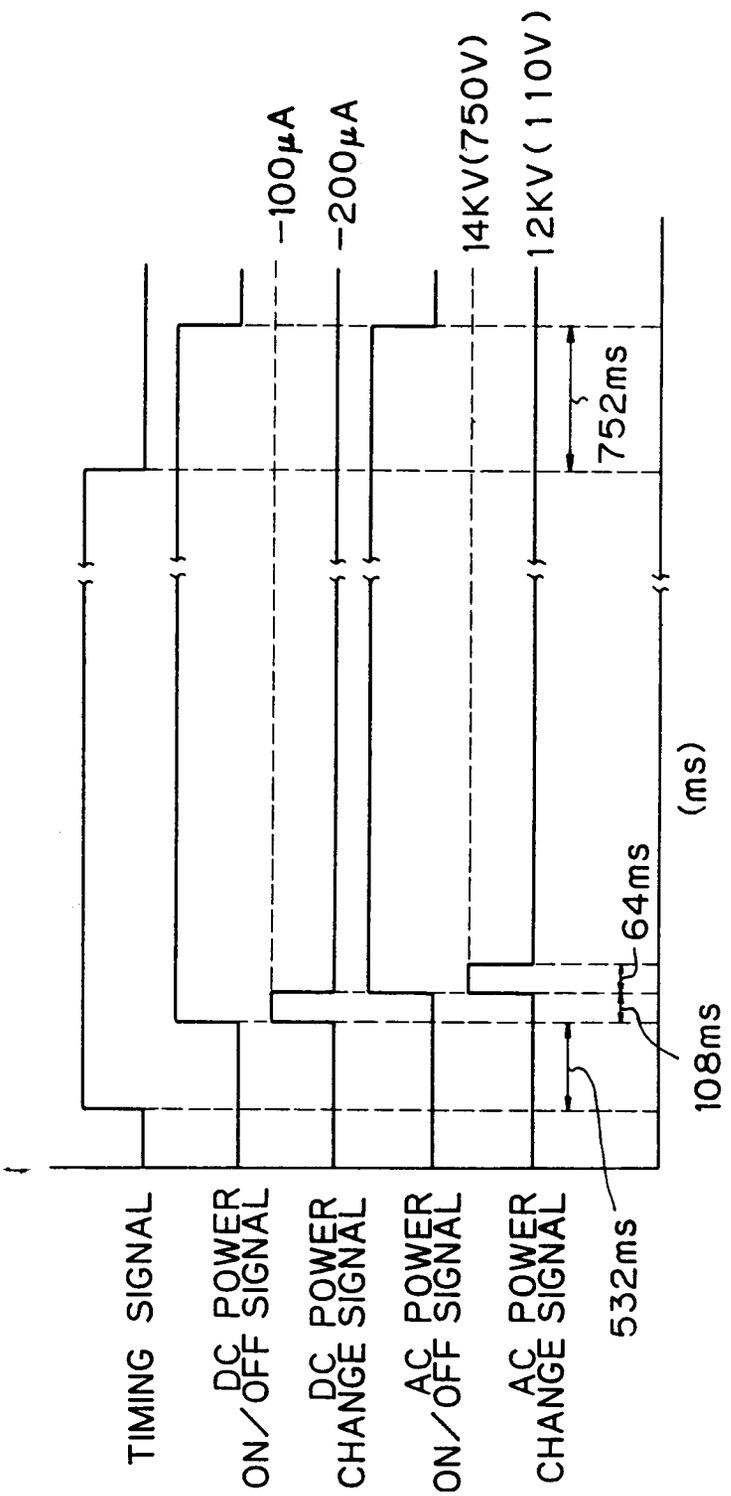

TIMING SIGNAL
DC POWER ON/OFF SIGNAL
DC POWER CHANGE SIGNAL
AC POWER ON/OFF SIGNAL
AC POWER CHANGE SIGNAL
-100μA
-200μA
14KV(750V)
12KV(110V)
752ms
64ms
532ms
108ms
(ms)

Fig. 20

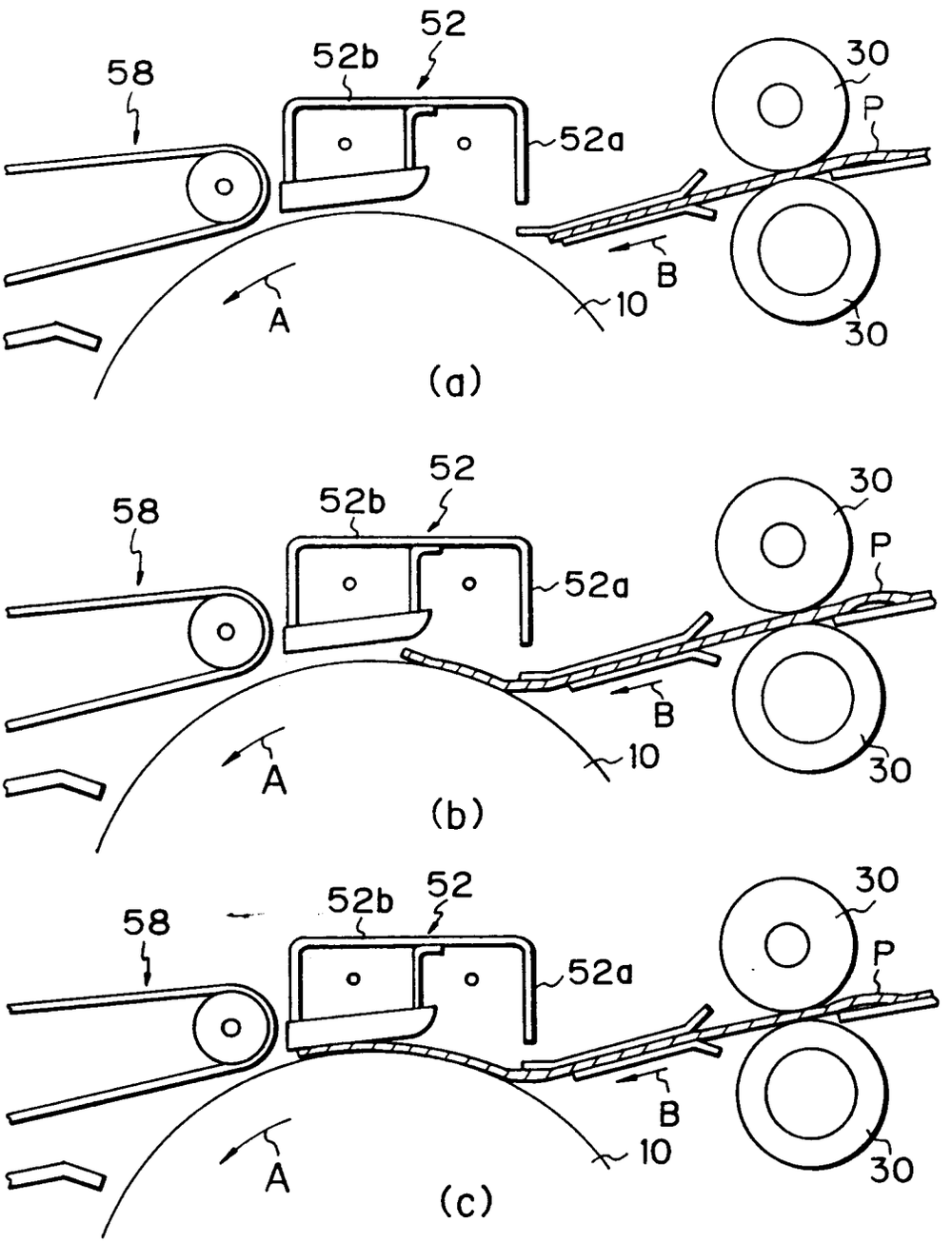

58
52b
52
52a
30
P
B
A
10
30
(a)
58
52b
52
52a
30
P
B
A
10
30
(b)
58
52b
52
52a
30
P
B
A
10
30
(c)

Fig. 21

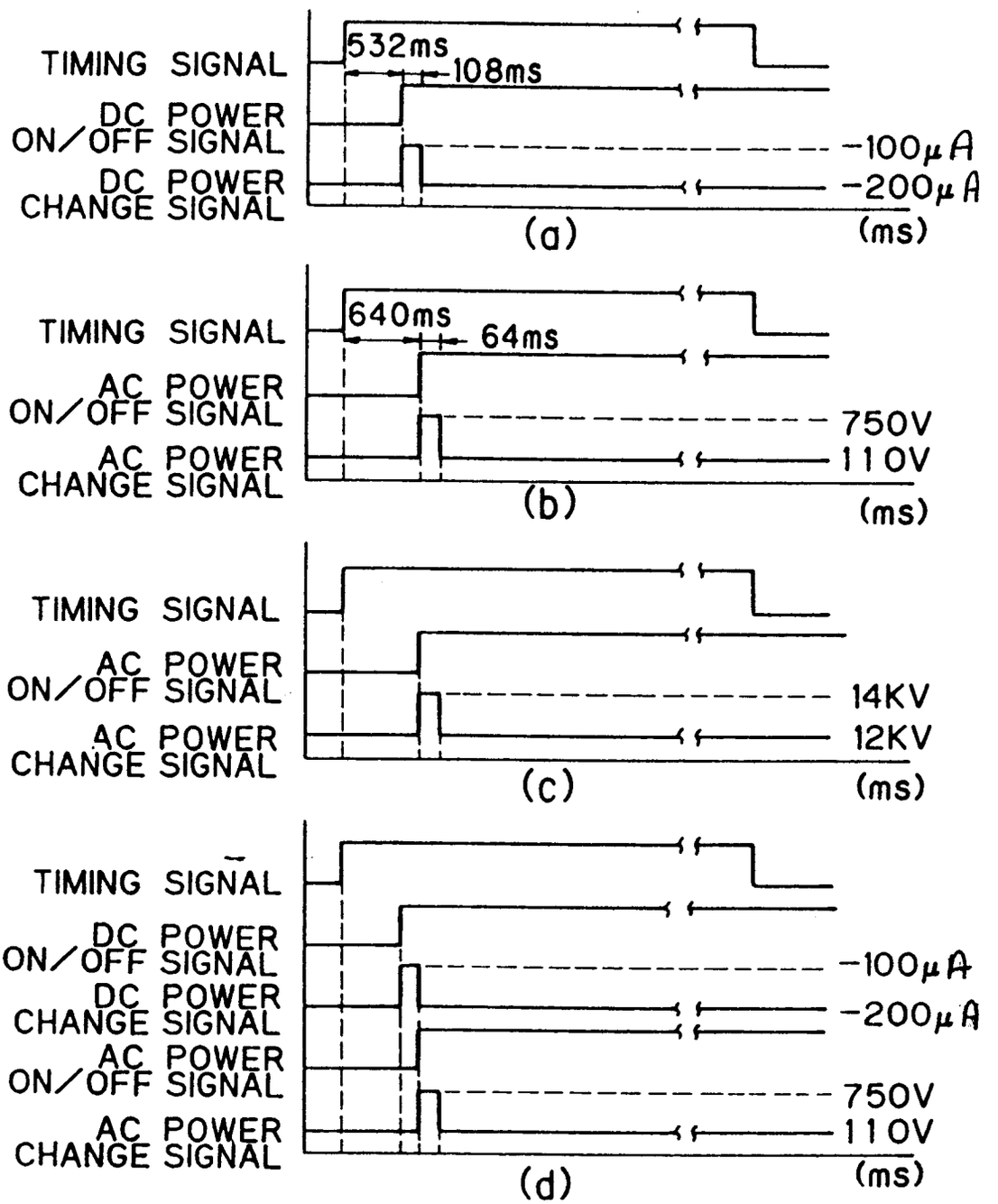
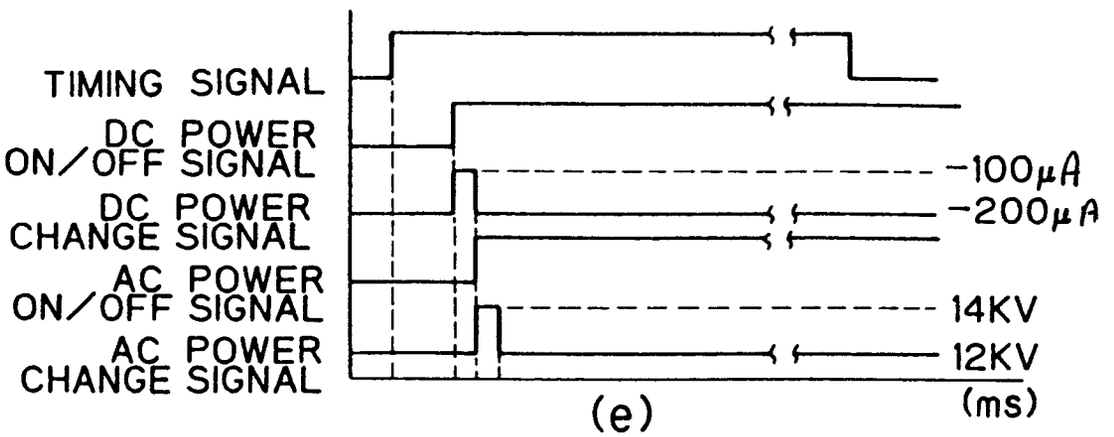
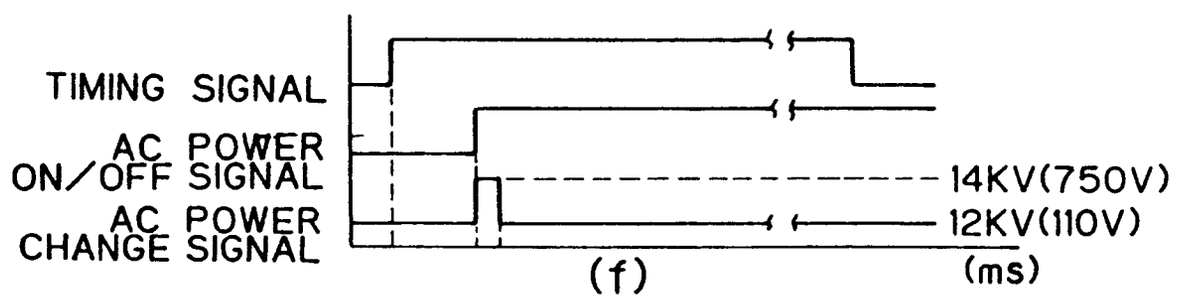

TIMING SIGNAL
DC POWER ON/OFF SIGNAL
DC POWER CHANGE SIGNAL
532ms
108ms
-100μA
-200μA
(a)
(ms)
TIMING SIGNAL
AC POWER ON/OFF SIGNAL
AC POWER CHANGE SIGNAL
640ms
64ms
750V
110V
(b)
(ms)
TIMING SIGNAL
AC POWER ON/OFF SIGNAL
AC POWER CHANGE SIGNAL
14KV
12KV
(c)
(ms)
TIMING SIGNAL
DC POWER ON/OFF SIGNAL
DC POWER CHANGE SIGNAL
AC POWER ON/OFF SIGNAL
AC POWER CHANGE SIGNAL
-100μA
-200μA
750V
110V
(d)
(ms)

Fig. 21


TIMING SIGNAL
DC POWER ON/OFF SIGNAL
DC POWER CHANGE SIGNAL
AC POWER ON/OFF SIGNAL
AC POWER CHANGE SIGNAL
-100μA
-200μA
14KV
12KV
(ms)
(e)


TIMING SIGNAL
AC POWER ON/OFF SIGNAL
AC POWER CHANGE SIGNAL
14KV(750V)
12KV(110V)
(ms)
(f)