(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 445 718 A2**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **91103290.2**

(51) Int. Cl.5: **G03G 21/00**, G03G 15/08

(22) Date of filing: **05.03.91**

(30) Priority: **06.03.90 JP 52698/90**

(43) Date of publication of application:
11.09.91 Bulletin 91/37

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **Oki Electric Industry Co., Ltd.**
7-12, Toranomon 1-chome Minato-ku
Tokyo(JP)

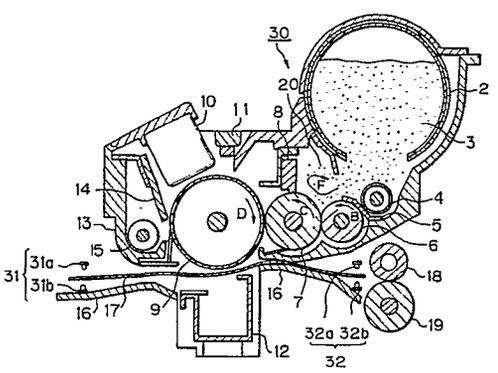
(72) Inventor: **Kikuchi, Hiroshi, c/o Oki Electric Ind. Co. Ltd.**
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)
Inventor: **Momiyama, Yoshiharu, c/o Oki Electric Ind. Co. Ltd**
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)
Inventor: **Koga, Yoshitomo, c/o Oki Electric Ind. Co. Ltd**
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)
Inventor: **Sakai, Masato, c/o Oki Electric Ind. Co. Ltd**
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)
Inventor: **Ito, Katsuyuki, c/o Oki Electric Ind. Co. Ltd**
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)
Inventor: **Katakura, Shinichi, c/o Oki Electric Ind. Co. Ltd.**
7-12, Toranomon 1-chome
Minato-ku, Tokyo(JP)

(74) Representative: **Betten & Resch**
Reichenbachstrasse 19
W-8000 München 5(DE)

(54) **Image forming apparatus having function of dust removal.**

(57) In a graphic type non-impact printer or the like a control means reverses the rotation of a developing roller (7) so as to remove dust or the like caught between the developing roller and a developing blade (8); or the dust or the like is released from its press-held condition between the developing roller (7) and the developing blade (8) even though it cannot be completely removed, thereby it is possible to remove the dust later.

Fig. 1



EP 0 445 718 A2

BACKGROUND OF THE INVENTION

The present invention relates to an image forming apparatus used for a graphic type non-impact printer, and particularly to an image forming apparatus in which toner is fed to an electrostatic latent image bearing medium.

In general, an image forming apparatus in a graphic type non-impact printer is operated by a process comprising the steps of electric charge, exposure, development, transfer and fixation.

When a toner cartridge is set in the image forming apparatus, toner stored therein is dropped onto an agitating shaft and guide plate.

At this time, when a main motor is energized, a supply roller, a developing roller and a photosensitive drum which are engaged to a gear on the shaft of the main motor are rotated.

Toner is fed toward the supply roller from the agitating shaft through holes in a guide plate, and is then fed to the developing roller by the rotating supply roller. Toner sticking to the outer surface of the developing roller is turned into a thin layer by a developing blade, and is then fed toward the photosensitive drum. At this time, the toner is negatively charged. Meanwhile, the outer surface of the photosensitive drum is uniformly and negatively charged by a charger, and is then exposed to light by a printing head in accordance with image signals. Then, negative charge is released from a part which is exposed to the light. Accordingly, an electrostatic latent image corresponding to an image to be printed is formed by the part which is exposed to the light and the part which is not exposed to the light.

When the photosensitive drum is rotated so that the section on which the latent image is formed comes to a position where it faces the developing roller, it attracts the negatively charged toner so as to effect development. The image on the outer surface of the photosensitive drum is transferred from the latter to a sheet by the charger when the sheet passes between the photosensitive drum and the charger. The image obtained by the transfer of the toner image is thereafter is fixed by a fixing unit.

Further, the toner remaining on the outer surface of the photosensitive drum after the transfer is scraped off by a cleaning blade so as to stand by for the next printing. The toner scraped off is fed toward the agitating shaft by a screw shaft so as to be reused.

It is noted that the toner which has been retained in a retaining part is fluidized circulately by the supply roller and the developing roller which are rotated.

However, in the above-mentioned apparatus, with the repetitions of printing, paper dust from sheets sticks to the outer surface of the photosensitive drum, and is then mixed into the remaining toner after being scraped off by the cleaning blade. Since the remaining toner is reused, the paper dust mixed therein is also sent to the agitating shaft together with the toner. Further, when the toner on the developing roller is turned into a thin layer by the developing blade, the paper dust is caught between the developing roller and the developing blade, and accordingly, is sometimes held therebetween since it cannot pass. In such a case, the toner is scraped off from the developing roller by the paper dust held therebetween. Thus, there has been raised such a problem that the toner cannot be uniformly fed onto the photosensitive drum. That is, in this case, when an image is transferred onto a sheet, the part of the sheet onto which no toner is fed, is left as a white line. Further, such a white line is sustained until the paper dust is removed naturally.

Accordingly, one object of the present invention is to provide an image forming apparatus in which the rotation of a developing roller is periodically reversed so as to remove paper dust held between a developing roller and a cleaning blade.

SUMMARY OF THE INVENTION

The invention may comprise an image forming apparatus comprising: (a) a developing blade for regulating thickness of toner layer; (b) a developing roller for supplying toner onto photosensitive drum through rotation; (c) drive means for rotating said developing roller; and (d) control means for periodically controlling the drive means for reversing the rotation of the developing roller.

The invention may also comprise an image forming apparatus comprising a developing blade for regulating thickness of toner layer and a developing roller for supplying toner onto photosensitive drum through rotation comprising: (a) drive means for rotating the drive roller; (b) a timer for measuring predetermined time period from turning on the power source; and (c) control means for periodically controlling the drive means for reversing the rotation of the developing roller after a predetermined time period.

The invention may also comprise an image forming apparatus comprising a developing blade for regulating thickness of toner layer, a developing roller for supplying toner onto photosensitive drum through rotation comprising: (a) drive means for rotating the developing roller; (b) sheet detecting means for detecting a sheet and delivering a detection signal; (c) counter means for counting number of conveyed sheets with the detection signal; (d) first memory means for memorizing number of sheets counted by the counter means; (e) second

memory means for storing a predetermined number of sheets; (f) comparator means for comparing the number of conveyed sheets with the predetermined number of sheets; and (g) control means for delivering instruction signals for reverse rotation to the drive means when the number of conveyed sheets gets equal to the predetermined number of sheets.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view illustrating an image forming apparatus;

Fig. 2 is a block diagram illustrating an embodiment according to the present invention;

Fig. 3 is a view illustrating a gear train; and

Fig. 4 is a flow-chart showing the operation of the embodiment according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Explanation will be made of an embodiment of an image forming apparatus according to the present invention, with reference to Fig. 1 which is a sectional view illustrating the image forming apparatus.

A toner cartridge 2 is set in the upper section of an apparatus 1. Toner 3 is filled in the toner cartridge 2. When the cartridge 2 is mounted and set in the apparatus 1, the toner 3 is discharged from the inside of the cartridge 2, and is fed into a developing section. After the toner in the cartridge being all consumed, the cartridge is replaced with a new one. An agitating shaft 4 is laid below the toner cartridge 2, and further, a supply roller 6 is disposed obliquely below the agitating shaft 4 with a guide plate 5 being laid therebetween. The agitating shaft 4 is constituted such that a wire is wound around a coiled shaft so that the toner 3 can be fed to the supply roller 6, uniformly in the axial direction. Several holes are formed in the guide plate in order to regulate the volume of the toner 3 to be fed. Further, a supply roller 6 is made of sponge, and is adapted to supply the toner, further to a developing roller 7.

A developing blade 8 makes contact with the developing roller 7 with a predetermined pressure. The toner 3 which is conveyed by the rotating developing roller 7, is regulated in its layer thickness since the developing blade 8 makes contact with the outer surface of the developing roller 7. A photosensitive drum 9 as a latent image bearing medium is rotatably mounted making contact with the developing roller 7.

A charger 10, a printing head 11, a transfer unit 12 and a cleaning unit 13 are arranged surrounding around the photosensitive drum 9. The charger 10 is adapted to charge the outer surface of the photosensitive drum 9 uniformly thereover, and the printing head 11 irradiates light to the outer surface of the photosensitive drum 9 in accordance with an image signal. The transfer unit 12 is adapted to produce an electric charge having a polarity reverse to that of the charger 10 so as to transfer the toner 3 sticking to the outer surface of the photosensitive drum 9, to a sheet. Further, the cleaning unit 13 is attached thereto with a cleaning blade 14 and a screw shaft 15. The cleaning blade 14 is formed of a rubber material bonded to a sheet metal, having its free end making contact with the outer surface of the photosensitive drum 9 so as to serve to scrape off the toner 3 remaining on the outer surface of the photosensitive drum 9 after the transfer. The screw shaft 15 has a helical blade attached to a shaft, and is connected to the above-mentioned agitating shaft 4 through the intermediary of another screw shaft inside of a side plate, which is not shown. That is, the toner 3 scraped off and trapped in the cleaning unit 13 is returned to the agitating shaft 4 so as to be reused.

Further, a guide 16 for conveying sheets is provided in the lower section of the apparatus 1, by which sheets 17 can pass between the photosensitive drum 9 and the transfer unit 12. The sheets 17 are conveyed by supply rollers 18, 19. Further, sensors 30, 31 are laid along the sheet conveying path so as to detect a number of the sheets 17. These sensors 31, 32 are composed of light emitting diodes 31a, 32a and light receiving diodes 31b, 32b, respectively.

Fig. 2 shows a control section for controlling the drive of the image forming apparatus in this embodiment.

The control section 35 controls the image forming apparatus in its entirety, and includes a memory unit 36, a central processing unit (which will be hereinbelow denoted as CPU) 37, a counting means 38 and a timer 40.

The memory unit 36 is ROM (read only memory) in which a control program 41 for controlling the operation of the apparatus in its entirety is stored.

Further, a set value m of a predetermined number of sheets is stored in the memory unit 36. This value m can be set, arbitrarily to, for example, 50, at the time of factory delivery. The memory unit 36 is connected to the CPU 37.

The CPU 37 conducts a computing process in accordance with the control program 41, and accordingly, it incorporates a comparing section 42, a storage section 43 and a drive control section 45. The comparing section 42 compares data stored in the storage section 43 with the set sheet number value m stored in the above-mentioned memory unit 36.

The storage section 43 is connected to a

counting means 38, and accordingly, it stores therein a result of counting by a counting means 38.

The drive control section 45 is connected to a drive circuit 46 so as to control the latter. The drive circuit 46 is adapted to drive a main motor for rotating the photosensitive drum 9, the developing roller 7 and the like in the image forming apparatus. That is, the drive control section 45 issues an instructing signal to the drive circuit 46 so as to normally and reversely rotate the main motor 47. The drive control section 45 is connected to the comparing section 42 so as to change the drive control for the main motor 47 in accordance with an output signal from the comparing section 42. Further, the drive control section 45 is connected to the timer 40.

The counting means 38 is connected to the sheet number detecting sensors 31, 32 attached to the sheet conveying path so as to count a number of printed sheets 17. The counting means 38 stores a result of counting in the storage section 43.

Fig. 3 is a view explaining a gear train. A main motor gear 48 is fitted on a shaft of the main motor 47 and is engaged with a photosensitive drum gear 50 through the intermediary of an idle gear 49. The photosensitive drum gear 50 is rotated integrally with the photosensitive drum 9, and is meshed with a developing roller gear 51. The developing roller gear 51 is rotated integrally with the developing roller 7, and is engaged with a supply roller gear 53 through the intermediary of an idle gear 52. The supply roller gear 53 is rotated integrally with the supply roller 6. As mentioned above, by rotating the main motor 47, the photosensitive drum 9, the developing roller 7 and the supply roller 4 can be rotated simultaneously.

Next, explanation will be hereinbelow made of operation of this embodiment with reference to Fig. 4 which is a flowchart explaining the operation of this embodiment.

When a power source is turned on (Step 1), the control section 35 is initialized (Step 2) while the image forming apparatus makes a preparation for printing. The timer 40 in the control section 35 is energized (Step 3). The timer 40 measures a predetermined time after the power source being turned on. However, this predetermined time is few seconds, which is shorter than the time by which the preparation of printing is completed.

When the predetermined time elapses (Step 4), the timer 40 delivers a time elapse signal to the drive control section 45 in the CPU 37. The drive control section 45 delivers a signal for reversing the main motor 47 is delivered to the drive circuit 46. When the main motor 47 is reversed, the developing roller 7 is rotated in a direction reverse to the direction indicated by the arrow C (Step 5).

Explanation will be made of operation of the reverse rotation of the developing roller 7 with reference to Fig. 1.

When the developing roller 7 is reversed, if dust such as paper dust or the like is held between the developing roller 7 and the developing blade 8, the dust such as paper dust or the like can come away from the position therebetween. Or, even though it does not come away completely, it is slightly moved so that it is released from its held condition, and it is easy to come off. Since the toner 3 in the retaining section 20 is circulately fluidized, if the dust falls in such a condition,that it can easily come away from the position between the developing roller 7 and the developing blade 8, the dust can be removed by the fluidization of the toner 3. As mentioned above, owing to the reverse rotation of the developing roller 7, the dust such as paper dust or the like held between the developing roller 7 and the developing blade 8 can be removed. It is noted here that a distance of movement by the reverse rotation of the developing roller 7 is few millimeters which is sufficient for removing the dust.

Again with reference to Fig. 4, the operation of the apparatus will be explained.

After the reverse rotation of the developing roller 7, whether the preparation of printing is completed or not is determined (Step 6). When the preparation of printing is completed, the operation of printing is carried out (Step 7). The printing operation is carried out in accordance with a series of steps of an image forming process for the sheets 17 one by one. Each time when a sheet is printed, the sheet number detecting sensors 31, 32 deliver detection signals to the counting means 38. The counting means 38 reads a set printed sheet number value previously stored in the storage section 43, and adds one to the value. The thus added value is then stored as a printed sheet number n in the storage section 43 (Step 8).

Then, the comparing section 42 in the CPU 37 reads the printed sheet number value n and the set printed sheet number value m which are stored in the storage section 43, and compares them with each other (Step 9). If the printed sheet number value n reaches the set printed sheet number value m, the process is advanced to Step 10, but if it does not yet reaches the value m, the process is returned to Step 7 so as to repeat the printing operation.

At Step 10, the CPU 37 determines whether continuous printing operation is carried out at the present or not, and if it is on the way of the continuous printing, the printing is continuously carried out (Step 11) in order to complete the continuous printing. At Step 10, if it is determined that it is not on the way of continuous printing, or if the

continuous printing is completed, the drive control section 45 shown in Fig. 1 delivers an instructing signal for stopping the main motor 47, to the drive circuit 46 (Step 12) after a printed sheet being discharged. Thereafter, the drive control section 45 delivers an instructing signal for reversing the main motor 47, to the drive circuit 46 (Step 13). Accordingly, the developing roller 7 is reversed through the intermediary of the gears 48, 49, 50, 51 shown in Fig. 3. The operation of this reverse rotation is similar to the operation at Step 5 mentioned above.

Owing to the reverse rotation of the developing roller 7 at this step, dust such as paper dust or the like which is newly caught between the developing roller 7 and the developing blade 8 after the power source being turned on, can be removed. After the reverse rotation of the developing roller 7, the printed sheet number value n stored in the storage section 43 is reset to zero (Step 14).

As mentioned above, by periodically reversing the developing roller 7 after a predetermined time elapsing from the time of turn-on of the power source and after a predetermined number of sheets being printed, dust such as paper dust or the like caught between the developing roller 7 and the developing blade 8 can be removed. Further, in the above-mentioned embodiment, even though the predetermined number is reached on the way of continuous printing, the printing is continued as it is without interruption, and thereafter, the developing roller 7 is reversed. Accordingly, no extra printing time is required. Further, in the above-mentioned embodiment, it has been explained that the developing roller 7 is reversed in two ways. However, the developing roller can be, of course, reversed in either one of the two ways. The present invention should not be limited to the above-mentioned embodiment. That is, there may be considered for example, such an arrangement that a number of revolutions of the photosensitive drum 9 may be detected, and when this revolution number reaches a predetermined number, the developing roller can be reversed.

As detailed hereinabove, according to the present invention, the developing roller is periodically reversed so as to remove dust such as paper dust or the like caught between the developing roller and the developing blade, and thereby it is possible to eliminate a lack of supply of toner onto the photosensitive drum.

Claims

1. An image forming apparatus comprising:
   (a) a developing blade for regulating thickness of toner layer;
   (b) a developing roller for supplying toner onto photosensitive drum through rotation;
   (c) drive means for rotating the drive roller; and
   (d) control means for periodically controlling the drive means for reversing the rotation of the developing roller after predetermined time period.

2. An image forming apparatus as set forth in claim 1, wherein said control means deliver instruction signals to the drive means for reversing rotation of said developing roller, when predetermined number of sheets are printed.

3. An image forming apparatus as set forth in claim 1, wherein said control means deliver instruction signals to said drive means for reversing rotation of said developing roller, when predetermined number of sheets are printed.

4. An image forming apparatus as set forth in claim 1, wherein said control means deliver instruction signals to said drive means for reversing rotation of said developing roller, when said photosensitive drum rotates by predetermined value.

5. An image forming apparatus comprising a developing blade for regulating thickness of toner layer and a developing roller for supplying toner onto photosensitive drum through rotation, comprising:
   (a) drive means for rotating said drive roller;
   (b) timer means for measuring predetermined time period from turning on the power source; and
   (c) control means for delivering instruction signals to said drive means for delivering instructing signals after predetermined time being elapsed.

6. An image forming apparatus comprising a developing blade for regulating thickness of toner layer and a developing roller for supplying toner onto photosensitive drum through rotation, comprising:
   (a) drive means for rotating said developing roller;
   (b) sheet detecting means for detecting a sheet and delivering a detection signal;
   (c) counter means for counting number of conveyed sheets with the detection signal;
   (d) first memory means for memorizing number of sheets counted by the counter means;
   (e) second memory means for storing a predetermined number of sheets;
   (f) comparator means for comparing the number of conveyed sheets with the pre-

determined number of sheets; and
(g) control means for delivering instruction signals for reverse rotation to the drive means when the number of conveyed sheets gets equal to the predetermined number of sheets.

7. An image forming apparatus as set forth in claim 6, wherein the counted number of conveyed sheets memorized in said first memory means initialized after said reversing.

Fig. 1

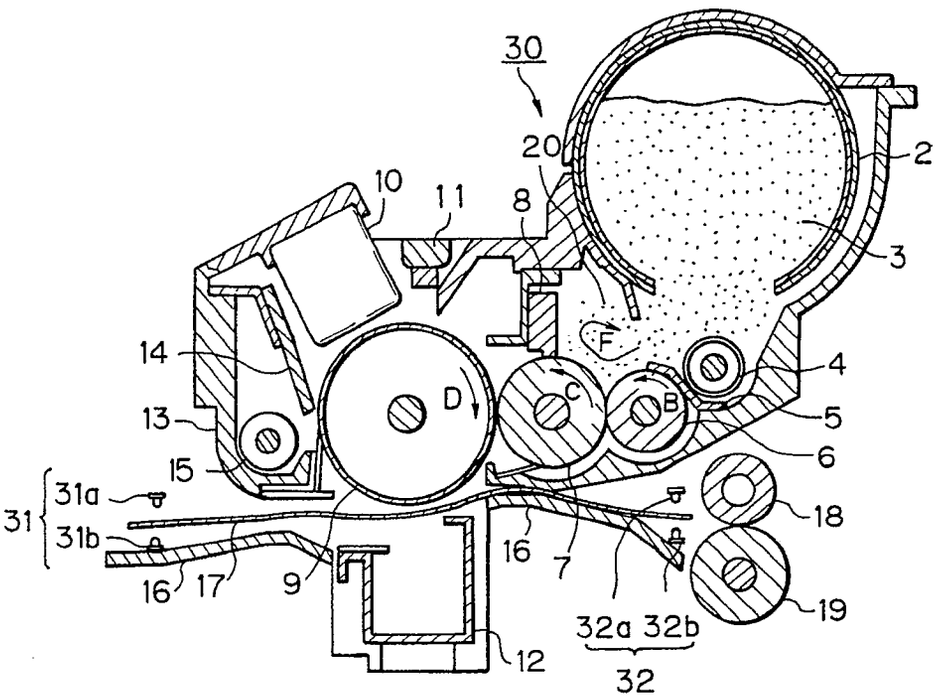

30
20
2
10
11
8
3
F
14
4
D
C
B
13
5
6
15
31
31a
31b
18
16
7
16
17
9
19
32a 32b
12
32

Fig. 3

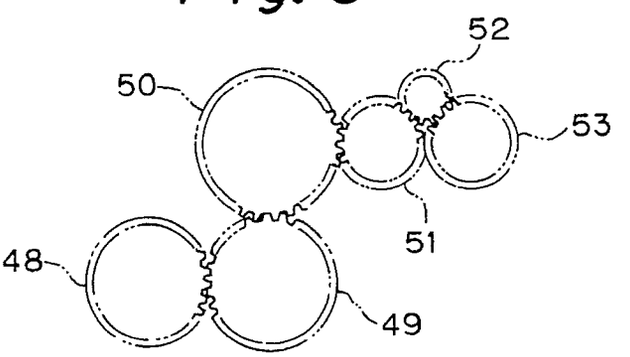

52
50
53
51
48
49

Fig. 2

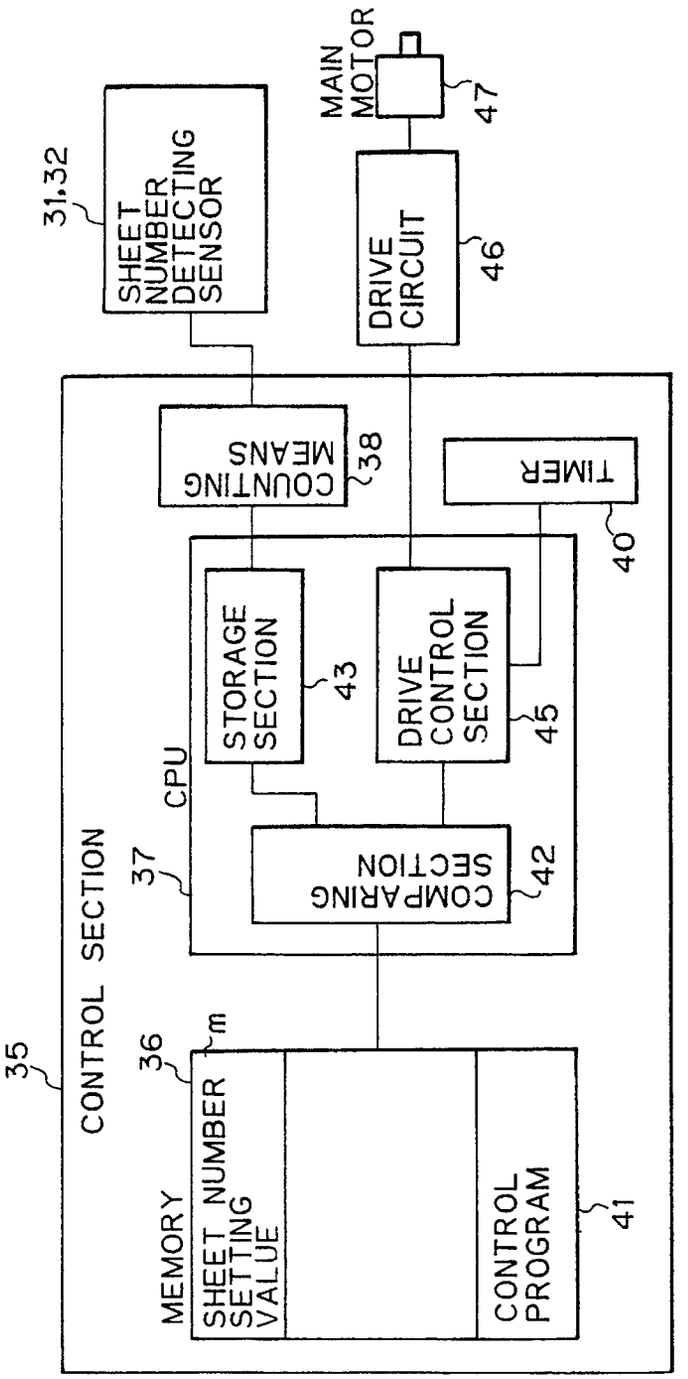

MAIN MOTOR
47
31,32
SHEET NUMBER DETECTING SENSOR
DRIVE CIRCUIT
46
COUNTING MEANS
38
TIMER
40
STORAGE SECTION
43
DRIVE CONTROL SECTION
45
CPU
37
COMPARING SECTION
42
CONTROL SECTION
35
36
m
MEMORY
SHEET NUMBER SETTING VALUE
CONTROL PROGRAM
41

Fig. 4A

Fig. 4

Fig. 4A

Fig. 4B

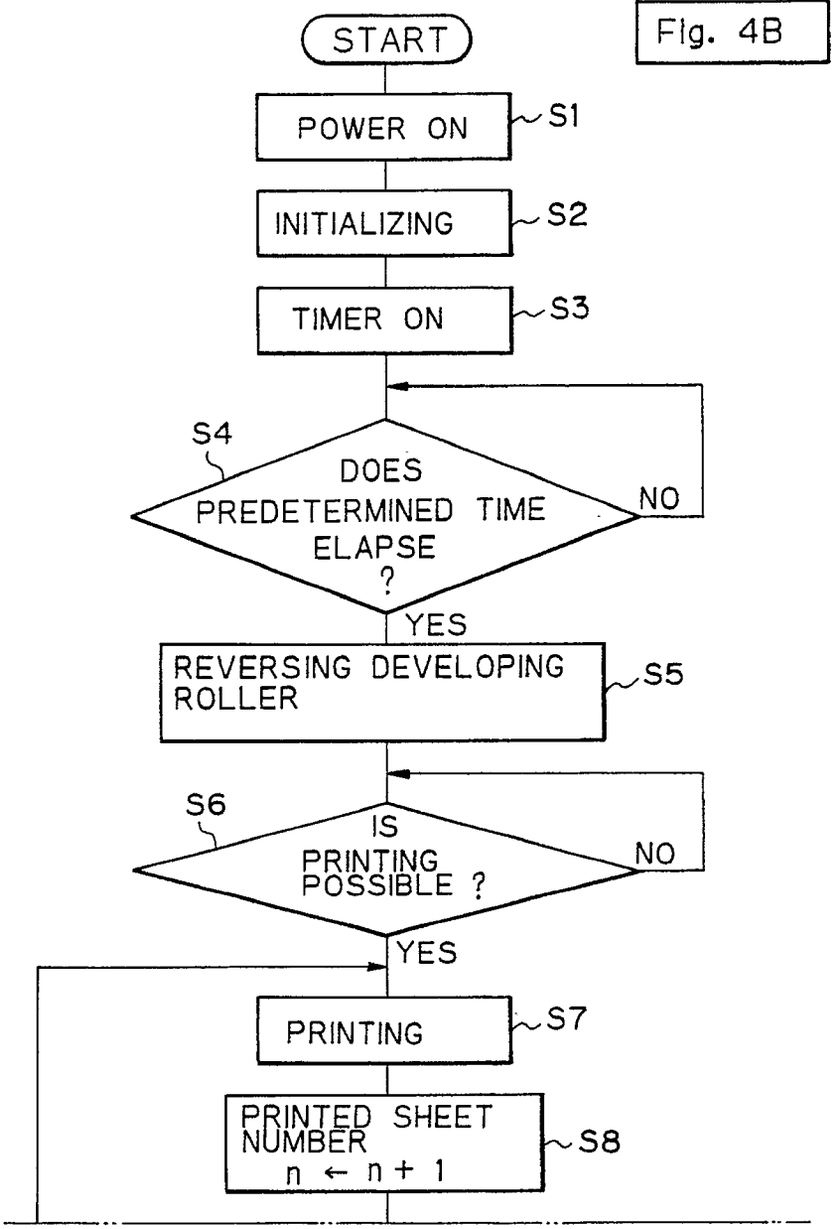
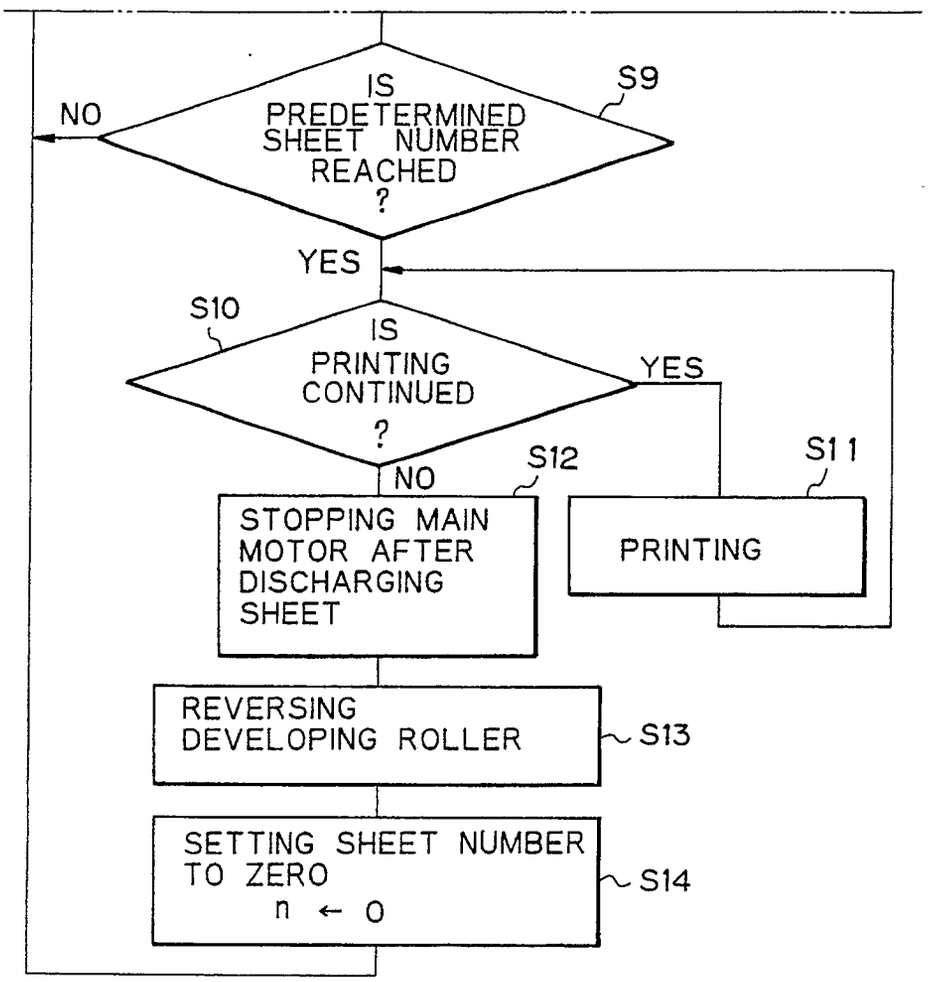


Fig. 4B


IS PREDETERMINED SHEET NUMBER REACHED ?
S9
NO
YES
IS PRINTING CONTINUED ?
S10
YES
NO
S12
S11
STOPPING MAIN MOTOR AFTER DISCHARGING SHEET
PRINTING
REVERSING DEVELOPING ROLLER
S13
SETTING SHEET NUMBER TO ZERO
n ← 0
S14