Description

This invention relates to an electrophotographic recording apparatus which prints characters and graphics on a sheet of paper using electrophotographic technology, and more particularly to a technique of handling the recording paper from the paper stocking position to the printed paper collecting position.

In attempts to respond to the needs for high-quality and high-speed printing, electrophotographic recording apparatuses based on the principle of the so-called "xerography" have been developed for practical applications. "Xerography" involves the process in which the optical beam controlled by printing data is irradiated onto a cylindrical photosensitive body to form a latent image thereon; colored toner is caused to adhere electrostatically to the latent image thus formed; and the toner image is then transferred to recording paper to thereby subject the image to a thermocompression bonding.

The printing technique using these electrophotographic recording apparatuses can produce high-density images at high printing speeds per unit time, thereby replacing conventional printing techniques such as offset printing and typography with the so-called desktop publishing in the field of small-scale printing.

In order to provide the best service in such a field of printing, electrophotographic recording apparatuses must be equipped with functions of printing on both sides of a sheet, sorting the printed sheets by page, printing large amounts of sheets with one supply of sheets, and requiring only a small floor area of installation.

In order to meed these requirements, Japanese Patent Application (UPA) Nos. 167853/1989, 170953/1989 (the term "UPA" as used herein means "Unexamined Published Application") disclose electrophotographic recording apparatuses whose printing path is arranged vertically and which causes a printed sheet to be inverted.

According to these electrophotographic recording apparatuses, the required area of installation can be reduced in proportion to the achieved reduction in sheet forwarding floor area.

However, such electrophotographic recording apparatuses have not addressed the problem of sorting the printed sheets by page because in them the printed sheets are only piled up in the same tray when a plurality of copies are made.

In addition, these electrophotographic recording apparatuses available only for cut sheet printing may not be capable of producing high-quality printing for continuous forms and slips in which positions of entries are specified. They may print out of position on these forms and slips.

The arrangement of a stacker or stackers as vertical as possible in order to reduce the floor area of installation not only causes sheets to be bent due to sheets falling from the sharply standing stacker but also entails the cumbersome operation of attaching and detaching the stacker to the apparatus body.

In order to overcome these problems, Japanese Patent Application (UPA) Nos. 76073/1989 and 49059/1989 disclose a type of electrophotographic recording apparatus with its stacker(s) arranged horizontally.

However, in such an electrophotographic recording apparatus, since the end portion of the cassette containing the recording sheets is located further behind the recording mechanism, the cassette extrudes from the apparatus body, thereby requiring a larger floor area of installation.

An object of the present invention is therefore to provide a novel electrophotographic recording apparatus capable of continuously printing both front and rear sides of a recording sheet without increasing the floor area of installation. This object is solved by the electrophotographic recording apparatus of independent claim 1. Further advantageous features of the apparatus are evident from the dependent claims as well as from the following description and the drawings.

The present invention also provides an electrophotographic recording apparatus capable of releasably arranging a sorter for sorting printed sheets by page without increasing the floor area of installation.

The present invention further provides a novel electrophotographic recording apparatus capable of selectively printing on a cut sheet and a continuous sheet.

The present invention also provides a novel electrophotographic recording apparatus capable of continuously printing large amounts of copies with one supply of recording sheets.

The present invention as well provides an electrophotographic recording apparatus capable of properly loading a recording sheet by horizontally stocking the sheet without increasing the floor area of installation.

Other objects and advantages of the present invention will be apparent from the descriptions of the embodiments thereof.

The electrophotographic recording apparatus according to the present invention includes means for feeding sheets, means for forming a printing image onto a photosensitive drum based on printing data and transferring the printing image onto the sheet, and means for fixing the transferred image on the sheet. These means are arranged vertically in upper and lower portions. Sheet switching guide means for switching the head end of the sheet in two directions, upper and lower, is arranged at a sheet discharge outlet of the fixing means. When the sheet switching guide means is set to the upper direction, a printed

sheet is forwarded to a second sheet guide member, inverted, and passed through the original printing path, in which process the printing data is written from the last line on the sheet. Accordingly, the required floor area of installation of the apparatus may be reduced as much as possible.

Fig. 1 is a perspective view showing the general configuration of a system using an electrophotographic recording apparatus according to the present invention;

Fig. 2 is a sectional view showing a first embodiment of the system in which the electrophotographic recording apparatus, a sorter, and a large-capacity sheet feeder according to the present invention are combined;

Figs. 3 and 4 are a sectional view showing the structure of a second sheet guide member of the apparatus shown in Fig. 2 and a front view of one of the board members, respectively;

Fig. 5 is a sectional view showing the structure of a sheet separating member of the apparatus shown in Fig. 2 and its vicinity;

Fig. 6 is a block diagram showing a control unit of the apparatus shown in Fig. 2;

Figs. 7(I) through 7(V) are diagrams explaining an operation of the apparatus shown in Fig. 2, respectively;

Figs. 8a and 8b are diagrams showing examples of front-side printing and back-side printing by the apparatus shown in Fig. 2, respectively;

Fig. 9 is a flowchart showing an operation of the apparatus shown in Fig. 2 in the case where one-side printing and double-side printing are performed for a copy;

Fig. 10 is a flowchart showing an operation of the apparatus shown in Fig. 2 in the case where one-side printing and double-side printing are continuously performed for a plurality of copies;

Fig. 11 is a schematic showing the appearance of a second embodiment of the electrophotographic recording apparatus according to the present invention;

Fig. 12 is a sectional view showing the structure of the apparatus shown in Fig. 11;

Figs. 13 through 15 are diagrams showing the state of handling a jam in the apparatus shown in Fig. 11, respectively;

Fig. 16 is a sectional view showing a third embodiment of the electrophotographic recording apparatus according to the present invention;

Fig. 17 is an enlarged sectional view showing the structure of the vicinities of a first tractor feeder and a second tractor feeder in the apparatus shown in Fig. 16;

Fig. 18 is a sectional view showing the state of cutting the sheet in the apparatus shown in Fig. 16;

Fig. 19 is a perspective view showing a fourth embodiment of the electrophotographic recording apparatus according to the present invention; and

Fig. 20 is a sectional view showing the structure of the apparatus shown in Fig. 19.

Fig. 1 shows a mode of using an electrophotographic recording apparatus according to the present invention. The electrophotographic recording apparatus 2 is very often used installed by a personal computer system 10 which includes a computer body 4, a display unit 6, and a keyboard 8. Such an electrophotographic recording apparatus 2 has its operation panel 12 arranged on the same side as the keyboard 8. Its stackers 14 and 16 for stocking sheets of recording paper are releasably mounted on the upper portion of the apparatus to feed a cut sheet automatically into the apparatus. The manual insertion of one sheet P is also allowed from the stacker located closest to the operator. The printed paper is discharged with the printed side facing downward, or facedown, to a tray 18 located in front.

Fig. 2 shows a first embodiment of the electrophotographic recording apparatus. Referring to the figure, reference numeral 20 designates a first sheet feeder releasably mounted on the upper portion of the apparatus body 22. The apparatus in this embodiment is provided with stackers 24 and 26 allowing two different sizes of printing paper P1 and P2 to be therein stocked, and pickup rollers 28 and 30 for taking these sheets of paper P1 and P2 out of the stackers on a sheet basis to thereby feed them to a sheet feed inlet 36 from sheet discharge outlets 32 and 34.

On the lower portion of the sheet feed inlet 36 is a sheet detector 38 for detecting the setup of a sheet of recording paper to be printed. When the head end of the sheet is positioned as predetermined further below the sheet detector, the sheet is forwarded to gate rollers 40 and 40, whereby the sheet is taken down to a printing mechanism (described later).

Downstream of the gate rollers 40 and 40 is a photosensitive drum 44, which rotates in a direction of the arrow A, i.e., a direction of forwarding the recording paper downward, for being subjected to a writing by an optical beam from an optical beam control mechanism 42. Around this photosensitive drum 44 are a charging unit 46, a developing unit 48, a sleeve 50, a transfer unit 52, a toner recovering unit 54, and an eraser 56, and below the photosensitive drum 44 is a fixing unit 58 for fixing the toner transferred on the recording paper. All these components constitute the printing mechanism.

Below the fixing unit 58, i.e., on the side of a sheet discharge outlet, are fixed sheet discharge guide boards 60, and switching guide boards 64 that turn around the sheet discharge outlet 62. The switching guide boards 64 serve to change the path of the sheet. When turned in the direction of the arrow B, the sheet is forwarded to discharge rollers 66, whereas

when turned in the direction of the arrow C, the sheet is directed to a second sheet guide 68.

The second sheet guide member 68 comprises a sheet guide board 72, which extends from the switching guide boards 64 to the uppermost sheet take-out rollers 70, 70, and includes therebetween sheet forwarding rollers 74, 74 and 76, 76, each pair of which is distanced shorter than the minimum printing length, for forwarding the sheet upward. This second sheet guide member 68 is arranged on the front side of the apparatus body 22, i.e., on the side of the sheet forwarding path. The sheet take-out rollers 70, 70 take the sheet up from the sheet guide board 72 and then are reversely rotated by a signal of a tail end detector 78 to thereby forward the sheet P downward.

The tail end detector 78 for detecting the tail end of the sheet when rear-side printing is performed is located below the take-out rollers 70, 70 and above the top of a triangular sheet forwarding path switching member 80.

Figs. 3 and 4 show an embodiment of the sheet guide board 72, which comprises board bodies 90 and 91 confronting each other at a predetermined distance. The confronting surface of each of the board bodies 90 and 91 is provided with a plurality of projecting members 92, 92, 92 ··· and 93, 93, 93 ··· in parallel with each other in the sheet forwarding direction in such a manner that the projecting members 92, 92, 92 ··· can confront the projecting members 93, 93, 93 ··· staggeredly.

Fig. 5 shows the structure of the sheet forwarding path switching member 80 and its vicinity. The sheet forwarding path switching member 80 has the top whose vertical cross-section is triangular facing the take-out rollers 70, 70 and which is cut so as to expand the space, or the entrance of a printing path 96, upward. The top 95 is located outside the tangent T of the take-out rollers 70, 70, i.e., to the left of the figure, so that the tail end of the sheet can easily be received from upward to the printing path 96. On a slope 97 of the sheet forwarding path switching member 80 is a guide board 98 that extends from its end portion and confronts the member 80 at an interval allowing the sheet to be guided. On the other slope 99 is a guide board 100 that is arranged to form the printing path 96. This guide board 100 is arranged so that it intersects the tangent T at a pressure contact point of the take-out rollers 70, 70 at an angle θ, which is approximately 5°, and the head end of the sheet pulled down from the rollers 70, 70 is caused to come into contact with the guide board 100.

In Fig. 2, reference numeral 101 designates a sorter that is releasably mounted to the electrophotographic recording apparatus. The sorter has sorter forwarding rollers 102 at a position where they are on the same level as the discharge rollers 66 of the electrophotographic recording apparatus body. On the end portions of the sorter forwarding rollers 102, i.e., on the discharge side, there are sorter guide boards 103, 103 that rise upright from the horizontal surface. On the vertical surface are a plurality of bin guides 104, 105, 106, 107, and 108 that are arranged at a predetermined interval, and bin selecting gate members 109, 110, 111, and 112 that serve to send the sheet into the bin guides. The end portions of the bin guides 104 through 108 are provided with sheet discharge rollers 114, 116, 118, 120, and 122, respectively, and the end portions of the sheet discharge rollers 114 through 122 are provided with releasable bin trays 124, 126, 128, 130, and 132 obliquely so that each of their discharge outlets faces downward.

Referring to the figure, reference numeral 140 designates a large-capacity sheet feeder, releasably mounted to the electrophotographic recording apparatus body 22, for continuously supplying a large number of sheets stocked in advance. Reference numeral 142 designates a large-capacity cassette capable of stocking, e.g., some 2000 sheets of recording paper horizontally, the bottom of which is provided with a push-up mechanism 144 for successively moving up according to the number of sheets printed, whereas the top of which is provided with a discharge outlet pickup roller 146 and a pickup pad 148, both coming into contact with the electrophotographic recording apparatus.

Fig. 6 shows an embodiment of a control unit, in which reference numeral 150 designates a microcomputer including a central processing unit (CPU) 152, a random access memory (RAM) 154, and a read only memory (ROM) 156. The microcomputer 150 controls not only the optical beam control mechanism 42 (Fig. 2) based on printing data transmitted from the host unit 10 (Fig. 1) but also the sheet forwarding path based on a signal from the respective detectors 38 and 78 depending on the single-side printing mode or double-side printing mode set via the operation panel 12 or the host unit 10 (Fig. 1).

Reference numeral 158 designates a main buffer memory for receiving the printing data from the host unit 10. This memory 158 stores the printing data in response to a command from the microcomputer 150 and applies the printing data to the optical beam control mechanism 42 through the microcomputer 150 at the time of printing.

Reference numeral 160 designates a double-side-printing buffer memory, which reads the printing data of the main buffer memory 158 from the last line, stores it, and applies it to the optical beam write control mechanism 42.

An operation of the electrophotographic recording apparatus body thus constructed will next be described with reference to the explanatory diagrams shown in Fig. 7.

When the photosensitive drum 44 is rotated at a constant speed, its surface is charged to a predetermined potential by the charging unit 46. When a light

beam is irradiated onto the photosensitive drum 44 surface as described above according to the image data from the optical beam control unit 42, the irradiated portion becomes electroconductive to thereby form a latent image thereon. This latent image is rendered into a real image, i.e., a toner image by its contact with the toner through the sleeve 50 of the developing unit 48.

[Single-side printing mode]

Upon instruction of the single-side printing mode via the host unit or the operation panel, the microcomputer 150 sets a path for a direct output of the main buffer memory 158 to the optical beam write control mechanism 42 without going through the double-side printing buffer memory 160. Upon output of printing data from the host unit, the microcomputer 150 not only causes the main buffer memory 158 to store that data (Step 501 in Fig. 9) but also the electrophotographic recording apparatus to get ready for printing.

That is, the sheet P stocked in the stacker section 24, 26 in the first sheet feeder 20 is introduced to the sheet feed inlet 36 from the pickup rollers 28, 30; the head end of which is stopped by the gate rollers 40, 40; the sheet P is further forwarded so that it will be bent to thereby cause the sheet detector 38 to operate (Step 502). A signal from the sheet detector 38 causes gate rollers 40, 40 to rotate in synchronism with the rotation of the photosensitive drum 44, to the surface of which the toner adhered, and then the sheet P is forwarded toward this photosensitive drum 44. The transfer unit 52 electrifies the back of the sheet P to thereby attract the toner that is on the surface of the photosensitive drum 44 toward the surface of the sheet P and have the toner transfer onto the sheet. The transferred toner is fixed on the sheet P while the sheet is passing through the fixing unit 58 (Steps 503 and 504).

The sheet P that has exited from the fixing unit 58 is discharged to the discharge roller 66 while guided by the fixed sheet discharge guide boards 60, and the switching guide boards 64 (Fig. 7(I)) (Step 505). If there exists the printing data of a next page (Step 506), that printing data is stored in the main buffer memory 158 (Step 507) and the operation in Step 502 and on is repeated for a required number of pages.

[Double-side printing mode]

Upon instruction of the double side printing mode (Step 500), the microcomputer 150 first sets a path for a direct output of the main buffer memory 158 to the optical beam write control mechanism 42. Upon output of the printing data from the host unit, the microcomputer 150 causes the main buffer memory 158 to store that printing data (Step 508).

The above operation is for single-page printing. In order to start with a second page with proper pagination (Step 509), the microcomputer 150 causes a first sheet P stocked in the stacker section 24, 26 to be ushered into the sheet feed inlet 36 by the pickup rollers 28, 30; the head end of which is stopped by the gate rollers 40, 40; and the sheet P is further forwarded to thereby operate the sheet detector 38 (Step 510). At this point, the microcomputer 150 not only causes the gate rollers 40, 40 to operate but also causes the optical beam write control mechanism 42 to write the printing data within the main buffer memory 158 to the photosensitive drum 44 in synchronism with the forwarding speed of the sheet P adjusted by the gate rollers 40, 40. The latent image thereby formed is then rendered into a real image by the developing unit 48 and this real image is transferred onto one of the sides of the sheet P entering the transfer region from the head to tail of the sheet by the transfer unit (Fig. 8a). Then the sheet enters the fixing unit 58 and gets the toner on its surface to be fixed, and then further forwarded to the fixed sheet discharge guide boards 60 (Step 511).

Upon completion of the writing of the printing data of the second page onto the photosensitive drum 44 (Step 512), the microcomputer 150 requests the host unit to transmit the printing data of the first page, i.e., the front side (Step 513) and stores this data in the main buffer memory 158 (Step 514).

The microcomputer 150 switches the switching guide boards 64 to the second guide member 68 side (Step 516). This causes the sheet to be forwarded upward (Fig. 7(II)) while guided by the second guide member 68 with the second guide rollers 74 without being discharged from the discharge rollers 66. In the process of the sheet moving along the sheet guide board 72 upward, the projecting members 92, 92, 92 ··· and 93, 93, 93 ···, which extend vertically, help cause the sheet to go up along the second guide member smoothly with only very small friction. Since the projecting members 92, 92, 92 ··· on the one side and those 93, 93, 93 ··· on the other side are arranged staggeredly, the sheet gets slightly, so to speak, "corrugated" and thus it becomes firm. For this reason, even if the head end of the sheet touches an obstacle, it can get over the obstacle without being folded, thereby forwarding upward without causing any jam.

In this way, the sheet P is guided up to the sheet take-out rollers 70 in the upper portion (Fig. 7(III)) and when the tail end of the sheet P passes by the tail end detector 78, a signal is produced from the tail end detector 78 to thereby reversely rotate the take-out rollers 70, 70 (Fig. 7(IV)). As a result, the sheet P is forwarded downward.

In the process of drawing the sheet downward, the tangent of the take-out rollers 70, 70 intersects the surface of the guide board 100, so that the tail end of the sheet is forwarded downward being in contact with the guide board 100. Further, the upper end of

the forwarding path switching member 80 allows the space above it to be open wider upward so that it is ensured that the sheet is guided to the printing path side, i.e., the sheet feed inlet 36.

Accordingly, the blank surface of the sheet is caused to face the photosensitive drum 44 and is set as predetermined in terms of width, i.e., with a binding margin L that corresponds to that of the front page (Fig. 7(V)). At this stage, the take-out rollers 70, 70 are rotated again in such a direction as to forward the sheet P downward. As a result, the sheet P is bent with its tail end pressed by the gate rollers 40, 40 to thereby operate the sheet detector 38 (Step 517). Upon storage of the first page data in the main buffer memory 158, the microcomputer 150 starts reading that data stored in the main buffer memory 158 from the start of the last line and writes to the double-side printing buffer memory 160.

The microcomputer 150 then rotates the gate rollers 40, 40 in synchronism with the writing to the photosensitive drum 44; forwards the sheet from the side which will be the last line of printing to the photosensitive drum 44; and applies the data read from the first address of the double-side printing buffer memory 160 to the optical beam write control mechanism 42. This causes the printing data to be printed on the sheet P backward from the last line to the first line (Fig. 8b) (Steps 518 and 519).

The sheet P which has exited from the fixing unit 58 enters the switching guide board 64 while guided by the fixed sheet discharge guide boards 60. Since the switching guide board 64 has been switched to the discharge roller 66 side up to this moment (Step 520), the sheet P is discharged outside the apparatus body from the discharge roller 66 without entering the second guide member 68 (Fig. 7(I)).

If there is data of a successive page (Step 521) upon completion of the printing on both sides of the first sheet P, the data of the successive page is stored in the main buffer memory 158 (Step 522). Returning to Step 509, the microcomputer 150 starts printing the second sheet, i.e., the data of the fourth page. This operation is repeated thereafter. If printing is completed in the absence of the data of even-numbered pages (Step 513), the switching guide board 64 is switched to the discharge roller 66 side to thereby discharge the sheet outside (Step 523).

Although the case where one copy is made per page has been described in the double-side printing mode of this embodiment, in the case of making a plurality of copies per page, continuous printing as shown by the flowchart of Fig. 10 may be performed without changing the data.

That is, upon instruction of the single-side printing mode (Step 530), the microcomputer 150 sets a path for a direct output of the main buffer memory 158 to the optical beam write control mechanism 42 without going through the double-side printing buffer memory 160. Upon output of the printing data from the host unit, the microcomputer 150 not only stores that data in the main buffer memory 158 (Step 531) but also causes the electrophotographic recording apparatus to get ready for printing.

That is, a sheet P of recording paper stocked in the stacker section 24, 26 disposed on the first sheet feeder 20 is taken out from the pickup rollers 28, 30 to the sheet feed outlet 36; the head end of which is stopped by the gate rollers 40, 40; the sheet P is further forwarded so that it will be bent to operate the sheet detector 38 (Step 532). Accordingly, the printing process is started (Step 533). Upon completion of the printing process (Step 534), the switching guide board 64 is switched to the discharge roller 66 side (Step 535) to thereby discharge the printed sheet outside the apparatus body. In order to print the same data on another sheet (Step 536), the process from Step 532 onward is repeated without data transfer.

In order to print the next page after printing a predetermined number of copies (Step 537), the printing data for the next page gets stored in the main buffer memory 158 (Step 538) and the process from Step 532 onward is repeated.

On the other hand, when the double-side printing mode is instructed (Step 530), the microcomputer 150 sets a path for a direct output of the main buffer memory 158 to the optical beam write control mechanism 42. Upon output of printing data from the host unit, the microcomputer 150 causes the main buffer memory 158 to store this printing data (Step 539). When the printing data is ready, the first sheet P stocked in the stacker section 24, 26 is taken out from the pickup rollers 28, 30 to the sheet feed inlet 36; the head end of which is stopped by the gate rollers 40, 40; the sheet P is further forwarded so that it will be bent to operate the sheet detector 38 (Steps 540 and 541). The microcomputer 150, at this point, causes the data to be printed on the back of the sheet through the same process as described above (Step 542). When the printing process has been completed (Step 543), it is judged whether or not the data will be printed for a plurality of copies (Step 544). If the data is to be successively printed for more pages, the switching guide board 64 is switched to the second guide roller 74 side (Step 545). Accordingly, the sheet is forwarded upward while guided to the sheet guide board 72 by the second guide rollers 74 without being discharged from the discharge rollers 66 (Fig. 7(II)).

In parallel with the process of forwarding the printed sheet upward, the microcomputer 150 causes the second sheet P stocked in the stacker section 24, 26 to be discharged, and returns to Step 541 and causes the same data in the main buffer memory 158 to be printed without having data transferred from the host unit.

When the printing of a predetermined number of copies has been completed (Step 546) as a plurality

of sheets having the same data printed thereon are accumulated on the sheet guide board 72 in this way, the microcomputer 150 causes the printing data of the previous page to be transferred to the main buffer memory 158 (Steps 547 and 548) and judges whether the page to be printed is odd-numbered or even-numbered (Step 540).

Meanwhile, in parallel with this process, the first sheet P accumulated in the sheet guide board 72 is guided to the sheet take-out rollers 70 (Fig. 7(III)), and when it is further pulled up so that the tail end of the sheet P passes through the tail end detector 78, a signal is produced by the tail end detector 78 to thereby reversely rotate the take-out rollers 70, 70 (Fig. 7(IV)). Accordingly, the sheet P is properly introduced into the sheet feed inlet 36 and received by the gate rollers 40. The side on which no data has been printed yet is set so that the front side faces the photosensitive drum 44 as predetermined widthwise, i.e., providing a binding margin L that corresponds to that of the rear side of the sheet (Fig. 7(V)). The take-out rollers 70, 70 are reversely rotated so that the sheet P can be forwarded downward. This causes the sheet P to be bent with its tail end being pressed by the gate rollers 40 to thereby operate the sheet detector 38 (Step 549).

The microcomputer 150 starts reading the printing data of the first page, or the front side, from the main buffer memory 158 to the double-side printing buffer memory 160 with its last line as the first piece of data (Step 550).

The microcomputer 150 then causes the gate rollers 40 to rotate in synchronism with the writing of the data to the photosensitive drum 44. It causes the sheet to be introduced to the photosensitive drum 44 "from tail to head" in terms of the direction of printing, and causes the data to be applied to the optical beam write control mechanism 42 from the first address of the double-side printing buffer memory 160. Thus, the sheet is subjected to inverted printing from tail to head (Fig. 8b).

The sheet P that has exited from the fixing unit 58 is forwarded to the switching guide board 64 while guided by the fixed sheet discharge guide boards 60 to thereby terminate the front-side printing (Step 551). Since the switching guide board 64 has been switched to the discharge roller 66 side up to this moment (Step 552), the sheet is discharged from the discharge rollers 66 outside the apparatus without entering the second guide member 68 (Fig. 7(I)). While the sheet remains in the sheet guide board 72 (Steps 553 and 554), the microcomputer 150 returns to Step 550 to repeat the above-described process.

If the next page must be printed after completing the double-side printing for a predetermined number of copies in this way (Step 555), the microcomputer 150 stores the printing data of two more pages, i.e., for the fourth and third pages, in the main buffer memory 158 (Step 556), and repeats the process starting with Step 540 onward to print the fourth and third pages.

If printing is terminated with an odd-numbered page (Step 544), the switching guide board 64 is set to the discharge roller 66 side to discharge the printed sheet outside the apparatus.

By the way, when a plurality of pages have been printed in this way, the sorting of the printed sheets by page will help make the successive process easier.

To this end, the page managing data, among the data within the microcomputer 150 that is responsible for managing all the operation of the electrophotographic recording apparatus body 22, is applied to the sorter 101.

The sheet discharged from the discharge rollers 66 is taken on by the sorter forwarding rollers 102, and enters the sorter guide boards 103, 103. If the lowermost bin tray 124 holds the first sheet and the uppermost bin tray 132 holds the fifth sheet, the bin selecting gate member 109 is operated to thereby close the path for introducing the sheet upward when the first sheet enters the sorter guide boards 103, 103. This maintains the horizontal position of the sheet that has entered through the sorter guide boards 103, 103, and admits the sheet into the first bin guide 104 by the bin selecting gate member 109 to thereby introduce the sheet into the first bin tray 124 with the discharge rollers 114. The sheet thus discharged from the electrophotographic recording apparatus body 22 can be subjected to a jam-free, highly reliable sorting operation because it is received with its horizontal position undamaged. As the sheet advances, the bin selecting gate member 109 not only closes the bin guide 104 but also opens the path for the sorter guide boards 103, 103.

When the second sheet is successively discharged from the electrophotographic recording apparatus body 22, the second bin selecting gate member 110 is operated to close the path located over the sorter guide boards 103, 103. This causes the sheet to pass through the first bin selecting gate member 109; the second bin selecting gate member 110 causes the sheet to be directed to the second bin guide 105 to be discharged to the second bin tray 126 by the discharge rollers 116. Upon end of the sheet discharge operation, the bin selecting gate member 110 not only closes the bin guide 105 but also opens the path for the sorter guide boards 103.

Likewise, by successively operating the bin selecting gate members 111, 112 in the upper portion, the sheet direction is inverted to the bin guides 106, 107, and 108 corresponding to the respective pages.

In order to discharge to the uppermost bin tray 132, which is the fifth tray, the inlets of the bin guides 104 through 107 are closed by all the bin selecting gates 109 through 112. Thus the sheet is guided to the bin guide 108 to be discharged to the bin tray 132.

In the case of printing large amounts of copies, the large-capacity sheet feeder 140 is connected to the rear side of the electrophotographic recording apparatus body and a cassette 140 that can accommodate 2000 sheets of recording paper in horizontal position is set thereto.

When printing is started after such preparation, the microcomputer 150 applies a sheet feed instruction to the pickup roller 146 of the large-capacity sheet feeder 140. When the pickup roller 146 starts rotating, the uppermost sheet is taken out from the large-capacity pickup pad 148 receiving pressure from both the pickup roller 146 and a plate spring; is forwarded in the direction of the arrow D through a guide path 31, 31 formed below the first sheet feeder 20 to be discharged to the sheet feed inlet 36. When the sheet is further forwarded by the pickup roller 146, the head end of the sheet is stopped by the gate rollers 40 so that the sheet will be bent and operate the sheet detector 38.

This causes the microcomputer 150 to start the printing process similar to that using the sheet from the stackers 24, 26.

Upon output of a sheet feed instruction after the previous sheet has been printed, the pickup roller 146 takes out the second sheet, discharges it to the sheet feed inlet 36, and causes the microcomputer 150 to likewise start the printing process.

In parallel with the printing process, the push-up mechanism 144 is operated to thereby lift the bottom of the sheet. This maintains the uppermost sheet at a predetermined height to thereby allow a next sheet to be properly taken out from the pickup roller 146.

Fig. 11 shows a second embodiment of the present invention. A recording apparatus body 200 is of such a design that an operation panel 202, a display unit 204, recording cassette mounting frames 206, 206 and the like are vertically arranged on the sheet feeding side of the sheet forwarding path in attempts to make the most of a limited space with the advantage of easy handling. It can be disposed close to a personal computer and its peripherals because it is constructed so that all operations including recording mode selection and jam processing can be performed in the front.

The detailed structure will be illustrated with reference to Fig. 12. The apparatus body 200 is arranged so that it can be divided into two portions, a lower unit 208 and an upper unit 210, with a sheet forwarding path extending obliquely upward from the sheet feeding side, or the front side (left of the figure) to the sheet discharging side, or the rear side (right of the figure) being as a boundary. The front side of the lower unit 208 is provided with a sheet feed unit 214 mounted so as to be separable with the vertical sheet feed guide 212 being as a boundary.

By the way, the lower unit 208 comprises a photosensitive drum 216, a cleaning unit 218, and a charger 220, these three components being unitized by a supporting frame (not shown) in such a manner that the photosensitive drum 216 faces the sheet forwarding path, and being releasably mounted. Upstream of the photosensitive drum 216 is a developing unit 222 removably mounted so that the opening of a toner hopper 220 faces the sheet forwarding path. On the rear side of the upper unit 210 are a U-shaped guide board 224 for inverting the sheet and a sorting guide board 226 arranged so as to bifurcate at a sheet forwarding path switching mechanism 228. The U-shaped guide board 224 is mounted so that its tail end is connected to an inverted sheet forwarding guide board 230 of the lower unit 208. The U-shaped guide board 224 is also arranged so that a discharge guide board 234 bifurcating upward at a sheet forwarding path switching mechanism 232 causes the sheet to be discharged to a discharge tray 238 through discharge rollers 236 arranged on the discharge end. On the other hand, the discharge end of the sorting discharge guide board 226 is provided with a sorting arm 242 capable of being angled stepwise using the shaft of the first discharge roller 240 as a pivot, and serve to discharge the sheet either one of a plurality of sorting trays 246 ··· releasably arranged on the rear side of the lower unit 208 by the second discharge rollers 244 provided on the end portion of this sorting arm 242.

The upper unit 210, on the other hand, is mounted on the lower unit 208 so as to be freely opened and closed; i.e., the upper unit 210 can be inverted with a common shaft 250 fixed on the upper portion in the front of the lower unit 208 as a pivot. On the bottom of the upper unit 210 is a guide board 252 for guiding the sheet along the sheet forwarding path. In this portion here, a pair of resist rollers 254, a transfer charger 257, and a fixing unit 258 are located over the lower unit 208, right about the developing unit 222, at a position confronting the photosensitive drum 216, and downstream of the photosensitive drum 216, respectively from the upstream to the downstream in the sheet forwarding direction. The upper surface of the upper unit 210 is entirely open and is provided with the inverted sheet forwarding guide board 230 substantially in parallel with the guide board 252 at the bottom. With the upper unit 210 closed on the lower unit 208, the end portion of the upstream in the sheet forwarding direction is connected to the U-shaped guide board 224 on the lower unit 208, while the end portion of the downstream is connected to the guide board 230 of a sheet forwarding mechanism 254 on a sheet feed unit 214 (described later).

Reference numeral 256 is a sheet guide member which is additionally provided on the upper surface of the upper unit 210. This sheet guide member 256 is mounted so as to be freely opened and closed on the upper unit 210 and thus it can be inverted with the common shaft 250 that supports both the upper unit

210 and the sheet feed unit 214 (described later) as a pivot. The upper surface of the sheet guide member 256 is provided with not only the operation panel 202 for specifying various printing modes but also the display unit 204, if necessary, for displaying the specified printing mode as shown in Fig. 11. The lower surface thereof is provided with a guide board 258' for guiding the inverted sheet in cooperation with the guide board 230 on the upper side of the upper unit 210, and a plurality of driven rollers 262 as paired by the sheet feed roller 260 on the upper unit 210 are supported by the shaft.

On the other hand, the sheet feed unit 214 arranged on the front side of the lower unit 208 is supported so as to be pulled upward with the common shaft 250 as a pivot; i.e., the sheet feed guide 212 surface of the lower unit 208 can be opened. This sheet feed unit 214 is provided, on the front thereof, one or more sheet feed cassette mounting frames 206, 206 and sheet feed rollers 266 ··· for forwarding the sheets in the sheet feed cassettes 264, 264. The sheet feed unit 214 has, on the upper portion thereof, the switchback type sheet forwarding mechanism 254' for sending back into the sheet forwarding path the inverted sheet that has been forwarded through the inverted sheet forwarding guide board 230 on the upper surface of the upper unit 210. The inner surface of the sheet feed unit 214 is provided with not only a sheet feed guide board 268 for guiding the sheet forwarded by the sheet feed roller 266 in cooperation with the sheet feed guide 212 disposed in the front of the lower unit 208 but also a guide board 274 for guiding the sheet forwarded by the sheet feed roller 272 that receives the sheet from a large-capacity sheet container 270 forming the frame for the apparatus body 200.

In the figure, reference numeral 276 designates a laser writing unit provided within the lower unit 208; and 278, sheet feed rollers provided on the switchback type sheet forwarding mechanism 254.

In this embodiment, under the normal recording operation; i.e., the upper surface of the obliquely opened lower unit 208 is covered by the upper unit 210 and the opened upper surface of the upper unit 210 is covered by the sheet guide member 256 as shown in Fig. 12, the operation panel 202 disposed on the sheet guide member 256 is sloped in the front of the apparatus body 200 so that an operator can handle it with ease (Fig. 11).

Therefore, when the operator selects a desired recording mode by operating a key or keys on the operation panel 202 under this normal condition and then presses a start button, the sheet in the sheet feed cassette 264 loaded in front of the apparatus body 200, in the manner similar to the conventional electrophotographic recording apparatus, is forwarded into the sheet forwarding path in synchronism with the writing operation; it is subjected to the transfer and fixing operations; and it is further forwarded through the guide board 234 bifurcated from the sheet inverting U-shaped guide board 224 to be thereby discharged to the discharge tray 238 located in the upper portion of the apparatus body 200. When the printed sheet must be sorted, the sheet is discharged from the sorting discharge guide board 226 into either one of the sorting trays 246 selected through the discharge rollers 244 on the already angled sorting arm 242. When the sheet is to be printed on both sides, the sheet inverted by the U-shaped guide board 224 is introduced into the switchback type sheet forwarding mechanism 254' through the inverted sheet forwarding guide board 230 placed on the upper surface of the upper unit 210, and is further forwarded into the sheet forwarding path from this forwarding mechanism 254' to thereby print on the rear side of the sheet.

By the way, if the sheet is jammed on its way through the sheet forwarding path during recording, the upper unit 210 is pulled in the direction of the arrow E with the common shaft 250 provided on the lower unit 208 as a pivot to thereby invert the upper unit 210 and expose the sheet forwarding path as shown in Fig. 13. The jammed sheet is then removed. If the sheet is jammed on its way through the inverted sheet forwarding guide board 230 at the time of double-side printing, the sheet guide member 256 is pulled in the direction of the arrow F to invert itself with the common shaft 250 as a pivot and thereby open the surface of the inverted sheet forwarding path on the upper unit 210 as shown in Fig. 14. The jammed sheet is then removed. If the sheet is jammed along the sheet feed path, the sheet feed unit 214 is rotated clockwise as indicated by the arrow G in the figure with the common shaft 250 as a pivot to thereby expose the sheet feed surface as shown in Fig. 15. The jammed sheet is then removed.

In this apparatus, the opening of the upper unit 210 allows the electrophotographic process unit to be opened concurrently. Therefore, in replenishing the toner, as shown in Fig. 13, a toner bottle (a) is inserted into the opening of the toner hopper 220 which is facing the sheet forwarding path to thereby allow the toner to be supplied to the developing unit 222. In inspecting the photosensitive drum 216, the cleaning unit 218, or the charger 220, the unit integrating these components can be removed from the lower unit 208 as shown in Fig. 13. In order to inspect the transfer charger 257 and the fixing unit 258, the upper unit 210 is inverted almost 180° to locate itself on the sheet feed cassette 264. This easily allows the inspection of these components.

Fig. 16 shows a third embodiment of the electrophotographic recording apparatus according to the present invention. This embodiment is suitable for use in case of large amounts of printing with a continuous sheet.

In the figure, reference numeral 290 designates

an electrophotographic recording apparatus body, which can roughly be divided into a lower unit 292, an upper unit 294, and a stacker 296 for supplying cut sheets.

At the boundary between the lower unit 292 and the upper unit 294 is a printing path 298 formed. On the lower unit 292 are a roller 300 forming gate rollers, a photosensitive drum 302, a roller 306 forming a fixing unit 304, and a sheet discharge roller 308 vertically lined up from top downward in the manner that they face the printing path 298. Around the photosensitive drum 302 are a developing sleeve 321 of a developing unit 310 equipped with a toner hopper 308', a toner recovery unit 314, an eraser unit 316, and a charging unit 318.

On the other hand, the upper unit 294 is pivotably mounted on the lower unit 292. On its surface connected to the lower unit 292 are a sheet detector 322, the other roller 324 forming the resist rollers, a transfer unit 326, the other roller 328 forming the fixing unit 304 from top downward. Between the sheet feed inlet 228' for receiving the sheet from the stacker (described later) and the discharge outlet of the fixing unit 304 is a first tractor feeder 334 arranged at an interval corresponding to the sheet width in the sheet forwarding direction. The tractor feeder, stretched by rollers 330 and 332, serves to forward the sheet by inserting pins 333, 333, 333 ··· into holes provided on both side edges of the sheet. One of the rollers 330 has a sensor 335 for detecting the phase of the first tractor feeder 334, i.e., the position of the pins 333, 333, 333, ···.

On the end portion of the first tractor feeder 334 are a first guide board 338 connected to the sheet discharge rollers 308, 308 bifurcated from a first gate member 336 and a second guide board 342 connected to a second gate member 340. At the tip of the second gate member 340 are a third guide board 344 connected to a sheet tray 343 containing sheets faceup and a fourth guide board 346 for forwarding the inverted sheet for double-side printing. The fourth guide board 346 is provided with sheet forwarding rollers 348, 350 at a predetermined interval, and the upper end thereof is connected to a guide board 352 of the stacker 296.

The stacker 296 is mounted so that a second tractor feeder (described later) can be accommodated between itself and the lower unit 292 of the electrophotographic recording apparatus body 200. The stacker 296 is further equipped with cassettes 354, 356 releasably attached to contain cut sheets in vertical position, and the sheet taken out from pickup rollers 358, 360 with which the tail end of the sheet comes in contact is forwarded to the sheet feed inlet 228'.

In the front of the stacker 296 is a guide board 352 for guiding the sheet substantially vertically. The tip thereof is provided with a tail end detector 362 for detecting the tail end of the sheet, and on the detector 362 are rollers 364, 364 for introducing the sheet to the sheet feed inlet 228' from the tail end by the switchback system.

In the figure, the second tractor feeder 370 for forwarding the sheet with pins 371, 371, 371, ··· is arranged so as to be stretched by the rollers 372, 374 between the upper surface of the lower unit 292 and the bottom surface of the stacker 296. The second tractor feeder 370 extends toward the front from the rear of the lower unit 292 and it is in parallel with the lower unit 292 with an interval corresponding to the sheet width. One 374 of the rollers has a sensor 376 for detecting its rotational position, and this sensor detects the positional relationship between the pins 333, 333, 333, ··· and 371, 371, 371, ··· of the two tractor feeders 334, 370 in cooperation with the sensor 335 of the first tractor feeder 334. On the tip of the second tractor feeder 370, i.e., on the sheet feed inlet 228' side, is a cutter 378 for cutting the continuous sheet as shown in Fig. 17, and at a position a predetermined distance away from the cutter 378 is a head end detector 380 for detecting the head end of the sheet.

Fig. 17 shows the relationship between the first tractor feeder 334 and the second tractor feeder 370. Between the discharge end of the second tractor feeder 370 and the charge end of the first tractor feeder 334 are guide boards 381, 382. The lower guide board 381 is pivotable downward around the end portion of the second tractor feeder 370 to thereby properly deliver the head end of the sheet to the first tractor feeder 334 from these guide boards 381, 382. In Fig. 16, reference numeral 388 designates an optical writing unit.

In order to print on a cut sheet with this embodiment, the continuous sheet is evacuate further toward the second tractor feeder 370 side than the sheet feed inlet 328, and the first and second tractor feeders 334, 370 must be stopped before operating the stacker 296. After making such preparation, the sheet taken out by the pickup rollers 358, 360 enters the sheet feed inlet 328 and is stopped by the gate rollers 300, 324. Upon the detection of the setup of the sheet by the sheet detector 322, the sheet is forwarded to the photosensitive drum 302 by the gate rollers 300, 324, subjected to the above-described printing process, and discharged from the fixing unit 304. At this time, if the first gate member 336 is opened toward the first guide board 338, the sheet is forwarded from the sheet discharge roller 308 out into the apparatus body. If a sorter 290 is connected, the sheet enters the sorter to be thereby sorted by page.

If the first gate member 336 and the second gate member 340 are opened toward the sheet tray 343, the sheet is accommodated in the tray 343 with the printed side facing upward.

In order to print on the rear side of the sheet, the second gate member 340 is opened toward the fourth

guide board 346, the sheet is first taken out into the upper end of the guide board 352 of the stacker 296, then switched back, and caused to enter the sheet feed inlet 328 from the tail end. Thus, the sheet is moving through the printing path 298 with the printed side facing upward to be thereby subjected to the above-described printing process for rear-side printing.

The printing with the continuous sheet will next be described.

The head end of the continuous sheet folded at the perforations is inserted into the pins 371, 371, 371 ··· and fixed by a pressing member 382'.

By operating the apparatus under this condition, the sheet P' is forwarded in the direction of the sheet feed inlet 328 and its head end is detected by the head end detector 380.

When the sheet P' is further forwarded a distance between the head end detector 380 and the first tractor feeder 334, the head end of the sheet P' put out of the second tractor feeder 370 enters into the inlet of the first tractor feeder 334 while guided by the guide board 381. The forwarding operation of the second tractor feeder 370 is adjusted based on the signals from the detectors 335 and 376 so that the holes of the sheet coincide with the pins 333, 333, 333, ··· of the first tractor feeder 334. As the sheet is introduced from the second tractor feeder 370 in this way, the first tractor feeder 334 causes the pins 333, 333, 333, ··· to be inserted into the holes of the head end of the sheet to thereby receive the sheet smoothly. Driving the first and second tractor feeders 334, 370 in synchronism under this condition, the sheet is forwarded and reaches the gate rollers 300, 324 while accurately positioned by the tractor feeders 334, 370 without receiving any undesired force, and detected by the sheet detector 322. At this point, the gate rollers 300, 324 are operated in synchronism with the speed of movement of the tractor feeders 334, 370, or the sheet is moved at a printing speed by the tractor feeders 334, 370 with the gate rollers 300, 324 being idle. Accordingly, the printing process as described above will be performed.

When a first line of perforations reaches a predetermined region from the cutter 378, the second tractor feeder 370 is accelerated while causing the first tractor feeder 334 to continuously maintain the printing speed. At the same time, the tip of the guide board 381 is turned downward. This causes the sheet P' present between the first tractor feeder 334 and the second tractor feeder 370 to be slack as shown in Fig. 18. Under this condition, the first tractor feeder 334 is causing the continuous sheet to move at the same printing speed until the line of perforations reaches the cutting position. When the line of perforations reaches the cutting position, the second tractor feeder 370 is stopped and the cutter 378 is operated. Thus, the sheet is cut at the perforations whereas its head end is forwarded by the first tractor feeder 334. After the sheet has been cut, the guide board 381 is returned to the initial position to get ready for another delivery of a sheet.

In the meantime, the sheet cut by the cutter is forwarded while held by the first tractor feeder 334 at both side, and printing is continuously performed for the remaining copies.

When the printing for one page has been completed in this way, the printed sheet is discharged at a position determined either by the first or second gate members 336, 340 as described previously.

In order to print the second page, the head end of the continuous sheet is delivered to the first tractor feeder 334 while the first and second tractor feeders 334, 370 are rotated in synchronization, and the previous printing process is repeated.

Fig. 19 shows a fourth embodiment of the present invention, in which reference numeral 390 designates an electrophotographic recording apparatus body, which comprises, at the lower portion of the front side thereof when installed, a sheet discharge outlet 394 for discharging a sheet from sheet discharge rollers 393, and a cover member 396 that stretches over the sheet discharge outlet 394 and can freely be opened and closed by a hinge. On the top of the apparatus body 390 is a cartridge type sheet feeder 398 for containing sheets in horizontal position. On the lateral side thereof is a housing 404 that contains a control circuit board and an external storage medium reading unit therein and that has a control panel 400 consisting of operation switches and an external storage medium inserting inlet 402 on the front thereof.

Fig. 20 shows the internal structure of the apparatus shown in Fig. 19. In the front of the housing of the apparatus body 390 (left of the figure) is a sheet guide board 410 in line with a sheet receiving inlet 408 whose upper end is wider upward. Lined up from top downward are a gate roller 412, a photosensitive drum 414, and a fixing unit 418 interposing a shield board 416 (described later) therebetween in the order written.

A magnetic brush on the surface of a magnetic sleeve 422 is in contact with the surface of the photosensitive drum 414, and a charging unit 424 is arranged at a predetermined distance in the circumferential direction with respect to the bottom of the container of the developing unit 420. Upstream in the direction of rotation of the charging unit 424 is a discharging unit 426.

Reference numeral 428 designates an optical writing unit, disposed in the space in the rear isolated by a partition wall 430. An optical beam from this unit is irradiated onto the surface of the photosensitive drum 414 through a window 432 of the partition wall 430 and a clearance formed between the developing unit 420 and the discharging unit 424 by an optical system. The lower portion of the photosensitive drum

414 is sloped from front to rear, and divides the housing body space into two portions, an upper portion and a lower portion, by arranging the shield board 416 integrally formed with the partition wall 430 on the back. In a space below the shield board 416 are a fixing unit 418 consisting of a heating roller 434 and a pressure roller 436, and an exhaust fan 438.

On the discharge side of the fixing unit 434 is a sheet guide 440 to thereby form a sheet forwarding path for forwarding the vertically forwarded sheet to a sheet discharge outlet 394 through sheet discharge rollers 442, 442.

Inside the cover member 396 are a sheet detector 444, a pinch roller 446 abutted against the gate roller 412, a transfer unit 448 confronting the photosensitive drum 414, and a guide member 450 stretching from the photosensitive drum 414 to the fixing unit 418, all arranged from top downward.

Upstream of the discharge roller 392 are a tail end detector 452 and a sheet forwarding path selecting board 454 that is pivotably arranged. In the case of double-side printing, the sheet is forwarded to a sheet inverting path 456.

In the figure, reference numeral 456 designates the sheet inverting path formed on the cover member 396. The sheet inverting path 456 is connected to the sheet feed inlet 408 upstream of the sheet discharge roller 393 interposing a roller 466 for forwarding the sheet upward.

Reference numeral 398 designates the sheet feeder, which is movable on the electrophotographic recording apparatus body 390 toward or away from the apparatus. The sheet feeder 398 is set to a sheet feed position (the position indicated in Fig. 19) and is removable by pulling toward the front. At the lower portion in the front of the feeder body is a sheet discharge outlet 468 formed so that it confronts the sheet feed inlet 408 of the electrophotographic recording apparatus body vertically. Above this outlet is a sheet feed inlet 470, opened, for manual insertion. The sheet discharge outlet 468 is provided with not only a guide member 472 that is winglike in cross-section for inverting the sheet direction by causing the horizontally forwarded sheet to be bent vertically downward but also a pickup roller 474 at a position where the head end of the sheet comes into contact. In the figure, reference numeral 476 designates a spring disposed on the bottom portion of a cassette 478 for pressing the head end of the sheet on the pickup roller 474.

In this embodiment, when the cassette 478 having the sheet P therein contained is set to the sheet feeder 398, the sheet is held horizontally, the bottom of the cassette being pushed up by the spring, and the top thereof being pressed by the pickup roller 474.

Upon start of the printing under this condition, a sheet is taken out from the cassette 478 by the pickup roller 474. The head end of the sheet is bent vertically downward to be thereby directed toward the sheet discharge outlet 468, enters the sheet feed inlet 408 of the electrophotographic recording apparatus body 390, and is abutted against the gate roller 412 by the sheet guide board 410. When the sheet is further pressed down by the pickup roller 474 under this condition, a signal is produced from the sheet detector 444.

Thus, the gate roller 412 is rotated to set the sheet to a reference position, and the sheet is forwarded further downward. The transfer unit 448 transfers a toner image formed on the photosensitive drum 414 onto the sheet. The fixing unit 418 fixes the toner on the sheet, and the sheet is further forwarded to the sheet discharge rollers 442, 442.

The waste heat of the fixing unit 418 during this process is stopped from going upward by the shield board 416 and is quickly discharged from the exhaust fan 438 to the outside.

The toner not adhering to the sheet out of the toner that has adhered to the photosensitive drum 414 during the developing process is scratched off by a blade located almost below the photosensitive drum 414 and received by a waste toner tank 480 located right below by its own weight.

By the way, in order to print on the rear side of the sheet as well, the gate member 454 is switched to the sheet inversion path 456, the sheet discharge rollers 392, 392 are reversely rotated to thereby pull the sheet into the apparatus body side with the tail end being bit by the sheet discharge rollers 392, 392. The tail end of the sheet is guided to the sheet inversion path 456 by the gate member 454, forwarded through the sheet inversion path 456, is stopped by the gate roller 446 by entering the sheet feed inlet 408 again. Under this condition, the rear side of the sheet faces the photosensitive drum 414, so that rear-side printing is performed by following the same process as described above.

On the other hand, in the case where a small number of copies are to be made using sheets not set in the cassette 478, the sheet is inserted into the manual insertion sheet feed inlet 470. The sheet is then guided to the sheet discharge outlet 468 by the guide member 472 and reaches the gate roller 412 passing through the sheet feed inlet 408. As the sheet is further pushed under this condition, a signal is produced by the sheet detector 444 to thereby operate the gate roller 412. It is at this time when the hand is released. Then, printing is performed by the same process as described above.

Claims

1. An electrophotographic recording apparatus for selectably printing on both sides of a recording sheet, comprising:

414 is sloped from front to rear, and divides the housing body space into two portions, an upper portion and a lower portion, by arranging the shield board 416 integrally formed with the partition wall 430 on the back. In a space below the shield board 416 are a fixing unit 418 consisting of a heating roller 434 and a pressure roller 436, and an exhaust fan 438.

On the discharge side of the fixing unit 434 is a sheet guide 440 to thereby form a sheet forwarding path for forwarding the vertically forwarded sheet to a sheet discharge outlet 394 through sheet discharge rollers 442, 442.

Inside the cover member 396 are a sheet detector 444, a pinch roller 446 abutted against the gate roller 412, a transfer unit 448 confronting the photosensitive drum 414, and a guide member 450 stretching from the photosensitive drum 414 to the fixing unit 418, all arranged from top downward.

Upstream of the discharge roller 392 are a tail end detector 452 and a sheet forwarding path selecting board 454 that is pivotably arranged. In the case of double-side printing, the sheet is forwarded to a sheet inverting path 456.

In the figure, reference numeral 456 designates the sheet inverting path formed on the cover member 396. The sheet inverting path 456 is connected to the sheet feed inlet 408 upstream of the sheet discharge roller 393 interposing a roller 466 for forwarding the sheet upward.

Reference numeral 398 designates the sheet feeder, which is movable on the electrophotographic recording apparatus body 390 toward or away from the apparatus. The sheet feeder 398 is set to a sheet feed position (the position indicated in Fig. 19) and is removable by pulling toward the front. At the lower portion in the front of the feeder body is a sheet discharge outlet 468 formed so that it confronts the sheet feed inlet 408 of the electrophotographic recording apparatus body vertically. Above this outlet is a sheet feed inlet 470, opened, for manual insertion. The sheet discharge outlet 468 is provided with not only a guide member 472 that is winglike in cross-section for inverting the sheet direction by causing the horizontally forwarded sheet to be bent vertically downward but also a pickup roller 474 at a position where the head end of the sheet comes into contact. In the figure, reference numeral 476 designates a spring disposed on the bottom portion of a cassette 478 for pressing the head end of the sheet on the pickup roller 474.

In this embodiment, when the cassette 478 having the sheet P therein contained is set to the sheet feeder 398, the sheet is held horizontally, the bottom of the cassette being pushed up by the spring, and the top thereof being pressed by the pickup roller 474.

Upon start of the printing under this condition, a sheet is taken out from the cassette 478 by the pickup roller 474. The head end of the sheet is bent vertically downward to be thereby directed toward the sheet discharge outlet 468, enters the sheet feed inlet 408 of the electrophotographic recording apparatus body 390, and is abutted against the gate roller 412 by the sheet guide board 410. When the sheet is further pressed down by the pickup roller 474 under this condition, a signal is produced from the sheet detector 444.

Thus, the gate roller 412 is rotated to set the sheet to a reference position, and the sheet is forwarded further downward. The transfer unit 448 transfers a toner image formed on the photosensitive drum 414 onto the sheet. The fixing unit 418 fixes the toner on the sheet, and the sheet is further forwarded to the sheet discharge rollers 442, 442.

The waste heat of the fixing unit 418 during this process is stopped from going upward by the shield board 416 and is quickly discharged from the exhaust fan 438 to the outside.

The toner not adhering to the sheet out of the toner that has adhered to the photosensitive drum 414 during the developing process is scratched off by a blade located almost below the photosensitive drum 414 and received by a waste toner tank 480 located right below by its own weight.

By the way, in order to print on the rear side of the sheet as well, the gate member 454 is switched to the sheet inversion path 456, the sheet discharge rollers 392, 392 are reversely rotated to thereby pull the sheet into the apparatus body side with the tail end being bit by the sheet discharge rollers 392, 392. The tail end of the sheet is guided to the sheet inversion path 456 by the gate member 454, forwarded through the sheet inversion path 456, is stopped by the gate roller 446 by entering the sheet feed inlet 408 again. Under this condition, the rear side of the sheet faces the photosensitive drum 414, so that rear-side printing is performed by following the same process as described above.

On the other hand, in the case where a small number of copies are to be made using sheets not set in the cassette 478, the sheet is inserted into the manual insertion sheet feed inlet 470. The sheet is then guided to the sheet discharge outlet 468 by the guide member 472 and reaches the gate roller 412 passing through the sheet feed inlet 408. As the sheet is further pushed under this condition, a signal is produced by the sheet detector 444 to thereby operate the gate roller 412. It is at this time when the hand is released. Then, printing is performed by the same process as described above.

Claims

1. An electrophotographic recording apparatus for selectably printing on both sides of a recording sheet, comprising:

* C L M S *

sheet feed inlet means (36) into which said recording sheet is inserted;
means (20) for feeding said recording sheet to said sheet feed inlet means (36);
means having a photosensitive drum (44) for forming a printing image on said photosensitive drum based on printing data and for transferring said printing image onto said recording sheet;
means (58) for fixing said transferred printing image on said recording sheet;
wherein said sheet feeding means (20), said image forming means (44), and said fixing means (58) are arranged vertically;
discharge roller means (66), arranged downstream of said fixing means (58) for discharging said recording sheet after said recording sheet has been printed;
means (64) for selectably switching the feeding direction of said recording sheet supplied from said fixing means (58) between a first and a second direction;
sheet guide means (68,72), having a portion thereof which is connected to said switching means (64) when said switching means switches the sheet feeding direction in said first direction, and having an outlet thereof;
means (78) for detecting a tail end of said recording sheet, said detecting means being arranged on an end portion of said sheet guide means;
sheet take-out roller means (70) located downstream of said detection means (78) for forwarding said recording sheet in a reverse direction by reverse rotation according to an output signal from said detecting means, after said recording sheet is fed through said sheet guide means in a direction; and
reading means for writing said printing data from the last line onward to said photosensitive drum when printing is performed on a second side of said recording sheet.

2. An apparatus as claimed in claim 1, wherein said sheet guide means (72) is provided with a plurality of projecting members (92,93) extending in the sheet forwarding direction; said plurality of projecting members (92,93) arranged for staggered confrontation with each other.

3. An apparatus as claimed in claim 1 or 2, further comprising:
a sheet forwarding path switching member (80), having a substantially triangular cross section, with an apex facing an upper portion; said sheet forwarding path switching member being arranged adjacent to said tail end detecting means (78).

4. An apparatus as claimed in one of claims 1 to 3, wherein an oblique line of said sheet forwarding path switching member includes a guide board (98) that provides sufficient clearance to allow said sheet to pass through; and wherein a direction in which said sheet take-out roller means are pulled is set to intersect said guide board on the side of a printing path.

5. An apparatus as claimed in one of claims 3 or 4, wherein said apex of said sheet forwarding switching member (80) is cut to guide said into said printing path; and wherein said apex is opened wider upward.

6. An apparatus as claimed in one of the preceding claims, further comprising:
sorter forwarding rollers (102) arranged to coincide with said discharge roller means (66); and
a sorting unit (101) for selectably sorting said sheet discharged from said discharge roller means into an upper and a lower direction.

7. An apparatus as claimed in one of the preceding claims further comprising a body, which is divided into an upper unit (210) and a lower unit (208) by a first sheet forwarding path;
said upper unit (210) including said first sheet forwarding path having respective means for performing electrophotographic processes; and having a second sheet forwarding path, connected to a sheet inverting path, additionally having a sheet guide member;
said upper unit and said sheet guide member (256) being supported so as to be freely opened and closed with respect to said lower unit (208) by a common shaft (250) that is fixed on the upper end of the sheet feed side of said lower unit (208) as a pivot.

8. An apparatus as claimed in one of the preceding claims, wherein a sheet feeder (214) having sheet feeding means is provided along a sheet feeding path on said lower unit (208); and wherein said sheet feeder is supported by said common shaft (250) as a pivot.

9. An apparatus as claimed in one of the preceding claims further comprising:
a housing body including, from top downward in the following order gate rollers (412), a developing unit (310), a photosensitive drum (302), a fixing unit (304), sheet discharging rollers (308), and a first tractor feeder (334) for forwarding a continuous sheet from said gate rollers to said fixing unit, said respective units forming a printing path (298);
a second tractor feeder (370) arranged on the upper portion of said housing body;

a cut sheet feeder means arranged on said second tractor feeder (370); and
a continuous sheet cutting means (378) arranged adjacent to said second tractor feeder.

10. An apparatus as claimed in claim 9, wherein said first tractor feeder (334) and said second tractor feeder (370) may be driven in synchronism with each other; and alternatively wherein said second tractor feeder is driven faster than said first tractor feeder.

11. An apparatus as claimed in one of claims 1 to 8, further comprising:
a body having from top downward in the following order, gate rollers (412), a developing unit (420), a photosensitive drum (414), a fixing unit (418), and discharge rollers (442);
a sheet feed inlet (408) for a printing path passing through said respective units in the front side of the upper portion of said body; and
a sheet feeder (398) having a discharge outlet (468), which is horizontally mountable on the upper portion of said body so as to confront with said sheet feed inlet (408).

Patentansprüche

1. Elektrofotografische Aufzeichnungsvorrichtung zum wahlweisen Bedrucken beider Seiten eines Aufzeichnungsblattes, mit:
einem Blattzuführeinlaßmittel (36), in welches das Aufzeichnungsblatt eingeführt wird;
einem Mittel (20) zum Zuführen des Aufzeichnungsblattes zu dem Blattzuführeinlaßmittel (36);
einem Mittel mit einer lichtempfindlichen Trommel (44) zur Erzeugung eines Druckbildes auf der lichtempfindlichen Trommel basierend auf Druckdaten und zum Übertragen des Druckbildes auf das Aufzeichnungsblatt;
einem Mittel (58) zum Fixieren des übertragenen Druckbildes auf dem Aufzeichnungsblatt;
wobei das Blattzuführmittel (20), das Bilderzeugungsmittel (44) und das Fixiermittel (58) vertikal angeordnet sind;
einem dem Fixiermittel (58) nachgeschalteten Ausgabewalzenmittel (66) zur Ausgabe des Aufzeichnungsblattes nach dem Bedrucken des Aufzeichnungsblattes;
einem Mittel (64) zum wahlweisen Umschalten der Zuführrichtung des von dem Fixiermittel (58) zugeführten Aufzeichnungsblattes zwischen einer ersten und einer zweiten Richtung;
einem Blattführungsmittel (68, 72), von dem ein Abschnitt mit dem Umschaltmittel (64) verbunden ist, wenn das Umschaltmittel die Blattzuführrichtung in die erste Richtung umschaltet, und das einen Ausgang aufweist;
einem Mittel (78) zum Erfassen eines hinteren Endes des Aufzeichnungsblattes, wobei das Erfassungsmittel auf einem Endabschnitt des Blattführungsmittels angeordnet ist;
dem Erfassungsmittel (78) nachgeschalteten Blattabzugswalzenmitteln (70) zum Befördern des Aufzeichnungsblattes in entgegengesetzter Richtung durch entgegengesetzte Drehung gemäß einem Ausgangssignal von dem Erfassungsmittel, nachdem das Aufzeichnungsblatt in einer Richtung durch die Blattführungsmittel befördert wird; und
einem Lesemittel zum Schreiben der Druckdaten von der letzten Zeile ab aufwärts auf die lichtempfindliche Trommel, wenn auf einer zweiten Seite des Aufzeichnungsblattes gedruckt wird.

2. Vorrichtung gemäß Anspruch 1, bei der das Blattführungsmittel (72) mit einer Mehrzahl von vorstehenden Elementen (92, 93) versehen ist, welche sich in die Blattbeförderungsrichtung erstrecken; wobei die Mehrzahl von vorstehenden Elementen (92, 93) so angeordnet sind, daß sie einander versetzt gegenüberliegen.

3. Vorrichtung gemäß Anspruch 1 oder 2, die des weiteren aufweist:
ein Blattbeförderungswegumschaltelement (80) mit einem im wesentlichen dreieckigen Querschnitt, wobei ein Scheitel an einem oberen Abschnitt liegt; wobei das Blattbeförderungswegumschaltelement neben dem Mittel (78) zur Erfassung des hinteren Endes angeordnet ist.

4. Vorrichtung gemäß einem der Ansprüche 1 bis 3, bei der eine schräge Linie des Blattbeförderungswegumschaltelements eine Führungsplatte (98) aufweist, welche genügend Zwischenraum bereitstellt, damit das Blatt hindurchbeförderbar ist; und wobei eine Richtung, in der die Blattabzugswalzenmittel gezogen werden, eingestellt ist, um die Führungsplatte auf der Seite eines Druckweges zu schneiden.

5. Vorrichtung gemäß einem der Ansprüche 3 oder 4, bei der der Scheitel des Blattbeförderungsumschaltelements (80) geschnitten ist, um das Aufzeichnungsblatt in den Druckweg zu führen; und wobei der Scheitel nach oben weiter geöffnet ist.

6. Vorrichtung gemäß einem der vorhergehenden Ansprüche, die des weiteren aufweist:
Sortierbeförderungswalzen (102), die so angeordnet sind, daß sie mit den Ausgabewalzenmitteln (66) koinzidieren; und
eine Sortiereinheit (101) zum wahlweisen Sortie-

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ren des von den Ausgabewalzenmitteln ausgegebenen Blattes in eine obere und eine untere Richtung.

7. Vorrichtung gemäß einem der vorhergehenden Ansprüche, die des weiteren ein Gehäuse aufweist, welches durch einen ersten Blattbeförderungsweg in eine obere Einheit (210) und eine untere Einheit (208) aufgeteilt ist;
wobei die obere Einheit (210) den ersten Blattbeförderungsweg mit jeweiligen Mitteln zur Ausführung elektrofotografischer Verfahren und einen zweiten Blattbeförderungsweg, welcher mit einem Blattwendeweg verbunden ist, sowie zusätzlich ein Blattführungselement aufweist;
wobei die obere Einheit und das Blattführungselement (256) so gelagert sind, daß sie in bezug auf die untere Einheit (208) durch eine gemeinsame Welle (250), welche auf dem oberen Ende der Blattzuführseite der unteren Einheit (208) als Drehelement befestigt ist, frei geöffnet und geschlossen werden.

8. Vorrichtung gemäß einem der vorhergehenden Ansprüche, bei der ein Blattzuführelement (214) mit Blattzuführmitteln entlang eines Blattzuführweges auf der unteren Einheit (208) bereitgestellt ist; und bei der das Blattzuführelement durch die gemeinsame Welle (250) als Drehelement gelagert ist.

9. Vorrichtung gemäß einem der vorhergehenden Ansprüche, die des weiteren aufweist:
einen Gehäusekörper, der von oben nach unten in der folgenden Reihenfolge Durchgangswalzen (412), eine Entwicklungseinheit (310), eine lichtempfindliche Trommel (302), eine Fixiereinheit (304), Blattausgabewalzen (308) und einen ersten Zuführtraktor (334) zur Beförderung eines Endlosblattes von den Durchgangswalzen zu der Fixiereinheit aufweist, wobei die jeweiligen Einheiten einen Druckweg (298) bilden;
einen zweiten Zuführtraktor (370), der auf dem oberen Abschnitt des Gehäusekörpers angeordnet ist;
ein auf dem zweiten Zuführtraktor (370) angeordnetes Einzelblattzuführmittel; und
ein neben dem zweiten Zuführtraktor angeordnetes Mittel (378) zum Schneiden von Endlosblättern.

10. Vorrichtung gemäß Anspruch 9, bei der der erste Zuführtraktor (334) und der zweite Zuführtraktor (370) synchron miteinander antreibbar sind; und bei der alternativ der zweite Zuführtraktor schneller als der erste Zuführtraktor angetrieben ist.

11. Vorrichtung gemäß einem der Ansprüche 1 bis 8, die des weiteren aufweist:
ein Gehäuse, das von oben nach unten in folgender Reihenfolge Durchgangswalzen (412), eine Entwicklungseinheit (420), eine lichtempfindliche Trommel (414), eine Fixiereinheit (418) und Ausgabewalzen (442) aufweist;
einen Blattzuführeinlaß (408) für einen Druckweg durch die jeweiligen Einheiten auf der vorderen Seite des oberen Abschnitts des Gehäuses; und
ein Blattzuführelement (398) mit einem Ausgabeausgang (468), das horizontal auf dem oberen Abschnitt des Gehäuses anbringbar ist, um so dem Blattzuführeinlaß (408) gegenüberzuliegen.

Revendications

1. Appareil d'enregistrement électrophotographique pour imprimer sélectivement sur les deux côtés d'une feuille d'enregistrement, comprenant :
un moyen à entrée de chargement de feuille (36) dans lequel ladite feuille d'enregistrement est insérée;
un moyen (20) pour avancer ladite feuille d'enregistrement jusqu'audit moyen à entrée de chargement de feuille (36) ;
un moyen comportant un tambour photosensible (44) pour former une image d'impression sur ledit tambour photosensible selon des données d'impression et pour transférer ladite image d'impression jusque sur ladite feuille d'enregistrement ;
un moyen (58) pour fixer ladite image d'impression transférée sur ladite feuille d'enregistrement ;
dans lequel ledit moyen d'avancement de feuille (20), ledit moyen de formation d'image (44), et ledit moyen de fixage (58) sont disposés verticalement ;
un moyen à rouleaux d'évacuation (66), disposé en aval dudit moyen de fixage (58) pour évacuer ladite feuille d'enregistrement après que ladite feuille d'enregistrement ait été imprimée ;
un moyen (64) pour changer sélectivement la direction d'avancement de ladite feuille d'enregistrement fournie par ledit moyen de fixage (58) entre une première direction et une deuxième direction ;
un moyen de guidage de feuille (68, 72), comportant une partie qui est connectée audit moyen de changement (64) quand ledit moyen de changement change la direction d'avancement de la feuille dans ladite première direction, et comportant une sortie ;
un moyen (78) pour détecter une extrémité en bout de ladite feuille d'enregistrement, ledit moyen de détection étant disposé à une extrémi-

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té dudit moyen de guidage de feuille ;

un moyen à rouleaux de sortie de feuille (70) situé en aval dudit moyen de détection (78) pour faire avancer ladite feuille d'enregistrement dans un sens inverse par rotation inverse selon le signal de sortie dudit moyen de détection, après que ladite feuille d'enregistrement ait été avancée dans ledit moyen de guidage de feuille dans une direction ; et,

un moyen de lecture pour écrire lesdites données d'impression à partir de la dernière ligne sur ledit tambour photosensible quand une impression est exécutée sur un second côté de ladite feuille d'enregistrement.

2. Appareil selon la revendication 1, dans lequel ledit moyen de guidage de feuille (72) est pourvu d'une pluralité d'éléments saillants (92, 93) s'étendant dans la direction d'avancement de la feuille, ladite pluralité des éléments saillants (92, 93) étant disposés pour les mettre en face en étant décalés les uns des autres.

3. Appareil selon l'une quelconque des revendications 1 et 2, comprenant en outre :

un élément de changement de voie d'avancement de feuille (80), ayant une section transversale sensiblement triangulaire, avec un sommet en face d'une partie supérieure, ledit élément de changement de voie d'avancement de feuille étant disposé à côté dudit moyen de détection d'extrémité en bout (78).

4. Appareil selon l'une quelconque des revendications 1 à 3, dans lequel une ligne oblique dudit élément de changement de voie d'avancement de feuille inclut une plaque de guidage (98) qui fournit un espace libre suffisant pour permettre à ladite feuille de passer par celle-ci, et dans lequel la direction suivant laquelle s'étend ledit moyen à rouleaux de sortie de feuille est définie comme coupant ladite plaque de guidage du côté de la voie d'impression.

5. Appareil selon l'une quelconque des revendications 3 ou 4, dans lequel ledit sommet dudit élément de changement de voie d'avancement de feuille (80) est coupé pour le guider dans ladite voie d'impression, et dans lequel ledit sommet est ouvert plus largement vers le haut.

6. Appareil selon l'une quelconque des revendications 1 à 5, comprenant en outre :

des rouleaux d'avancement d'unité de classement (102) disposés pour coïncider avec ledit moyen à rouleaux d'évacuation (66) ; et,

une unité de classement (101) pour classer sélectivement ladite feuille évacuée par ledit moyen à rouleaux d'évacuation dans une direction supérieure et une direction inférieure.

7. Appareil selon l'une quelconque des revendications 1 à 6, comprenant en outre un corps, qui est divisé en une unité supérieure (210) et une unité inférieure (208) par une première voie d'avancement de feuille ;

ladite unité supérieure (210) incluant ladite première voie d'avancement de feuille où se trouvent des moyens respectifs pour exécuter des traitements électrophotographiques, et une deuxième voie d'avancement de feuille, reliée à une voie d'inversion de feuille, où se trouve en outre un élément de guidage de feuille ;

ladite unité supérieure et ledit élément de guidage de feuille (256) étant supportés de manière à les ouvrir et les fermer librement par rapport à ladite unité inférieure (208) au moyen d'un arbre commun (250), qui est fixé sur l'extrémité supérieure du côté d'avancement de feuille de ladite unité inférieure (208), comme pivot.

8. Appareil selon l'une quelconque des revendications 1 à 7 dans lequel un élément d'entraînement de feuille (214) comportant un moyen d'entraînement de feuille est prévu le long d'une voie d'avancement de feuille sur ladite unité inférieure (208), et dans lequel ledit élément d'entraînement de feuille est supporté par ledit arbre commun (250) comme pivot.

9. Appareil selon l'une quelconque des revendications 1 à 8, comprenant en outre :

un corps de logement incluant, de haut en bas dans l'ordre suivant, des rouleaux de passage (412), une unité de développement (310), un tambour photosensible (302), une unité de fixage (304), des rouleaux d'évacuation de feuille (308), et une première unité d'entraînement (334) pour faire avancer une feuille continue desdits rouleaux de passage contrôlé jusqu'à ladite unité de fixage, lesdites unités respectives formant une voie d'impression (298) ;

une deuxième unité d'entraînement (370) disposée sur la partie supérieure dudit corps de logement ;

un moyen d'entraînement de feuille coupée disposé sur ladite deuxième unité d'entraînement (370) ; et,

un moyen de coupe de feuille continue (378) disposé à côté de ladite deuxième unité d'entraînement à picots.

10. Appareil selon la revendication 9, dans lequel ladite première unité d'entraînement (334) et ladite deuxième unité d'entraînement (370) peuvent être commandées en synchronisme l'une par

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rapport à l'autre, et, alternativement, dans lequel ladite deuxième unité d'entraînement est commandée plus rapidement que ladite première unité d'entraînement.

11. Appareil selon l'une quelconque des revendications 1 à 8, comprenant en outre :

un corps comportant de haut en bas dans l'ordre suivant, des rouleaux de passage (412), une unité de développement (420), un tambour photosensible (414), une unité de fixage (418), et des rouleaux d'évacuation (442) ;

une entrée de chargement de feuille (408) pour une voie d'impression passant par lesdites unités respectives à l'avant de la partie supérieure dudit corps ; et,

un distributeur de feuille (398) comportant une sortie d'évacuation (468), qui peut être monté horizontalement sur la partie supérieure dudit corps de manière à se trouver en face de ladite entrée de chargement de feuille (408).