

PROCESS UNIT

Field of the Invention

This invention relates to a process unit detachably mounted in an image forming machine such as an electrostatic copying machine or a laser
5 printer.

Description of the Prior Art

There is a known process unit including a drum unit having a photoconductor drum on which a latent electrostatic image is formed by exposure
10 means; a developing device having a development housing accommodating a developer, and a developing roller disposed in the development housing to supply the developer to the drum unit; and a support shaft (fulcrum) for supporting the developing device so as
15 to be pivotable relative to the drum unit (see, for example, Japanese Laid-Open Patent Publication No. 66662/93). Such a process unit is detachably mounted in an image forming machine. In the process unit disclosed in that publication, the support shaft is
20 placed at an upper portion of the drum unit so as to be capable of producing a turning moment for urging the developing roller toward the photoconductor drum by gravity acting on the developing device. A spring is interposed between the developing device and the
25 drum unit. This spring is located so as to urge the developing device in a direction in which the turning moment is decreased.

The developing device is provided with an input gear for transmitting a drive force to the
30 developing roller, and the image forming machine is provided with an output gear for transmitting a drive force to the input gear. The direction of the drive pressure angle of the output gear is defined so that

a moment for urging the developing roller toward the photoconductor drum can be generated.

5 The above-mentioned input gear and output gear are disposed only on one side of the developing device and the image forming machine. Thus, when a drive torque is given by the output gear to the input gear, a greater load is imposed on that one side of the developing device than on the other side thereof, whereby the force of pressed contact of the
10 developing roller with the photoconductor drum tends to become nonuniform. In the conventional process unit, moreover, the direction of the drive pressure angle of the output gear with respect to the input gear is defined so that a moment for urging the
15 developing roller toward the photoconductor drum can be formed. Thus, a drive torque acting on the developing device (the force in the aforementioned direction of the pressure angle) widely varies according to the amount of the developer accommodated
20 in the development housing. Consequently, the force of pressed contact between the developing roller and the photoconductor drum markedly changes with changes in the amount of the developer, and may result in the unstable formation of an image.

25 Summary of the Invention

 The object of this invention is to provide a novel process unit capable of minimizing the change in the force of pressed contact between the developing roller and the photoconductor drum due to
30 changes in the drive torque.

 Specifically, the invention provides a process unit detachably mounted in an image forming machine, the process unit including a drum unit having a photoconductor drum on which a latent
35 electrostatic image is formed; a developing device

having a development housing accommodating a developer, and a developing roller disposed in the development housing to supply the developer to the photoconductor drum; and support shaft means for
5 supporting the developing device so as to be pivotable relative to the drum unit; wherein
spring means is interposed between the developing device and the drum unit to impart to the developing device a turning moment about the support
10 shaft means so that the developing roller is urged toward the photoconductor drum,
the developing device is provided with an input gear for transmitting a drive force to the developing roller, the image forming machine is
15 provided with an output gear for transmitting a drive force to the input gear, and the direction of the drive pressure angle of the output gear to the input gear, or a direction opposite to this direction is headed for the support shaft means.
20 According to the invention, as described above, the direction of the drive pressure angle of the output gear, provided on the image forming machine, to the input gear provided on the developing device, or a direction opposite to this direction is
25 headed for the support shaft means. Thus, the drive torque acting on the developing device does not cause the developing device a moment of turning about the support shaft means, and so does not vary according to the amount of the developer accommodated in the
30 development housing. Hence, the drive torque does not affect the force of pressed contact between the developing roller and the photoconductor drum, regardless of changes in the amount of the developer, so that stable image formation is carried out.
35 Brief Description of the Drawings

Fig. 1 is a front view schematically showing a printer in which an embodiment of a process unit constructed in accordance with the present invention is mounted;

5 Fig. 2 is a schematic front view showing a part of the process unit of Fig. 1 in a partially cutaway manner; and

Fig. 3 is a schematic front view of the process unit of Fig. 1, illustrating a drive unit for rotating members of a developing device.

10 Detailed Description of the Preferred Embodiments

An embodiment of a process unit constructed in accordance with the present invention will now be described in detail by reference to the accompanying drawings.

15 Fig. 1 schematically shows a printer 4 in which an embodiment of a process unit 2 constructed in accordance with the present invention is mounted. The printer 4 in this embodiment is a small slow speed laser printer for use as a printing apparatus for a word processor or the like. The printer 4 includes a body 6, and a cover 10 mounted so as to be pivotable about a shaft 8 of the body 6. The process unit 2 is mounted detachably in the body 6.

20 The process unit 2, as shown in Fig. 2, has a drum unit 12, and a developing device 16 pivotably supported on the drum unit 12 via support shafts 14. The drum unit 12 has a pair of metallic side wall members 18 arranged with spacing in the face-to-back direction of the drawing, and a transverse frame member (not shown) disposed between the side wall members 18 to connect them together. At a lower portion of each of the side wall members 18, a support arm 20 is formed so as to extend parallel to one another in the same direction. At the front end

of each of the support arms 20, a bearing 22 is provided. The respective bearings 22 are disposed to have a common axis. At a portion upward of each of the side wall members 18, an annular grip 23 is
5 formed so as to extend upwards parallel to one another. Although not clearly shown, each of the grips 23 is formed of a plastic material and mounted on the side wall member 18.

The drum unit 12 also has a photoconductor
10 drum 24 having a photosensitive layer formed on the peripheral surface thereof, a paper dust removing brush 26, and a charging corona discharger 28. The photoconductor drum 24 is supported rotatably between the respective side wall members 18. The paper dust
15 removing brush 26 and the charging corona discharger 28 are mounted between the respective side wall members 18. The photoconductor drum 24 is open to the above and to the left.

The developing device 16 has a development
20 housing 30 accommodating a developer composed of a one-component toner, a developing roller 32 disposed in the development housing 30 for holding the developer and supplying the held developer to a latent electrostatic image on the photoconductor drum
25 24, a replenishing roller 34 for supplying the developer to the peripheral surface of the developing roller 32, and agitating means 36 for agitating the developer. The developing roller 32 is composed of conductive solid synthetic rubber, such as urethane
30 rubber, secured to the outer peripheral surface of a rotating shaft 76 (see Fig. 3) rotatably supported between both side walls of the development housing 30. The replenishing roller 34 is composed of a foam, such as silicone foam or urethane foam, secured
35 to the outer peripheral surface of a rotating shaft

62 (see Fig. 3) rotatably supported between both side walls of the development housing 30. The replenishing roller 34 is contacted under pressure with the developing roller 32. The agitating means
5 36 is composed of an agitating member fixed to a rotating shaft 66 (see Fig. 3) rotatably supported between both side walls of the development housing 30.

The support shafts 14 are fixed so as to
10 protrude laterally outwardly from a pair of support members which are formed so as to extend downwardly from the bottom of both side walls of the development housing 30. The respective support shafts 14 are disposed to have a common axis. The distance between
15 the support arms 20 of the drum unit 12 is formed to be larger than the distance between both side walls of the development housing 30. Thus, both side walls of the development housing 30 are positioned between the support arms 20, and each of the support shafts
20 14 is pivotably supported by the bearings 22 of the corresponding support arms 20. Each of the bearings 22 and each of the support shafts 14 constitute support shaft means.

Between both side walls of the development
25 housing 30 and the corresponding side wall members 18 of the drum unit 12, coiled springs 40, spring means, are interposed. Each coiled spring 40 imparts a turning moment about the support shaft 14 to the developing device 16 so that the developing roller 32
30 is urged toward the photoconductor drum 24. By this action, the developing roller 32 is brought into pressed contact with the photoconductor drum 24.

The process unit 2 constructed as above is detachably mounted in the printer 4 as illustrated in
35 Fig. 1. In detail, the cover 10 of the printer 4 is

turned about the shaft 8 counterclockwise in Fig. 1, whereby the top of the printer 4 is rendered open to the outside. Then, the process unit 2 is mounted inside the printer 4 from above. In the printer 4, 5 positioning means (not shown) capable of bringing the drum unit 12 of the process unit 2 at a predetermined position is provided. The cover 10 of the printer 4 is turned about the shaft 8 clockwise in Fig. 1, whereby the top of the printer 4 is closed. Within 10 the cover 10, press members (not shown) are provided at positions corresponding to the grips 23 of the drum unit 12. With the cover 10 being closed, the press members press on the upper portions of the corresponding grips 23 at a predetermined pressure to 15 hold the drum unit 12 in the printer 4. Each of the grips 23 is formed of an elastic plastic material, and elastically deforms downward when pressed down by the press members of the cover 10. As a result, the drum unit 12 is firmly held inside the printer 4.

20 As shown in Fig. 1, while the drum unit 12 is being mounted in the printer 4, there are disposed around the photoconductor drum 24 a laser unit 40 downstream from the charging corona discharger 28, and a non-contact transfer roller 42 downstream from 25 the developing roller 32. The laser unit 40 is placed at the bottom of the printer 4. At an upper left portion of the cover 10, a sheet feed tray 44 bearing transfer sheets is provided. Downstream from the sheet feed tray 44, a sheet feed roller 46 is 30 disposed, and a friction pad 48 for sheet separation is disposed at a position opposed to the sheet feed roller 46. Downstream from the photoconductor drum 24 and the transfer roller 42, a fixing roller pair 50 is disposed. Downstream from the fixing roller 35 pair 50, a discharge roller pair 52 is disposed.

Downstream from the discharge roller pair 52, a sheet discharge tray 54 is provided. The respective rollers provided on the printer 4 side and the photoconductor drum 24 provided on the process unit 2 side are rotationally driven in directions of arrows by a drive unit (not shown).

A drive unit for the rotating members including the developing roller 32 provided in the developing device 16 of the process unit 2 will now be described with reference to Fig. 3. On one side of the printer 4 (the face side of Fig. 3), an output gear 60 is mounted. The output gear 60 is drivingly connected to an electric motor (not shown), a drive source, disposed in the printer 4. To one side of the rotating shaft 62 of the replenishing roller 34, an input gear 64 and another gear 65 are secured. The other gear 65 has the same diameter as the input gear 64, and is positioned on the rear side of the input gear 64 in Fig. 3, and thus does not appear in this drawing. For convenience of explanation, however, it is indicated as (65) in Fig. 3. The positional relationship between the input gear 64 and the output gear 60 is defined such that when the process unit 2 is mounted in the printer 4, as has been described, the input gear 64 releasably meshes with the output gear 60. Fig. 3 shows the aforementioned condition of mounting.

To one side of the rotating shaft 66 of the agitating means 36, a gear 68 is secured. The gear 68 meshes with the other gear 65. On one side wall of the development housing 30, a rotating shaft 70 is provided, and intermediate gears 72 and 74 are secured to the rotating shaft 70. The intermediate gear 72 meshes with the other gear 65. To one side of a rotating shaft 76 of the developing roller 32, a

gear 78 is secured. The gear 78 meshes with the intermediate gear 74.

When the output gear 60 is rotationally driven by the electric motor in the direction of the arrow in Fig. 3, the gears 64 (65), 68, 72, 74 and 78 are rotationally driven in the directions of the arrows. As a result, the replenishing roller 34, agitating means 36, and developing roller 32 are rotationally driven in the directions of arrows in Fig. 2.

As has been described, while the process unit 2 is being mounted in the printer 4, the output gear 60 provided in the printer 4 is engaged with the input gear 64 provided on the developing device 6 side. In this state of engagement, it is important that the direction F of the drive pressure angle of the output gear 60 to the input gear 64 be headed for the support shaft 14. In the instant embodiment, the direction F of the drive pressure angle is headed for the shaft center C of the support shaft 14.

In the printer 4 constructed as above, when the printer switch (not shown) is turned on for printing, the photoconductor drum 24 is rotationally driven by the drive unit, and simultaneously the output gear 60 is rotationally driven. The photosensitive layer on the surface of the photoconductor drum 24 is charged by the charging corona discharger 28 to a specific polarity substantially uniformly. Then, the surface of the photosensitive layer of the photoconductor drum 24 is illuminated with laser light based on print information from the laser unit 40 as exposure means for forming a latent electrostatic image. Thus, a latent electrostatic image is formed. The latent electrostatic image formed on the surface of the

photosensitive layer of the photoconductor drum 24 is developed to a toner image by the developing roller 32 of the developing device 16. Transfer sheets borne on the sheet feed tray 44 are fed, one by one, by the action of the sheet feed roller 46 and the friction pad 48. The so fed transfer sheet is conveyed through a guide path 56 into the nip between the photoconductor drum 24 and the transfer roller 42 to have the toner image, adhering to the photoconductor drum 24, transferred onto the surface thereof. The transfer sheet having the transferred toner image is conveyed through a guide path 58 to the fixing roller pair 50. The transfer sheet having the toner image heat-fixed by the fixing roller pair 50 is discharged onto the discharge tray 54 by the discharge roller pair 52.

As described previously, the rotational drive force of the output gear 60 provided in the printer 4 is transmitted to the input gear 64 provided on the developing device 16 side. A drive torque heading in the direction F of the drive pressure angle of the output gear 60 to the input gear 64 acts on the developing device 16, and may give a drive torque (running torque) around the support shaft 14. On the other hand, roughly a predetermined number of transfer sheets are printed by the printer 4; whereupon the amount of the toner in the development housing 30 changes from a full state to an empty state. With a conventional apparatus, the above-described drive torque acting on the developing device 16 markedly varies with the decrease in the amount of the toner, thereby greatly changing the force of pressed contact between the developing roller 32 and the photoconductor drum 24.

In the present invention, by contrast, the

direction F of the drive pressure angle of the output gear 60 to the input gear 64 is headed for the support shaft 14, so that a drive torque around the support shaft 14 is not generated for the developing device 16. In this invention, therefore, the
5 aforementioned drive torque does not affect the force of pressed contact between the developing roller 32 and the photoconductor drum 24, regardless of changes in the amount of the developer. Hence, stable
10 formation of image is performed. When the direction F of the drive pressure angle is headed for the shaft center C of the support shaft 14 as in the instant embodiment, the change in the aforementioned drive torque, accordingly the change in the force of
15 pressed contact, can be kept to the minimum.

 The embodiment of the process unit according to the present invention has been described above. However, it is to be understood that the invention is not limited to this embodiment, but
20 various changes and modifications are possible without departing from the spirit and scope of the invention. For example, the direction F of the drive pressure angle of the output gear 60 to the input gear 64 is headed for the support shaft 14 in this
25 embodiment. However, in the case of the opposite direction, in other words, when a direction opposite to the direction F of the drive pressure angle is headed for the support shaft 14, the same action and effect can be achieved. Other embodiments covering
30 this case are also included in the present invention. Furthermore, the invention is also applicable to the process unit in which the support shaft 14 is located at an upper position as in the prior art.

 According to the process unit constructed
35 by the present invention, changes in the force of

pressed contact between the developing roller and the photoconductor drum due to the drive torque acting on the developing device can be kept to the minimum, and thus stable image formation is performed.

What we claim is:

1. A process unit detachably mounted in an image forming machine, said process unit including a drum unit having a photoconductor drum on which a latent electrostatic image is formed; a developing device having a development housing accommodating a developer, and a developing roller disposed in said development housing to supply the developer to said photoconductor drum; and support shaft means for supporting said developing device so as to be pivotable relative to said drum unit; wherein
spring means is interposed between said developing device and said drum unit to impart to said developing device a turning moment about said support shaft means so that said developing roller is urged toward said photoconductor drum,
said developing device is provided with an input gear for transmitting a drive force to said developing roller, said image forming machine is provided with an output gear for transmitting a drive force to said input gear, and the direction of the drive pressure angle of said output gear to said input gear, or a direction opposite to said direction is headed for said support shaft means.

