

DESCRIPTION

DEVELOPING DEVICE, DEVELOPING CARTRIDGE,
ROTATIONAL FORCE TRANSMITTING PART

5

AND

ELECTROPHOTOGRAPHIC IMAGE FORMING APPARATUS

[TECHNICAL FIELD]

The present invention relates to a developing
10 device, a developing cartridge, a rotational force
transmitting part, and an electrophotographic image
forming apparatus with which the developing cartridge
is used.

The electrophotographic image forming apparatus
15 forms an image on a recording material using an
electrophotographic image forming process. The
electrophotographic image forming apparatus includes
an electrophotographic copying machine, an
electrophotographic printer (a laser beam printer, an
20 LED printer), and so on.

In addition, the developing cartridge is
dismountably mounted to a main assembly of the
electrophotographic image forming apparatus, and
develops an electrostatic latent image formed on the
25 electrophotographic photosensitive member. By a user
exchanging the developing cartridge, a maintenance
operation of the image forming apparatus is carried

out in effect.

[BACKGROUND ART]

Conventionally, in the electrophotographic
5 image forming apparatus, when the electrostatic latent
image formed on the electrophotographic photosensitive
member (photosensitive drum) of a drum configuration
is developed using the developing cartridge, the
operation is carried out as follows.

10 The developing cartridge is provided with a
gear, and is engaged with a gear provided in the main
assembly of the electrophotographic image forming
apparatus. A rotational force of a motor provided in
the main assembly is transmitted to a developing
15 roller through the gear provided in the main assembly,
and the gear provided in the developing cartridge side.
By this, such a type of rotating the developing roller
is known (Japanese Laid-open Patent Application 2003-
202727).

20 In a known color electrophotographic image
forming apparatus, a developing rotary member rotated
in the state that a plurality of developing devices
are mounted is provided in a main assembly. In this
device, in order to transmit the rotational force from
25 the main assembly to the developing cartridge the
following structures are known. The a main assembly
side coupling provided in the main assembly, and a

developing device side coupling of the developing device mounted to the developing rotary member are connected with each other. By this, the rotational force is transmitted from the main assembly to the developing device. And, in connecting the main assembly side coupling, and the developing device side coupling with each other, the main assembly side coupling is once retracted in the device so that it does not interfere with the movement of the developing rotary member. Then, the developing rotary member is moved to move a predetermined developing device toward the main assembly side coupling. Thereafter, the main assembly side coupling retracted using a moving mechanism such as a solenoid is moved toward the developing device side coupling. By this, both of the couplings are connected with each other. And, the rotational force of the motor provided in the main assembly is transmitted to the developing roller through the main assembly side coupling, and the developing device side coupling. By this, the developing roller is rotated. Such a type is known (Japanese Laid-open Patent Application common 11-015265).

However, according to the conventional structure described in the Japanese Laid-open Patent Application 2003-202727, a drive connecting portion of the main assembly, and the developing device is a

gear-to-gear type. For this reason, it is difficult to prevent a rotation unevenness of the developing roller.

On the other hand, in the structure described in Japanese Laid-open Patent Application Hei 11-015265, as has been described hereinbefore, the main assembly side coupling is once retracted. In transmitting the rotational force, it is necessary that the retracted main assembly side coupling is moved toward the developing device side coupling.

Then, it is necessary that a mechanism for moving the main assembly side coupling toward the developing device side coupling is provided in the main assembly.

[DISCLOSURE OF THE INVENTION]

The principal object of the present invention is to provide a developing device, a developing cartridge, and an electrophotographic image forming apparatus usable with the developing device or the developing cartridge, which are improved to avoid the problem of the prior art.

Another object of the present invention is to provide a rotational force transmitting part usable with such a developing cartridge.

A further object of the present invention is to maintain a coupling member at a pre-engagement angular position (second angular position) even in the case

where the developing cartridge is in a free state.
Therefore, the coupling member is prevented from
unintentional movement in transporting the developing
cartridge, for example.

5 A further object of the present invention is to
provide a rotational force transmitting part usable
with such a developing cartridge. A further object of
the present invention is to provide a usable
electrophotographic image forming apparatus with such
10 a developing cartridge.

 A further object of the present invention is to
provide a developing device (developing cartridge)
which is usable with the main assembly which not
provided with the mechanism for moving the main
15 assembly side coupling member in the axial direction
thereof by a solenoid mechanism.

 A further object of the present invention is to
provide a developing device (developing cartridge),
wherein the coupling member provided on the developing
20 device (developing cartridge) is engaged with the
drive shaft by moving the developing device
(developing cartridge) in the direction substantially
perpendicular to the axial direction of the drive
shaft relative to the main assembly.

25 A further object of the present invention is to
provide an electrophotographic image forming apparatus
usable with such a developing device (developing

cartridge).

A further object of the present invention is to provide a developing device (developing cartridge), wherein the engagement with the drive shaft is carried
5 out by the movement in the direction substantially perpendicular to the axial direction of the drive shaft provided in the main assembly of the electrophotographic image forming apparatus.

A further object of the present invention is to
10 provide a rotational force transmitting part usable with such a developing device (developing cartridge).

A further object of the present invention is to provide an electrophotographic image forming apparatus usable with such a developing device (developing
15 cartridge).

A further object of the present invention is to provide a developing device (developing cartridge), wherein the developing roller is rotated smoothly as compared with the case in which a driving connection
20 between the main assembly, and the developing device (developing cartridge) is carried out by the gear-to-gear transmission.

A further object of the present invention is to provide a rotational force transmitting part usable
25 with such a developing cartridge.

A further object of the present invention is to provide an electrophotographic image forming apparatus

usable with such a developing device (developing cartridge).

A further object of the present invention is to provide a developing device (developing cartridge),
5 wherein the developing roller which can be engaged with the drive shaft in the direction substantially perpendicular to the axial direction of the drive shaft provided in the main assembly is rotated smoothly.

10 A further object of the present invention is to provide a rotational force transmitting part usable with such a developing device (developing cartridge).

A further object of the present invention is to provide an electrophotographic image forming apparatus
15 usable with such a developing device (developing cartridge).

A further object of the present invention is to provide a developing device (developing cartridge) which is engaged and disengaged in the direction
20 substantially perpendicular to the axial direction relative to the drive shaft provided in the main assembly of the electrophotographic image forming apparatus by rotation of a rotary member.

A further object of the present invention is to
25 provide a rotational force transmitting part usable with such a developing device (developing cartridge).

A further object of the present invention is to

provide an electrophotographic image forming apparatus usable with such a developing device (developing cartridge).

A further object of the present invention is to
5 provide the developing device (developing cartridge)
which is engaged and disengaged in the direction
substantially perpendicular to the axial direction of
the drive shaft relative to the drive shaft provided
in the main assembly by the movement (rotation) of a
10 movable member (rotary member) and which rotates the
developing roller smoothly.

A further object of the present invention is to
provide a rotational force transmitting part usable
with such a developing device (developing cartridge).

15 A further object of the present invention
provides an electrophotographic image forming
apparatus usable with such a developing device
(developing cartridge).

A further object of the present invention is to
20 provide a developing device (developing cartridge),
wherein the coupling member is maintained in the pre-
engagement angular position in the state that it is
stabilized.

A further object of the present invention is to
25 provide a rotational force transmitting part usable
with such a developing device (developing cartridge).

A further object of the present invention is to

provide an electrophotographic image forming apparatus usable with such a developing device (developing cartridge).

A further object of the present invention is to
5 provide a developing device (developing cartridge), wherein the coupling member is assuredly maintained in the pre-engagement angular position.

A further object of the present invention is to provide a rotational force transmitting part usable
10 with such a developing device (developing cartridge).

A further object of the present invention is to provide an electrophotographic image forming apparatus usable with such a developing device (developing cartridge).

15 A further object of the present invention is to provide a developing device (developing cartridge) which is applicable to the case where the developing device (developing cartridge) moves in the direction perpendicular to the axial direction of the drive
20 shaft provided in the main assembly in response to the movement (rotation) of the movable member (developing rotary member) which has a swinging rotation axis.

A further object of the present invention is to provide a developing device (developing cartridge),
25 wherein even in such a case, the engagement and disengagement relative to the drive shaft are assured, and the developing roller is rotated smoothly.

A further object of the present invention is to provide a rotational force transmitting part usable with such a developing device (developing cartridge).

A further object of the present invention is to
5 provide an electrophotographic image forming apparatus usable with such a developing device (developing cartridge).

A further object of the present invention provides a developing device to which a developing
10 roller which is rotating can be contacted to the electrophotographic photosensitive member.

A further object of the present invention is to provide an electrophotographic image forming apparatus usable with such a developing device.

15 A further object of the present invention is to provide a rotational force transmitting part usable with such a developing device.

In addition, a further object of the present invention is to provide a developing device, wherein
20 even if the drive shaft fixed so as not to move in the direction substantially perpendicular to the direction of the axis of the drive shaft is used, the developing roller in the rotating state and the electrophotographic photosensitive member can be
25 contacted to each other.

A further object of the present invention is to provide an electrophotographic image forming apparatus

usable with such a developing device.

A further object of the present invention is to provide a rotational force transmitting part usable with such a developing device.

5 According to an aspect of the present invention, there is provided a developing device usable with an electrophotographic image forming apparatus, said apparatus including a driving shaft rotatable by a motor and having a rotating force applying portion,
10 and a movable member, said developing device being mountable to the movable member, and said developing device being movable in a direction substantially perpendicular to an axial direction of the driving shaft in response to movement of the movable member in
15 one direction with said developing device mounted to the movable member, wherein said driving shaft is not movable in a direction perpendicular to an axis thereof, said developing device comprising i) a developing roller for developing an electrostatic
20 latent image formed on an electrophotographic photosensitive drum, said developing roller being rotatable about an axis, wherein said developing roller is contacted to and separated from said electrophotographic photosensitive member drum in
25 response to movement of said movable member; and ii) a coupling member for transmitting a rotating force to said developing roller, said coupling member including,

a rotating force receiving portion engageable with the rotating force applying portion to receive a rotating force from the driving shaft, and a rotating force transmitting portion for transmitting the rotating force received through said rotating force receiving portion to said developing roller, said coupling member being capable of taking a rotational force transmitting angular position for transmitting the rotational force for rotating said developing roller to said developing roller, a pre-engagement angular position which is taken before said coupling member is engaged with the rotating force applying portion and in which said coupling member is inclined away from said rotational force transmitting angular position, and a disengaging angular position which is taken for said coupling member to disengage from the driving shaft and in which said coupling member is inclined away from the rotational force transmitting angular position in a direction opposite to said pre-engagement angular position, wherein in response to a movement of said developing device when the movable member moves in said one direction, said coupling member moves from the pre-engagement angular position to the rotational force transmitting angular position, and wherein when the movable member makes a further movement in said one direction, in response to the further movement, said coupling member is moved from

said rotational force transmitting angular position to
said disengaging angular position to disengage said
coupling member from said driving shaft, and wherein
said developing roller is contacted to said

5 electrophotographic photosensitive member in response
to the movement of said developing device in a state
that developing roller is being rotated through
engagement between said coupling member and said
rotating force applying portion.

10 According to another aspect of the present
invention, there is provided an electrophotographic
image forming apparatus for forming an image on a
recording material, said electrophotographic image
forming apparatus comprising i) a driving shaft
15 rotatable by a motor and having a rotating force
applying portion, wherein said driving shaft is not
movable in a direction perpendicular to an axis
thereof; ii) a movable member; iii) a developing
device which is movable in a direction substantially
20 perpendicular to an axial direction of the driving
shaft in response to movement of the movable member in
a state that developing device is mounted to said
movable member, in response to the moment of said
movable member, said developing roller including a
25 developing roller for developing an electrostatic
latent image formed on an electrophotographic
photosensitive drum, said developing roller being

rotatable about an axis, wherein said developing roller is contacted to and separated from said electrophotographic photosensitive member drum in response to movement of said movable member; iv) a
5 coupling member for transmitting a rotating force to said developing roller, said coupling member including, a rotating force receiving portion engageable with the rotating force applying portion to receive a rotating force from the driving shaft, and a rotating force
10 transmitting portion for transmitting the rotating force received through said rotating force receiving portion to said developing roller, said coupling member being capable of taking a rotational force transmitting angular position for transmitting the
15 rotational force for rotating said developing roller to said developing roller, a pre-engagement angular position which is taken before said coupling member is engaged with the rotating force applying portion and in which said coupling member is inclined away from
20 said rotational force transmitting angular position, and a disengaging angular position which is taken for said coupling member to disengage from the driving shaft and in which said coupling member is inclined away from the rotational force transmitting angular
25 position in a direction opposite to said pre-engagement angular position to disengage from the driving shaft, wherein in response to a movement of

said developing device when the movable member moves in said one direction, said coupling member moves from the pre-engagement angular position to the rotational force transmitting angular position, and wherein when
5 the movable member makes a further movement in said one direction, in response to the further movement, said coupling member is moved from said rotational force transmitting angular position to said disengaging angular position to disengage said
10 coupling member from said driving shaft, and wherein said developing roller is contacted to said electrophotographic photosensitive member in response to the movement of said developing device in a state that developing roller is being rotated through
15 engagement between said coupling member and said rotating force applying portion.

According to a further aspect of the present invention, there is provided a developing device usable with an electrophotographic image forming
20 apparatus, said apparatus including a driving shaft rotatable having a rotating force applying portion, and a rotatable rotary, said developing device being movable in a direction substantially perpendicular to an axial direction of the driving shaft in response to
25 rotation of said rotary with said developing device mounted to said rotary, said developing device comprising i) a developing roller for developing an

electrostatic latent image formed on an
electrophotographic photosensitive member drum; ii) a
developer accommodating portion for accommodating a
developer for use by said developing roller to
5 developing the electrostatic latent image; iii) a
coupling member for transmitting a rotating force to
said developing roller in a state that developing
cartridge is mounted to said rotary, said coupling
member including a rotating force receiving portion
10 for engaging with the rotating force applying portion
to receive said driving shaft the rotating force from
the driving shaft, wherein the driving shaft is not
movable in a direction substantially perpendicular to
an axial direction of said driving shaft; iv) a
15 regulating member including a regulating portion for
regulating said coupling member at a pre-engagement
angular position before engagement with the driving
shaft, and including a permitting portion for
permitting said coupling member to revolve
20 substantially; v) an elastic member for elastically
urging said coupling member to position said coupling
member at the regulating portion, wherein when said
rotary rotates, said coupling member moves from the
pre-engagement angular position to a rotational force
25 transmitting angular position the response to movement
of said coupling member from the regulating portion To
the permitting portion against an elastic force of

said elastic member by said coupling member contacting
said driving shaft member with movement of said
developing cartridge, and when said rotary further
rotates, said coupling member moves from the
5 rotational force transmitting angular position to a
disengaging angular position to disengage said
coupling member from the driving shaft against an
elastic force of said elastic member.

According to a further aspect of the present
10 invention, there is provided an electrophotographic
image forming apparatus for forming an image on a
recording material, said apparatus comprising i) a
driving shaft including a rotating force applying
portion; ii) a rotatable rotary; a developing
15 cartridge movable in a direction substantially
perpendicular to an axial direction of the driving
shaft in response to rotation of said rotary with said
developing device mounted to said rotary; a developing
roller for developing an electrostatic latent image
20 formed on an electrophotographic photosensitive member
drum; a developer accommodating portion for
accommodating a developer for use by said developing
roller to developing the electrostatic latent image;
iii) a coupling member for transmitting a rotating
25 force to said developing roller in a state that
developing cartridge is mounted to said rotary, said
coupling member including a rotating force receiving

portion for engaging with the rotating force applying
portion to receive said driving shaft the rotating
force from the driving shaft, wherein the driving
shaft is not movable in a direction substantially
5 perpendicular to an axial direction of said driving
shaft; iv) a regulating member including a regulating
portion for regulating said coupling member at a pre-
engagement angular position before engagement with the
driving shaft, and including a permitting portion for
10 permitting said coupling member to revolve
substantially; and v) an elastic member for
elastically urging said coupling member to position
said coupling member at the regulating portion,
wherein when said rotary rotates, said coupling member
15 moves from the pre-engagement angular position to a
rotational force transmitting angular position the
response to movement of said coupling member from the
regulating portion To the permitting portion against
an elastic force of said elastic member by said
20 coupling member contacting said driving shaft member
with movement of said developing cartridge, and when
said rotary further rotates, said coupling member
moves from the rotational force transmitting angular
position to a disengaging angular position to
25 disengage said coupling member from the driving shaft
against an elastic force of said elastic member.

According to a further aspect of the present

invention, there is provided a rotating force transmitting part usable with a developing cartridge, said developing cartridge being mountable to a main assembly of an electrophotographic image forming apparatus including a driving shaft, and movable in a direction substantially perpendicular to an axial direction of the driving shaft, developing cartridge being provided with a regulating member including a permitting portion and a regulating portion, said rotating force transmitting part comprising a recess provided at one longitudinal end of said rotating force transmitting part and engageable with the driving shaft when said developing cartridge is mounted to the main assembly of the apparatus; a spherical portion provided at the other end; a plurality of projections interposing a center of said recess and projected away from said spherical portion in a longitudinal direction of said rotating force transmitting part for receiving the rotational force from the driving shaft which is provided in the main assembly of the apparatus such that it does not move in a direction substantially perpendicular to the axial direction of said driving shaft in a state that developing cartridge is mounted to the main assembly of the apparatus; a first projected portion projected from said spherical portion away from said one end, said projected portion being revolvable between said

permitting portion for permitting substantial
revolution of said rotating force transmitting part
and said regulating portion for regulating an
inclination angle position of said rotating force
5 transmitting part in a state that rotating force
transmitting part is mounted to said developing
cartridge; and a plurality of second projected
portions provided between said projections and said
first projected portion and interposing said spherical
10 portion, said second projected portions being
projected outwardly from spherical portion, said
second projected portions are effective to transmit
the rotational force received from the driving shaft
by the projections to the developing roller.

15 These and other objects, features, and
advantages of the present invention will become more
apparent upon consideration of the following
description of the preferred embodiments of the
present invention, taken in conjunction with the
20 accompanying drawings.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Figure 1 is a side sectional view of a
developing cartridge according to an embodiment of the
25 present invention.

Figure 2 is a perspective view of the
developing cartridge according to an embodiment of the

present invention.

Figure 3 is a perspective view of the developing cartridge according to an embodiment of the present invention.

5 Figure 4 is a side sectional view of an electrophotographic image forming apparatus main assembly according to an embodiment of the present invention.

Figure 5 is a perspective view of a developing
10 roller according to an embodiment of the present invention.

Figure 6 is a perspective view of a coupling according to an embodiment of the present invention.

Figures 7A, 7B, 7C, 7D, 7E and 7F are
15 perspective views of a coupling according to an embodiment of the present invention.

Figures 8A, 8B, 8C, 8D, 8E and 8F are front views, and side sectional views of a driving input gear according to an embodiment of the present
20 invention.

Figure 9 is a sectional view of a developing cartridge according to an embodiment of the present invention.

Figures 10A1, 10A2, 10A3, 10A4, 10A5, 10B1,
25 10B2, 10B3, 10B4 and 10B5 are perspective views of a coupling according to an embodiment of the present invention.

Figures 11A, 11B, 11C and 11D are longitudinal sectional views of a coupling according to an embodiment of the present invention.

Figures 12A, 12B, 12C and 12D are perspective
5 views of a regulating portion according to an embodiment of the present invention.

Figures 13A, 13B, 13C, 13D, 13E, 13F and 13G are perspective views illustrating a positional relation between the coupling, and the regulating
10 portion according to an embodiment of the present invention.

Figure 14 is a perspective view of an elastic material (urging member), and a supporting member according to an embodiment of the present invention.

15 Figure 15 is a perspective view of a cartridge drive portion according to an embodiment of the present invention.

Figures 16A, 16B, 16C, 16D and 16E are perspective views illustrating an assembling method of
20 the cartridge drive portion according to an embodiment of the present invention.

Figure 17 is a longitudinal sectional view illustrating a main assembly of the electrophotographic image forming apparatus in a
25 development stand-by position according to an embodiment of the present invention.

Figure 18 is a longitudinal sectional view

illustrating the developing cartridge mounted state of the electrophotographic image forming apparatus main assembly according to an embodiment of the present invention.

5 Figure 19 is a perspective view illustrating a process in which the developing cartridge according to an embodiment of the present invention is mounted to the rotary member.

 Figure 20 is a longitudinal sectional view of a
10 rotary member according to an embodiment of the present invention.

 Figure 21 is a longitudinal sectional view of the rotary member according to an embodiment of the present invention.

15 Figure 22 is a longitudinal sectional view of the rotary member according to an embodiment of the present invention.

 Figure 23 is the longitudinal sectional view of the rotary member according to an embodiment of the
20 present invention.

 Figure 24 is a longitudinal sectional view illustrating an engaged state between the drive shaft, and the coupling according to an embodiment of the present invention.

25 Figure 25 is a longitudinal sectional view illustrating the engaged state between the drive shaft, and the coupling according to an embodiment of the

present invention.

Figure 26 is a perspective view between the drive shaft, and the coupling according to an embodiment of the present invention.

5 Figure 27 is a longitudinal sectional view illustrating the process in which the drive shaft, and the coupling disengage from each other according to an embodiment of the present invention.

 Figure 28 is a longitudinal sectional view
10 illustrating the process in which the drive shaft, and the coupling disengage from each other according to an embodiment of the present invention.

 Figure 29 is a perspective view of an elastic material, and a supporting member according to another
15 embodiment of the present invention.

 Figure 30 is a perspective view of an elastic material, and a supporting member according to a further embodiment of the present invention.

 Figure 31 is a perspective view of the coupling
20 (rotational force transmitting part) according to an embodiment of the present invention.

[BEST MODE FOR CARRYING OUT THE INVENTION]

 The preferred embodiments of the present
25 invention will be described in conjunction with the accompanying drawings First a coupling member (rotational force transmitting part) according to an

embodiment of the present invention will be described.

The present invention relates to a developing cartridge (Figure 2, for example), and an electrophotographic image forming apparatus (Figure 4, for example) itself. In addition, the present invention is applicable to a coupling member (rotational force transmitting part) (Figure 7A-7F, for example, Figure 31) itself.

(1) Developing cartridge

Referring to Figure 1-Figure 4, a developing cartridge B as the developing device (cartridge) according to an embodiment of the present invention will be described. Figure 1 is a sectional view of a cartridge B. The Figures 2 and 3 are perspective views of the cartridge B. Figure 4 is a sectional view of color electrophotographic image forming apparatus main assembly A (main assembly).

The cartridge B is mounted to a rotary member C provided in a main assembly A, and is dismounted from the rotary member C by the user.

The main assembly A is the structure of the electrophotographic image forming apparatus 100 other than the cartridge B.

In Figure 1 - Figure 3, the cartridge B has a developing roller 110. The developing roller 110 receives the rotational force through the coupling mechanism as will be described hereinafter from the

main assembly A at the time of a developing action to rotate.

A developer t of a predetermined color is accommodated in a developer containing frame 114. More particularly, the frame 114 is provided with a developer accommodating portion 116 which accommodates a developer t. The developer t is supplied to the surface of the developing roller 110 by the rotation of the developer supply roller 115 in the form of a sponge in a developer chamber 113a. And, by the friction between the thin-plate-like developing blade 112, and the developing roller 110, the developer t is triboelectrically charged, and is formed into a thin layer. The developer t of the thin layer on a peripheral surface of the developing roller 110 is fed to a developing position by the rotation. The predetermined developing bias is applied to the developing roller 110. By this, the developing roller 110 develops an electrostatic latent image formed on the electrophotographic photosensitive drum (photosensitive drum) 107. In other words the electrostatic latent image is developed with the developer t by the developing roller 110. The developer t used for the development of the electrostatic latent image by the developing roller 110 is accommodated in the accommodating portion 116. The developer t accommodated in the accommodating

portion 116 is supplied to a developer chamber 113a through a feed opening 116a. An opening 116a is sealed by a sealing member (unshown) which unsealably seals the opening 116a. A user pulls out the sealing member
5 prior to using the cartridge B to unseal the opening 116a. By this, the developer t in the accommodating portion 116 is supplied to the developer chamber 113a.

The developer which has not contributed to the development of the electrostatic latent image, that is,
10 the developer which remains on the surface of the developing roller 110 is scraped off by a roller 115. Simultaneously therewith, the new developer is supplied to the surface of the developing roller 110 by the roller 115. In this manner, the developing
15 operation is carried out continuously.

The developing cartridge B is in the form of a developing unit 119. The developing unit 119 includes a developing device frame 113, and a developer containing frame 114. The developing unit 119 is
20 provided with the developing roller 110, the developing blade 112, the developer supply roller 115, the developer chamber 113a, and the developer containing frame 114.

The developing roller 110 is rotatable about a
25 rotation axis L1 (Figure 5).

The developing cartridge B is mounted to a developing cartridge accommodating portion 130a of a

developing rotary member C provided in the main assembly A by the user (Figure 4). In this case, as will be described hereinafter, the a drive shaft 180 provided in the main assembly A, and a coupling member
5 150 of the cartridge B connect with each other in interrelation with the positioning operation of the cartridge B to the predetermined position (photosensitive drum opposing portion) by the developing rotary member C. And, the developing roller
10 110 receives the rotational force from the main assembly A to rotate. The coupling member is a rotational force transmitting part.

The developing device frame 113 and the developer containing frame 114 constitute a cartridge
15 frame.

(2) Electrophotographic image forming apparatus

Referring to Figure 4, a color electrophotographic image forming apparatus 100 used with the developing cartridge B will be described.
20 Here, the color electrophotographic image forming apparatus 100 is a color laser beam printer as an exemplary image forming apparatus.

As shown in Figure 4, a plurality of the cartridges B (B1, B2, B3 and B4) which accommodate
25 different color developers (toner) is mounted on the rotary member C. The mounting and demounting of the cartridge B relative to the rotary member C is carried

out by the user. By the rotation of the rotary member C by the rotational force from the motor (unshown), the cartridge B containing the predetermined color developer opposes to the photosensitive drum 107. The electrostatic latent image formed on the photosensitive drum 107 is developed by the developing roller 110 of the cartridge B. A developed image is transferred onto the transfer belt 104a. This development and transfer operation is carried out for each color. By this, a color image is provided. The detailed description will be made. A recording material S is for the formation of an image, and it is paper, an OHP sheet or the like.

As shown in Figure 4, the light based on the image information is projected from optical means 101 to the photosensitive drum 107. By this, the electrostatic latent image is formed on the photosensitive drum 107. And, the latent image is developed by the developing roller 110 using the developer. By this, the developer image is formed on the photosensitive drum 107. The developer image formed on the photosensitive drum 107 is transferred onto the intermediary transfer member.

Then, the developer image transferred onto the intermediary transfer belt 104a which is a intermediary transfer member is transferred onto the recording material S by a secondary transfer roller

104b as second transferring means. The recording material S onto which the developer image has been transferred is fed to the fixing means 105 which has a pressing roller 105a, and a heating roller 105b. The
5 developer image transferred onto the recording material S is fixed on the recording material S. After the fixing, the recording material S is discharged to a tray 106.

Furthermore, an image formation step will be
10 described.

The photosensitive drum 107 is rotated counter-clockwisely (Figure 4) in synchronism with the rotation of the transfer belt (intermediary transfer member) 104a. The surface of the photosensitive drum
15 107 is uniformly charged by a charging roller 108. Thereafter, by the optical means 101, the photoirradiation of a yellow image is carried out to the photosensitive drum 107 in response to the image information. By this, an electrostatic latent image
20 corresponding to the yellow color is formed on the photosensitive drum 107.

The exposure means has the following structures
The exposure means 101 carries out photoirradiation to the photosensitive drum 107 on the basis of the image
25 information (image signal including color information) read from an external device (unshown). By this, the electrostatic latent image is formed on the

photosensitive drum 107. The exposure means includes a laser diode, a polygonal mirror, a scanner motor, an image formation lens, and a reflection mirror (unshown).

5 In more detail, the laser diode emits light in accordance with the image information, and is directed by the polygonal mirror as the image light. The polygonal mirror is rotated at a high speed by the scanner motor, and the image light reflected by the
10 polygonal mirror is selectively projected to the surface of the photosensitive drum 107 by way of the image formation lens, and the reflection mirror. By this, the electrostatic latent image corresponding to the image information is formed on the photosensitive
15 drum 107.

Simultaneously with a formation of this latent image, the rotary member C is rotated. By this, a yellow cartridge B1 is moved to a developing position. The predetermined bias voltage is applied to the
20 developing roller 110 of a cartridge B1. By this, a yellow developer is deposited to the latent image. By this, the latent image is developed with the yellow developer. Thereafter, a bias voltage of the polarity opposite to the developer is applied to the confining
25 roller (primary transfer roller) 104j of the transfer belt 104a. By this, the developer image of the yellow color formed on the photosensitive drum 107 is

transferred primarily onto the intermediary transfer belt 104a.

As has been described hereinbefore, when the primary transfer of the yellow developer image
5 finishes, the rotary member C rotates again. A next cartridge B-2 is moved, and it is positioned to the position which opposes to the photosensitive drum 107. These steps are carried out for a magenta cartridge B-2, a cyan cartridge B3, and a black cartridge B4. By
10 this, the four-color developer image is overlaid on the transfer belt 104a.

The yellow cartridge B1 accommodates the developer of the yellow color, and forms a yellow developer image. The magenta cartridge B-2
15 accommodates the developer of a magenta color, and forms a magenta developer image. The cyan cartridge B3 accommodates the developer of a cyan color, and forms a cyan developer image. The black cartridge B4 accommodates the developer of a black color, and forms
20 a black developer image. The cartridges B differ in the color of the accommodated developer, but they have the same structures.

During this period, the secondary transfer roller 104b is not in contact with the transfer belt
25 104a. At this time, a cleaning charging roller 104f is not in contact with the transfer belt 104a, either.

And, after the four color developer image is

formed on the transfer belt 104a, the transfer roller 104b is press-contacted to the transfer belt 104a (Figure 4). Furthermore, in synchronism with a press-contact of the transfer roller 104b, the recording material S which has waited adjacent to a registration roller couple 103e is fed to a nip between the transfer belt 104a, and the transfer roller 104b. Simultaneously, the next recording material S is fed from the cassette 103a by a feeding roller 103b, and the feeding roller pair 103c as the feeding means 103.

Here, a sensor 99 is provided immediately before a registration roller couple 103e. The sensor 99 detects a free end of the recording material S, and in response thereto, the rotation of the registration roller couple 103e is stopped, to make the recording material S wait at the predetermined position.

In addition, the bias voltage of the polarity opposite to the developer is applied to the transfer roller 104b. By this, the developer images on the transfer belt 104a are transferred secondarily onto the recording material S all together.

The recording material S onto which the developer image has been transferred is fed to the fixing means 105 by way of the transportation belt unit 103f. By this, the developer image is fixed on the recording material S. And, the recording material S having been subjected to the fixing is discharged to

the discharging tray 106 of the upper portion of the main assembly by the discharging roller pair 103g. By this, the formation of the image on the recording material S is completed.

5 On the other hand, after the end of the secondary transfer, a charging roller 104f is press-contacted to the transfer belt 104a. By this, the predetermined bias voltage is applied to the developer which remained on the surface of a belt 104a. And, the
10 residual charge is removed.

 The discharged residual developer is electrostatically re-transferred onto the photosensitive drum 107 from the belt 104a through the primary transfer nip. By this, the cleaning of the
15 surface of the belt 104a is carried out. The residual developer after the secondary transfer re-transferred onto the photosensitive drum 107 is removed by a cleaning blade 117a which is in contact with the photosensitive drum 107.

20 The removed developer is collected into a removed developer box 107d along the feeding path (unshown).

 An accommodating portion 130a is a chamber which accommodates the cartridge B, and a plurality of
25 such accommodating portions are provided. In the state that the cartridge B is mounted to this chamber, the rotary member C unidirectionally rotates. By this, the

coupling member, which will be described hereinafter,
of the cartridge B engages and disengages relative to
the drive shaft 180 provided in the main assembly A.
Cartridge B (developing roller 110) is mounted to the
5 accommodating portion 130a, and therefore, in response
to the movement in one direction of the rotary member
C, it moves in the direction substantially
perpendicular to a direction of the rotation axis L3
of the drive shaft 180.

10 (3) Structure of developing roller

Then, referring to Figure 5, the structure of
the developing roller will be described. In Figure 5,
(a) is a perspective view of the developing roller 110,
as seen from main assembly A (driving side). In Figure
15 5, (b) is a perspective view, as seen from the non-
driving side.

The developing roller 110 includes a shaft
portion 110b, and a rubber portion (elastic material)
110a.

20 The shaft portion 110b is made of
electroconductive material such as iron, and has an
elongated configuration, and is covered by a rubber
portion 110a. The opposite ends 110b1, 110b2 of the
shaft portion 110b are supported rotatably through a
25 bearing (unshown) by the developing device frame 113.
The developing roller 110 is mounted rotatably to the
developing device frame 113.

The rubber portion 110a coats the shaft portion 110b coaxially. The rubber portion 110a carries the developer t, and develops the electrostatic latent image by a bias voltage applied to the shaft portion 110b.

A nip width regulation member 136, 137 maintains a uniform width of a nip between the photosensitive drum 107, and the rubber portion 110a in the state that the developing roller 110 contacts to the photosensitive drum 107.

The bearing (unshown) is disposed on each end 110b1, 110b2 of the developing roller 110, to support the developing roller 110 rotatably.

A regulation member 136 is provided at a one end of the developing roller 110, and a regulation member 137 is provided at the other end of the developing roller 110.

In the state of contacting with the photosensitive drum 107 the developing roller 110 of the present embodiment develops the latent image (so-called contact type developing system).

(4) Drive transmission mechanism (rotational-driving-force-transmitting mechanism)

A development gear 145 is provided at the end of the developing roller 110, and a supplying roller gear 146 is provided at the end of a supplying roller 115 (Figure 1). And, the gears 145, 146 are fixed to

the shaft. By this, the rotational force which the coupling member (coupling) 150 receives from the main assembly A is transmitted to the developing roller 110 through the gear 145, and is transmitted to the supplying roller 115 through a gear 146. The rotational force received by the coupling 150 from the main assembly A may be transmitted to a rotatable member other than the developing roller 110 and the supplying roller 115.

10 The main assembly A is the portion of the electrophotographic image forming apparatus 100 other than the cartridge B.

 Then, a driving input gear (rotatable member) 147 which supports the coupling 150 will be described.

15 As shown in Figure 6, a gear 147 is mounted to the developing unit 119 rotatably at the position for meshing engagement with the development gear 145 and the supplying roller gear 146. The gear 147 includes a development gear portion (first gear portion) 147a and
20 a supplying roller gear portion (second gear portion) 147b. A gear portion 147a engages with the development gear 145 to transmit the rotational force received from the main assembly A to the developing roller 110. A gear portion 147b engages with the supplying roller
25 gear 146 to transmit the rotational force received from the main assembly A to the supplying roller 115. The gear 145 is mounted to the end of the developing

roller 110. The gear 146 is mounted to the end of the supplying roller 115. The gear 147 is provided with a coupling mounting portion (coupling accommodating portion) 147j (Figures 8A-8F) therein. A mounting
5 portion 147j accommodates a driving portion 150b of the coupling 150. The coupling 150 is restricted in the movement in the direction of the arrow X34 relative to the gear 147 by the retaining portion 147k (147k1, 147k2, 147k3, 147k4) provided inside of the
10 gear 147. The coupling 150 is inclinable relative to the mounting portion 147j and relative to a rotation axis L4 of the gear 147 (Figures 16A and 16B). More particularly, the coupling 150 is inclinable relative to the axis L4 in the state of being restricted in the
15 movement toward the driven portion 150a of the driving portion 150b relative to the mounting portion 147j by the retaining portion 147k.

The axis L4 is parallel to the rotation axis L1 of the developing roller 110.

20 The cartridge B has the developing device frame 113 and a supporting member 157, and the supporting member 157 is mounted to the developing device frame 113 (Figure 2).

The supporting member 157 is provided with a
25 hole 157j, and the inner surface 157m thereof is in engagement with the gear 147 (Figures 16C, 16D and 16E).

(5) Rotational force transmitting part (Coupling, and coupling member)

Referring to Figure 7A-7F, the description will be made as to an example of a coupling (coupling member) as a rotational force transmitting part according to an embodiment of the present invention. In Figure 7A is a perspective view of the coupling, as seen from a main assembly side, and Figure 7B is a perspective view of the coupling, as seen from a developing roller side. In Figure 7C shows a view of the coupling, as seen in the direction perpendicular to a direction of the rotation axis L2. In Figure 7D, is a side view of the coupling, as seen from the main assembly side, and Figure 7E shows a view, as seen from the developing roller side. In Figure 7E is a sectional view taken along S3 in Figure 7D. Figure 31 is a perspective view which illustrates only the coupling illustrated in Figures 13A-13G.

The cartridge B is dismountably mounted to a cartridge accommodating portion 130a of the rotary member C provided in the main assembly A. This is carried out by the user. In the state that the cartridge B is mounted to the accommodating portion 130a, the rotary member C is rotated by the rotational force of the motor (unshown). When the cartridge B reaches a predetermined position (the position which opposes to the photosensitive drum 107, that is, the

developing position), the rotation of the rotary member C is stopped. By this, the coupling (coupling member) 150 is engaged with the drive shaft 180 provided in the main assembly A. By unidirectionally rotating the rotary member C further, the cartridge B is moved from the predetermined position (developing position). In other words, it is retracted from the predetermined position. By this, the coupling 150 is disengaged from the drive shaft 180. It receives the rotational force from the motor (unshown) provided in the main assembly A in the state that the coupling 150 is in engagement with the drive shaft 180. The rotational force is transmitted to the developing roller 110. By this, the developing roller 110 is rotated by the rotational force received from the main assembly A.

In this embodiment, the coupling 150 receives an external force for rotating the developing roller 110. The coupling 150 rotates the developing roller 110 by transmitting the external force to the developing roller 110. Here, according to this embodiment, the external force is the rotational force transmitted to the coupling 150 by the drive shaft 180. Thus, the coupling 150 receives the external force transmitted from the drive shaft 180 to the coupling 150 to rotate.

In the state that the cartridge B is mounted to

the accommodating portion 130a, it is moved in the direction substantially perpendicular to the direction of the rotation axis L3 of the drive shaft 180 in accordance with the rotation of the rotary member C.

5 In response to the rotation in one direction of the rotary member C, the coupling 150 engages with the drive shaft 180, and is disengaged from the drive shaft 180.

As has been described hereinbefore, the drive
10 shaft 180 is provided with a pin 182 (rotational force applying portion), and is rotated by the motor (unshown).

The material of the coupling 150 is desirably a resin material, and is the polyacetal, for example.
15 This is because the balance in the rigidity, the toughness, and the processability thereof is suitable for the present embodiment. However, in order to raise the rigidity of the coupling 150, in consideration of a load torque, the rigidity may be raised by adding
20 the glass fibers in the resin material. In addition, a metallic material may be used. The material can be properly selected by the person skilled in the art. Since the resin material is easy in the processing, the couplings in the present embodiment are made of
25 the resin material.

The coupling 150 mainly has the three portions. The first portion is a driven portion 150a. As shown

in Figure 7C, the driven portion 150a is engaged with the drive shaft 180 (as will be described hereinafter). The driven portion 150a engages with a rotational force transmitting pin 182 as the rotational force
5 applying portion (main assembly side rotational force transmitting part) provided on the drive shaft 180 to receive the rotational force from the pin 182. The second portion is a driving portion 150b. In the driving portion 150b, a pin (rotational force
10 transmitting part) 155 engages with the driving input gear (rotational force receiving portion, and rotational force transmitted portion) 147, and transmits the rotational force to the gear 147. More specifically, the driving portion 150b transmits the
15 rotational force to a mounting portion 147j. The third portion is the intermediate portion 150c connected between the driven portion 150a, and the driving portion 150b.

The pin 182 projects in the each of the two
20 positions opposed to each other in the direction perpendicular to a rotation axis L3 of the drive shaft 180 (182a1, 182a2).

As shown in Figure 7F, the driven portion 150a has a drive shaft insertion opening 150m which expands
25 from a rotation axis L2 of the coupling 150. The driving portion 150b has a spherical portion 150i, a drive transmission pin 155, and a portion-to-be-

regulated-of-the-coupling 150j. Here, the regulating portion 150j is substantially co-axial with an axis L2, and engages with a regulating portion accommodating portion 160b as will be described hereinafter (Figures 5 12A-12D). By this, the regulating portion 150j can regulate an inclining direction of the axis L2. The detail thereof will be described hereinafter.

An opening 150m is provided with a driving shaft receiving surface 150f which has the 10 configuration of a circular cone expanded toward the drive shaft (180) side. As shown in Figure 7F, a receiving surface 150f constitutes a recess 150z. The recess 150z is provided with an opening 150m (opening) in an opposite side from a driving input gear 147 with 15 respect to a direction of the axis L2.

By this, the coupling 150 can move relative to the rotation axis L3 of the drive shaft 180 (pivoting) without being prevented by a free end portion 180b of the drive shaft 180, irrespective of a rotational 20 phase of the developing roller 110 in the cartridge B. More particularly, the coupling 150 can be moved (pivoted) between the rotational force transmitting angular position (the position shown in (d) of Figure 24), and the disengaging angular position (the 25 position shown in (c) and (d) of Figure 27), and between the pre-engagement angular position (the position shown in (a) of Figure 24), and a rotational

force transmitting angular position (the position shown in (d) of Figure 24).

The detail thereof will be described hereinafter.

5 The two projections (projections) 150d (engaging portions) are provided at equal intervals along the phantom circle periphery about the axis L2 in the end surface of the circular recess 150z (150d1 or 150d2). The portions between the projection 150d
10 constitute the entrance portions 150k (150k1, 150k2). An interval between the projections 150d1 or 150d2 is larger than an outer diameter of the pin 182 so that the intervals can receive the pin 182 provided in the drive shaft 180. The pin 182 is the rotational force
15 transmitting part. The spaces between the projection are the entrance portions 150k1, 150k2. When the rotational force is transmitted from the drive shaft 180 to the coupling 150, the pins 182 are positioned in the entrance portions 150k1, 150k2, respectively.
20 Furthermore, in Figure 7D, a upstream side of the projections of each 150d with respect to the clockwise direction is provided with a rotational force reception surface (rotational force receiving portion) 150e (150e1, 150e2). This rotational force reception
25 surface 150e is faced against a rotational direction of the coupling 150. More particularly, the projection 150d1 is provided with the receiving surface 150e1,

and the projection 150d2 is provided with the receiving surface 150e2. In the state that the drive shaft 180 rotates, the pins 182a1, 182a2 abut to either of the receiving surfaces 150e. By this, the pins 182a1, 182a2 push the contacted receiving surfaces 150e. By this, the coupling 150 is rotated about the axis L2.

More particularly, the coupling 150 receives the external force for rotating the developing roller 110. The coupling 150 rotates the developing roller 110 by transmitting the external force to the developing roller. Here, according to this embodiment, the external force is a rotational force transmitted to the coupling 150 by the drive shaft 180. More particularly, the coupling 150 receives the external force transmitted to the coupling 150 by the drive shaft 180 to rotate.

In this embodiment, the projections 150d (rotational force receiving surfaces 150e) are disposed on the phantom circle periphery about the axis L2, and they oppose with each other interposing the center. Therefore, to the coupling 150, the force is uniformly transmitted from the drive shaft 180. By this, the coupling 150 can stably be rotated with high degree of accuracy. In this embodiment, only two projections 150d (rotational force reception surfaces) are employed 150e, and therefore, the sizes of the

entrance portions 150k are large. By this, the pin 182 enters easily into the entrance portion 150k.

Therefore, the contact between the rotational force reception surface 150e, and the pin 182 is assured.

5 As shown in Figure 7F, the receiving surface 150f has the conical shape, the center thereof is on the axis L2, and the apex angle thereof is α_2 . By this, in the case where the coupling 150 is in the rotational force transmitting angular position in the state that the coupling 150 and the drive shaft 180 are in engagement with each other, the free end 180b of the drive shaft (Figure 24) abuts to the receiving surface 150f. The axis of the conical shape 1, i.e., the axis L2 of the coupling 150, and an axis L3 (Figure 26) of the drive shaft 180 are substantially co-axial with each other. By this, the coupling 150, and the drive shaft 180 align with each other, and a torque transmitted to the coupling 150 is stabilized. In this embodiment, α_2 is 60 degrees - 150 degrees. Depending on the angle of α_2 , the non-conical portions 150n of the opening 150m (Figure 7A, and Figure 7D) may be wide, or it may not be provided (Figure 8B).

It is desirable that the rotational force reception surface 150e is provided on a phantom circle (common circle) C1 which has the center O on the axis L2 (Figure 7D). By this, the radius of rotational force transmission is constant, and therefore, the

torque transmitted is stabilized. In addition, as for the projection 150d, the position of the coupling 150 is preferably stabilized by the balance of the forces received by the coupling 150, by. For this reason, in 5 the present embodiment, the receiving surfaces 150e are spaced by 180 degrees. In other words, in this embodiment, the receiving surface 150e1, and the receiving surface 150e2 diametrically oppose with respect to the axis L2. By this, the forces which the 10 coupling 150 receives form a force couple. For this reason, rotation of the coupling 150 can be continued only by receiving the force couple. In other words, the coupling 150 can be rotated without the regulation of the position of the axis L2.

15 Here, in the case of the present embodiment, a diameter of the pin 182 is approx. 2mm. And, a circumferential length of the entrance portion 150k is approx. 8mm. Here, the circumferential length of the entrance portion 150k is the interval between the 20 adjacent projections 150d on the phantom circle. However, the present invention is not limited to these values. In this manner, the pins 182 enter easily the entrance portions 150k.

In addition, the projection 150d is provided at 25 a free end portion of the recess 150z. In other words, it is provided at the free end portion of the coupling 150. And, the projection (projection) 150d projects in

a crossing direction crossing with the rotational direction of the coupling 150, and it is provided at the two places with the intervals along the rotational direction. By using the two projections 150d, more
5 assured engagement is possible in engaging with the rotating drive shaft 180.

Rotary member C (accommodating portion 130a) rotates in the state that the cartridge B is mounted. In the state that the developing roller 110 of a
10 desired developing cartridge B is placed in the developing position with the rotary member C which is not rotated, the coupling 150 is engaged with the drive shaft 180. The receiving surface 150e is in the state engageable with the pin 182. Or, the receiving
15 surface 150e engages with the pin 182. The receiving surface 150e is pushed by the pin 182 for receiving the force from the rotated drive shaft 180. By this, the receiving surface 150e receives the rotational force from the drive shaft 180. In addition, the
20 receiving surfaces 150e are equidistant from the axis L2, it is the surfaces of the projections 150d which diametrically oppose to each other, and face in the circumferential direction.

An entrance portion (recess) 150k is recessed
25 in the direction of the axis L2. The entrance portion 150k is formed as the space between the projection 150d, and the projection 150d. In the case where the

drive shaft 180 is at rest, and when the coupling 150 engages with the drive shaft 180, in the state that the cartridge B is mounted to the rotary member C, the pin 182 enters the entrance portion 150k. And, the receiving surface 150e is pushed by the pin 182 of the drive shaft 180. Or, when the coupling 150 engages with the drive shaft 180, in the case where the drive shaft 180 already rotates, the pin 182 enters the entrance portion 150k to push the receiving surface 150e. By this, the coupling 150 is rotated. The rotational force reception surface (rotational force receiving portion) 150e may be inside of the driving shaft receiving surface 150f. Or, the receiving surface 150e may be disposed at the portion which outwardly projected from the receiving surface 150f in the direction of the axis L2. In the case where the receiving surface 150e is disposed inside of the receiving surface 150f, the entrance portion 150k is also disposed inside of the receiving surface 150f. In other words, the entrance portion 150k is the recess, and is disposed inside of the arc portion of the receiving surface 150f, and between the projections 150d. In the case where the receiving surface 150e is disposed at the portion which outwardly projects, the entrance portion 150k is the recess, and is disposed between the projections 150d. Here, the recess may be the hole penetrated in the direction of the axis L2 or

may have the bottom portion. It is satisfactory if the recess is a space region which is between the projections 150d. And, it will be satisfactory if the pin 182 can be entered into the region in the state
5 that the cartridge B is mounted to the rotary member C.

The free end of the driving portion 150b is a spherical surface, so that irrespective of the rotational phase in the cartridge B of the gear 147, it can move between the rotational force transmitting
10 angular position and the pre-engagement angular position (or the disengaging angular position) relative to an axis L1 (Figure 10) of the gear 147. Here, the rotational force transmitting angular position is a first angular position. The pre-
15 engagement angular position is a second angular position. The disengaging angular position is a third angular position. In the illustrated example, the driving portion 150b is provided with a spherical retaining portion 150i which has the axis L2 as its
20 axis. A fixing hole 150g co-axial with the centerline of the driving portion 150b is provided, and the fixing hole is penetrated by the transmission pin 155. Furthermore, the driving portion 150b is provided with a cylindrical regulating portion 150j co-axial with
25 the axis L2 at the position which opposes to the intermediate portion 150c. The regulating portion 150j is engaged with the regulating portion accommodating

portion 160b as will be described hereinafter (Figures 12A-12D). By this, the inclining direction of the axis L2 of the coupling is regulated. The detail thereof will be described hereinafter.

5 The coupling 150 has an integral structure in this embodiment however separate driven portion 150a, intermediate portion 150c, and driving portion 150b may be connected. Other various structures are usable, but it is satisfactory if the integral operation is
10 possible as the coupling.

 In addition, the coupling 150 is provided with a circular flat portion 150x and a circular recess 150z at the center O of the flat portion 150x at the free end portion. A rotational force receiving portion
15 150e projects from the edge of the flat portion 150x, and they oppose to each other interposing the center of the flat portion 150x (Figure 6 and so on). In other words, the free end portion which is provided with the rotational force reception surface
20 (rotational force receiving portion) 150e is provided with the circular flat portion 150x, and the circular recess 150z provided at the center of the flat portion 150x.

 Here, the flat portion 150x may not be employed.
25 However, in the case where the rotation axis of the rotary member C swings as shown in the present embodiment, it is preferable to provide the flat

portion 150x because when the coupling 150 is engaged with the drive shaft 180, the engagement is still more assured.

As has been described hereinbefore, the
5 coupling 150 as the rotational force transmitting part is used for the developing cartridge B. The cartridge B is mounted, and dismounted with the movement in the direction substantially perpendicular to a direction of the axis L3 of the drive shaft 180 relative to the
10 main assembly A of the electrophotographic image forming apparatus. In other words, the cartridge B is moved in the direction substantially perpendicular to the direction of the axis L3 of the drive shaft 180. The drive shaft 180 is provided in the main assembly A.
15 The cartridge B is provided with a regulation member 160 which includes a permitting portion 160b2, and a regulating or confining portion 160b1. The permitting portion 160b2 permits the revolution of the coupling 150 substantially. The regulating portion 160b1
20 restricts an inclination angle position of the coupling 150. In the state that the regulating portion 150j as the projection is positioned in the permitting portion 160b2, the regulating portion 150j is not engaged or contacted relative to the regulation member
25 160.

The coupling 150 has a spherical portion (retaining portion) 150i, and the recess 150z at the

one-end portion of the spherical portion 150i with respect to the longitudinal direction of the coupling 150. The recess 150z is provided at the one-end portion in the longitudinal direction. The spherical
5 portion 150i is provided at the other end portion opposite from the one-end portion. The recess 150z is engaged with the drive shaft 180 in the state that the cartridge B is mounted to the main assembly A. The coupling 150 has the projection 150d. The projections
10 150d oppose to each other interposing center of the recess 150z O (rotation axis), and they project in the direction away from the spherical portion 150i in the longitudinal direction L1. In other words, the projections project in the longitudinal direction at
15 the free end of one-end portion in the longitudinal direction 150d. The projections 150d receive the rotational force from the drive shaft 180 in the state that the cartridge B is mounted to the main assembly A. The projection 150d is provided in each of the
20 positions. The coupling 150 has the regulating portion 150j as the projection which projects at the other end portion of the spherical portion 150i in the longitudinal direction. The regulating portion 150j is movable between the permitting portion 160b2 for
25 permitting the substantial revolution of the coupling 150, and the regulating portion 160b1 for regulating the inclination angle position of the coupling 150 in

the state that the coupling 150 is mounted to the cartridge B.

The coupling 150 includes the a plurality of pins (rotational force transmitting part, and
5 projection) 155 which outwardly project from the spherical portion 150i interposing the spherical portion 150i between the projection 150d, and the regulating portion 150j with respect to the longitudinal direction of the coupling 150. A pin 155
10 transmits the rotational force received by the projection 150d from the drive shaft 180 to the developing roller 110 in the state that the cartridge B is mounted to the main assembly A. In other words, the pin 155 is engaged with the rotational force
15 reception surface (rotational force transmitted portion) 147h to transmit the rotational force to a receiving surface 147h. By this, the gear 147 rotates, to transmit the rotational force to the developing roller 110 through the first gear portion 147a of the
20 gear 147. In addition, the rotational force is transmitted to the supplying roller 115 through the second gear portion 147b of the gear 147.

Here, the longitudinal direction of the coupling 150 is directed by the free end of the
25 projection 150d from the free end of the regulating portion 150j.

Furthermore, the coupling 150 includes the

circular flat portion 150x at the free end portion which is provided with the projection 150d. The recess 150z is provided at the center O of the flat portion 150x. The projection 150d projects from the edge of the flat portion 150x, and it opposes relative to each other interposing the center O of the flat portion 150x.

Here, the projection 150d is disposed on the phantom circle C1 about the center O. In addition, the regulating portion 150j has a cylindrical shape.

Referring to Figures 8A-8F, a development input gear 147 which supports the coupling 150 will be described.

An opening 147g 1 or 147g2 shown in Figure 8A are the groove extended in a rotational axis direction of the driving input gear 147. In mounting the coupling 150 a rotational force transmitting pin (rotational force transmitting part, and projection) 155 enters the openings 147g1 or 147g2.

The transmission pin 155 moves in the opening 147g 1 or 147g2. By this, the coupling 150 is movable between the rotational force transmitting angular position, and the pre-engagement angular position (or disengaging angular position) irrespective of the rotational phase of the driving input gear 147 in the cartridge B.

In Figure 8A, and 8D, the clockwise upstream

side of the opening 147 (147g1 or 147g2) is provided with the rotational force reception surface (rotational force transmitted portion) 147h (147h1 or 147h2). A side of the transmission pin (rotational force transmitting part) 155 of the coupling 150 contacts to the receiving surface 147h. By this, the rotational force is transmitted to the developing roller 110. In other words, the transmitting surfaces 147h 1 - 147h2 are the surfaces crossed to the rotational direction of the driving input gear 147. By this, the transmitting surface 147h (147h1 or 147h2) is pushed by the side of the transmission pin 155 to rotate about rotation axis L1 (Figure 8B). Here, the axis L4 is the rotation axis of the gear 147.

As will be described hereinafter, the coupling 150 is provided with a gap between the pin (rotational force transmitting part) 155, and the rotational force reception surface (rotational force transmitted portion) 147h engaged with it (Figure 8D) so that it can incline in the substantially all directions relative to the axis L4.

In this manner, the coupling 150 is mounted to the longitudinal end portion of the cartridge B. Therefore, the coupling 150 is inclinable in the substantially all directions relative to the rotation axis L4. As has been described hereinbefore, in the state that the cartridge B is mounted to a rotary

member C the coupling 150 receives the rotational force from the drive shaft 180, and transmits the rotational force to the developing roller 110 (and supplying roller 115). The coupling 150 has the rotational force reception surface 150e for receiving the rotational force from the drive shaft 180 by engaging with the pin 182, and the pin (projection) 155 for transmitting the rotational force received through the receiving surface 150e to the developing roller 110. The pin 182 is the rotational force applying portion. The rotational force reception surface 150e is the rotational force receiving portion. The pin 155 is the rotational force transmitting part. The pin 155 is engaged with the rotational force reception surface (rotational force transmitted portion) 147h to transmit the rotational force to the receiving surface 147h. By this, the gear 147 rotates, to transmit the rotational force to the developing roller 110 through the first gear portion 147a of the gear 147. The rotational force is transmitted to the supplying roller 115 through the second gear portion 147b of the gear 147.

When the rotary member C rotates, the coupling 150 contacts to the drive shaft 180 in accordance with the movement of the cartridge B. By this, the coupling 150 moves from the pre-engagement angular position to the rotational force transmitting angular position

with the movement of the coupling 150 to the
permitting portion 160b2 from the regulating portion
160b1. By this, the coupling 150 opposes to the drive
shaft 180 to receive the rotational force from the
5 drive shaft 180. And, when the rotary member C further
rotates from the position in which the coupling 150
opposes to the drive shaft 180, the coupling 150 moves
from the rotational force transmitting angular
position to the disengaging angular position in
10 accordance with the movement of the cartridge B. By
this, the coupling 150 disengages from the drive shaft
180.

As shown in Figure 8B), the gear 147 is
provided with a coupling mounting portion 147j which
15 accommodates the drive transmitting portion 150b of
the coupling 150.

The mounting portion 147j is provided with the
retaining portion (spherical portion) 147k (147k1-
147k4) for preventing the disengagement, from the gear
20 147, of the accommodated transmitting portion 150b.

Figure 8B is a sectional view illustrating the
step of fixing the coupling 150 to the gear 147.

First, the coupling 150 is moved in an X33
direction. Then, the transmitting portion 150b is
25 inserted into the mounting portion 147j. Before the
insertion, the diameter $\phi Z6$ of retaining portion
(spherical portion) 150i is larger than diameter D15

(Figure 8A) of the circle constituted by the inside edge lines 147m (147m1-147m4) of the retaining portion 147k. In other words, a relation of $Z6 > D15$ is satisfied.

5 In accordance with the insertion of the transmitting portion 150b, retaining portion 147k (147k1-147k4) is temporarily retracted radially outwardly of the gear 147 by the elastic deformation thereof. By this, the transmitting portion 150b can be
10 inserted into the mounting portion 147j. In other words temporarily, the relation of $D15 > Z6$ is satisfied. When the insertion of the transmitting portion 150b to the mounting portion 147j is completed, the retaining portion 147k (147k1-147k4) elastically
15 deformed is restored. In other words the relation of $Z6 > D15$ is satisfied.

 Then, the retaining member 156 is inserted in the direction of the arrow X33, and is fixed to the gear 147. Here, the outer diameter D10 of the driven
20 portion 150a is smaller than the diameter D16 of an opening 156i of the retaining member 156. In other words the relation of $D16 > D10$ is satisfied. By satisfying this relation, in the state that the coupling 150 is inserted into the gear 147, the
25 retaining member 156 can be inserted into the gear 147. As shown in Figure 8C), by the insertion of the retaining member, the elastical deformation of

retaining portion 147k (147k1-147k4) radially outward of the gear 147 is prevented. By this, the relation of $Z6 > D15$ is maintained. In this state, even in the case where the force in the direction opposite from the inserting direction is applied to the coupling 150, the disengagement of the coupling 150 from the gear 147 can be prevented. In addition, the force in the direction opposite an inserting direction is the force in X34 direction when the coupling 150 (transmitting portion 150b) disengages from the mounting portion 147j. This is because, the transmitting portion 150b is contacted to the retention surface 147l (147l1-147l4 (147l3 and 147l4 are unshown), Figure 8B)) of the retaining portion 147k (147k1-147k4), and the further movement is restricted. The mounting portion 147j is provided inside of the gear 147.

By this, the coupling 150, the gear 147 and the retaining member 156 are unified to provide a drive unit U (Figure 8C, 8A and Figure 16B)).

As shown in Figure 8E, the retaining member 156 as will be described hereinafter which functions as a coupling retaining portion 157a of the supporting member 157 can be unified with the supporting member 157. In this case, the step of fixing the retaining member 156 to the gear 147 in the step described above is omitted. In mounting the coupling 150 as will be described hereinafter to a developing device frame

(cartridge frame) 113, the coupling retaining portion 157a of the supporting member 157 is inserted into the gear 147 (Figure 8F). In the state shown in Figure 8F, the retaining portion 157a prevents the radially
5 outward elastical deformation of the retaining portion 147k (147k1-147k4) of the gear 147. By this, the retaining portion 157a prevents the disengagement of the coupling 150 from the gear 147. A function of the retaining portion 157a described above is the same as
10 the function of the retaining member 156.

The coupling 150 is movable (pivotal) between the rotational force transmitting angular position, and the disengaging angular position, and between the rotational force transmitting angular position, and
15 the pre-engagement angular position in the gear 147. Retaining portion 147k (147k1-147k4) restricts the movement of the coupling 150 in the direction of X34 relative to the gear 147. In other words, the inside edge line 147m (147m1-147m4) of an opening has a
20 diameter $\phi D15$ smaller than a diameter Z6 of the retaining portion 150i.

As has been described hereinbefore, a bearing portion 160a engages rotatably with the gear 147 (rotatable member) which has the development gear
25 portion (first gear portion) 147a, and the supplying roller gear portion (second gear portion) 147b. The coupling 150 is mounted to the inside of the gear 147.

The coupling 150 is mounted. By such a structure, a coupling mounting structure is a compact. Similarly to the projection 150d, it is desirable that a rotational force transmitting surface (rotational force transmitting part) 150h 1 or 150h2 diametrically opposes on the same circumference.

By the unification as described above, the coupling 150, and the gear 147 can be treated as a unit. By this, a handling at the time of assembling the coupling 150 to the cartridge B is easy. Therefore, the improvement of the assembling property can be accomplished. If strength of the retaining portion 147k is sufficient, the retaining member may be omitted.

As has been described hereinbefore, the coupling 150 is mounted to the gear 147, so that a rear end portion thereof is revolvable inside of the gear (rotatable member) 147, and the coupling 150 does not disengage from the gear 147. In other words the coupling 150 has the retaining portion (spherical portion) 150i so that the movement toward the free end portion in the longitudinal direction (direction of the axis L2) of the coupling 150 is regulated. The pin (rotational force transmitting part) 155 projects in the direction perpendicular to the longitudinal direction from the retaining portion 150i. The movement of the retaining portion 150i toward the free

end portion is regulated by the retaining portion 147k. By such the structure, the coupling mounting structure is compact.

The free end portion of the coupling 150 is the side which opposes to the drive shaft 180 (side engaged with the drive shaft 180) in the state that the cartridge B is mounted to the rotary member C. The rear end portion is the side opposite from the free end portion, and is the side at which the rotational force is transmitted to the developing roller 110 (side mounted to the gear 147).

Referring to Figures 10A1-10A5 and 10B1-10B5, the description will be made as to a range of the movement of the coupling 150 relative to the gear 147.

Figure 10 is a view showing a connection state between the gear 147 and the coupling 150. (a1) - (a5) of Figure 10 is a view, as seen in the direction of the drive shaft 180, and (b1) - (b5) of Figure 10 is a perspective view thereof.

As shown in Figure 10, the coupling 150 is mounted so that the rotation axis L2 thereof can incline in all directions relative to the axis L4. The drive shaft 180 is provided in the main assembly A at the one longitudinal end portion of the rotary member C. The drive shaft 180 is provided at the predetermined position in the main assembly A so that it is rotatable. The drive shaft 180 is fixed to the

main assembly A so that it does not move in the direction substantially perpendicular to the rotation axis thereof. In other words a rotation axis of the drive shaft 180 per se does not shift in the direction
5 substantially perpendicular to the rotation axis thereof. The drive shaft 180 is not mounted to a member which swings in the direction substantially perpendicular to the rotation axis thereof with the rotary member C. The axis L2 is co-axial with the axis
10 L4 in (a1), and (b1) of Figure 10. Figures 10A2 and 10B2 show the state when the coupling 150 inclines upward from this state. The coupling 150 inclines toward an opening 147g. In this state, the transmission pin 155 is moved along the opening 147g
15 ((Figure 10A2 and B2). As a result, the coupling 150 inclines about an axis AX perpendicular to the opening 147g.

In Figures 10A3 and 10B3, the coupling 150 inclines rightward. When the coupling 150 this
20 inclines in the orthogonal direction perpendicular to the opening 147g, the pin 155 is rotated in the opening 147g. The axis of the pin 155 at the time of the pin 155 rotating is the central axis AY of the pin 155.

25 In Figures 10A4 and 10B4, and Figure 10A5 and 10B5, the state that the coupling 150 is inclined downward, and the state of being inclined leftward are

shown. The coupling 150 inclines about the rotation axes AX and AY.

Here, the inclination of the coupling 150 is a combined inclination of the rotation around the axis AX, and the rotation around the axis AY. In addition, this direction is the direction shown in Figures 10A2 and 10A3; 10A3 and 10A4; 10A4 and 10A5; and 10A5 and 10A2. In this manner, the axis L2 can incline in all directions relative to the axis L1.

10 It has been described that the axis L2 is inclinable in all directions relative to the axis L4. However, it is not necessary that the axis L2 is inclinable to the predetermined angle in any direction over 360 degrees to the axis L4. For example, the opening 147g is made relatively wide in the circumferential direction, for example. With such a setting, when the axis L2 inclines relative to the axis L4, the coupling 150 rotates slightly about the axis L2 even in the case where the coupling cannot
15 incline up to the predetermined angle linearly. By this, the axis L2 can incline to the predetermined angle relative to the axis L4. In other words a play in the rotational direction of the opening 147g can be selected properly, as needed.

25 As has been described hereinbefore referring to Figure 8A-8F, a spherical surface 150i contacts to the retention surface 147l. For this reason, the coupling

150 is mounted rotatably about the center P2 of the spherical surface 150i. In other words, the axis L2 is inclinable irrespective of a phase of the gear 147. In further words the coupling 150 is revolvable relative to the axis L4. As will be described hereinafter, in order to engage the coupling 150 with the drive shaft 180, it is necessary that the axis L2 inclines toward the downstream side with respect to a rotational direction X4, relative to the axis L4, immediately before the engagement. As shown in Figures 11A-11D, in other words, it is necessary that the axis, L2 of the coupling 150 inclines relative to the axis L4, so that the position of the driven portion 150a is the downstream with respect to the rotational direction X4 of the rotary member C.

Figure 2 illustrates the state that the axis L2 inclines relative to the axis L4. Figure 9 is a sectional view taken along S24-S24 of Figure 2.

By the structure described in the foregoing, the coupling can also be shifted to the state that the axis L2 is substantially parallel with the axis L4 from the state that the axis L2 inclines as shown in Figure 9. The maximum possible inclination angle α_4 (Figure 9) of the axis L4 and the axis L2 is the angle that a driving portion 150a and intermediate portion 150c contacts to the end member 151, and the supporting member 157. The angle α_4 may be set to the

angle required when mounting and demounting on the main assembly.

Here, the maximum possible inclination angle α_4 is 20 degrees - 80 degrees in the case of the present embodiment. In the foregoing, it has been described hereinbefore that it is necessary that the axis L2 inclines downstream in the rotational direction X4 relative to the axis L4 immediately before the coupling 150 engages with the drive shaft 180. The regulating or confining method will be described.

(6) Angular position regulating member

Referring to Figures 12A-12D and Figures 13A-13G, the description will be made as to the angular position regulation member (regulation member) for regulating the inclining direction of the coupling 150. .

The rotational force transmitting angular position is the first angular position. The pre-engagement angular position is the second angular position. The disengaging angular position is the third angular position.

According to the regulation member 160 of the present embodiment, the coupling 150 can be maintained in the pre-engagement angular position (second angular position) even if it is before the cartridge B is mounted to the rotary member C. The coupling 150 can be maintained in the pre-engagement angular position

(second angular position) also in the free state of the cartridge B. Therefore, when the cartridge B is transported, for example an unintended movement of the coupling 150 is prevented.

5 This is one of the remarkable effects according to an embodiment of the present invention.

Figure 12A is a perspective view of the regulating portion 160, as seen from the outside with respect to the longitudinal direction of the
10 developing roller 110. Figure 12B is a side view of the regulating portion 160, as seen from the outside. Figure 12C and 12D illustrates another embodiment of a configuration of the regulating portion 160. Figure
13A is a perspective view illustrating the positional
15 relation between the coupling 150, and the regulation member 160 in the state that the coupling 150 is in the rotational force transmitting angular position (as will be described hereinafter). Figure 13B is a
perspective view illustrating the positional relation
20 between the coupling 150, and the regulating portion 160 in the state that the coupling 150 is in the pre-engagement angular position (as will be described hereinafter). In addition, Figures 13C and 13D
illustrate the states of the gear 147, and the
25 retaining member 156 in the state of Figure 13A, and Figure 13B. Figure 13E is a perspective view illustrating the state that the portion-to-be-

regulated-of-the-coupling 150j is positioned in a positioning portion (regulating portion) 160b1. Figure 13F is a perspective view illustrating the state that the regulating portion 150j is positioned in the
5 permitting portion 160b2. Figure 13G is a perspective view of the coupling 150 engaged with the regulation member 160, as seen from the bottom. In Figure 13G, the bottom of the regulation member 160 is not illustrated. Actually, the regulation member 160 is
10 provided with the bottom, and therefore, the regulating portion 150j is not visible.

The regulation member 160 is provided with the circular bearing portion 160a and the regulating portion accommodating portion 160b. The regulation
15 member 160 is provided with a groove 160g. An accommodating portion 160b is a groove. The bearing portion 160a surrounds the groove 160g. The accommodating portion 160b includes a positioning portion 160b1 and permitting portion 160b2. The
20 regulation member 160 is integral with the bearing 138 described above. Therefore, the regulation member 160 is provided on an outside surface of the bearing 138.

The bearing portion 160a supports inner surface 147i (Figure 8B) of the gear 147 rotatably. The inner
25 surface 147i engages with an outer surface of the bearing portion 160a. By this, the gear 147 is mounted rotatably to the bearing portion 160a. The regulating

portion 150j is accommodated in the accommodating portion 160b. In this state, the coupling 150 freely is movable within the range that the regulating portion 150j does not interfere with the wall 160b3 of an accommodating portion. The portion-to-be-regulated 150j has the cylindrical shape. The portion-to-be-regulated 150j projects away from the intermediate portion 150c co-axially with the axis L2 from the driving portion 150b. The portion-to-be-regulated 150j projects from the end of the coupling 150. More specifically, the portion-to-be-regulated 150j is co-axial with the retaining portion (spherical portion) 150i, and projects away from the intermediate portion 150c from the retaining portion 150i. With such a structure, the coupling mounting structure is compact. Before engaging with the drive shaft 180, the coupling 150 takes the pre-engagement angular position by elastic material (urging member) or the like as will be described hereinafter. At this time, the portion-to-be-regulated 150j contacts to the positioning portion (regulating portion) 160b1. More particularly, the inclining direction of the coupling 150 is regulated by abutting a part for a circular column portion of the portion-to-be-regulated (projection) 150j to a wall 160b4 of the V-shaped groove portion as the positioning portion 160b1. The portion-to-be-regulated (projection) 150j of the coupling 150

projects at a trailing end at the opposite side from the end which is provided with the rotational force reception surface (rotational force receiving portion) 150e. The portion-to-be-regulated 150j is regulated in the inclining direction by abutting to a narrow portion 160b7 of the V-shaped groove portion 160b4 as the positioning portion 160b1. The coupling 150 is regulated in the inclination angle by the abutment to the positioning portion 160b1 of the free end of the regulating portion 150j. Therefore, the coupling 150 is positioned at an optimal pre-engagement angular position for the engagement with the drive shaft 180. In this manner, the regulating portion 150j is regulated in the inclining direction by the positioning portion 160b1. By this, the coupling 150 is positioned to the pre-engagement angular position (in Figure 13E, the inclined coupling 150 is positioned at the pre-engagement angular position). This position will be described hereinafter. The positioning portion 160b1 functions as the positioning portion only in the case where the coupling 150 is in the pre-engagement angular position.

In the case where the coupling 150 is in the position other than the pre-engagement angular position, it is freely movable within the range in which the regulating portion 150j does not interfere with the wall 160b3 of the permitting portion 160b2.

When in the case where the coupling 150 is in a position between the pre-engagement angular position, and the rotational force transmitting angular position, the rotational force transmitting angular position, a position between the rotational force transmitting angular position, and the disengaging angular position, or the disengaging angular position, in the range that the regulating portion 150j does not interfere with the wall 1603 of the permitting portion 160b2, it is freely movable. In other words, in the case where the portion-to-be-regulated 150j does not contact to the positioning portion (regulating portion) 160b1, the coupling 150 is revolvable (in Figure 13F, and Figure 13E, perpendicular coupling 150). By doing so, by, in the state that the coupling 150 is in engagement with the drive shaft 180, when it moves from the pre-engagement angular position to the rotational force transmitting angular position, or when it moves from a rotational force transmission position to the disengaging angular position, the coupling 150 can be moved with the drive shaft 180. Therefore, a stress imparted to the coupling 150 can be suppressed in the case where the rotary member C as will be described hereinafter moves radially, more particularly, in the case where the coupling 150 moves in the radial direction of the rotary member C. Therefore, the coupling 150 can be smoothly engaged with the drive

shaft 180, and can be smoothly disengaged from the drive shaft 180. The permitting portion 160b2 is constituted by a wide portion 160b8.

In the case where the coupling 150 moves from
5 the position other than the pre-engagement angular position to the pre-engagement angular position by the urging member, the portion-to-be-regulated 150j is guided by the wall 160b3 of the permitting portion 160b2, and is guided to the positioning portion 160b1.
10 The coupling 150 inclines to the pre-engagement angular position.

As has been described hereinbefore, the regulation member 160 has the positioning portion (regulating portion) 160b1 for regulating the coupling
15 150 at the pre-engagement angular position before engaging with the drive shaft 180, and the permitting portion 160b2 for permitting the substantial revolution of the coupling 150 member.

As for the configuration of the portion-to-be-regulated accommodating portion 160b, the
20 configuration as shown in Figure 12C and Figure 12D can be used, if the positioning portion 162a and the permitting portion 162b satisfy the functions described above. In the embodiment shown in 12C, the
25 configuration of the positioning portion (regulating portion) 160b1 is an arc shape 160b6, and the configuration of the permitting portion 160b2 is a

curved surface. In the embodiment shown in Figure 12D, the configuration of the permitting portion 160b2 is curved.

As has been described hereinbefore, the
5 regulation member 160 is provided with the groove 160g. The groove 160g includes a narrow portion 160b7 as the positioning portion 160b1 as the regulating portion, and a wide portion 160b8 as the permitting portion 160b2. The trailing end of the coupling 150 includes
10 the portion-to-be-regulated 150j (projection) which is projected. In the state that the portion-to-be-regulated 150j is positioned in the narrow portion 160b7, the inclining direction of the coupling 150 is restricted to the pre-engagement angular position, and
15 in the state that the portion-to-be-regulated 150j is positioned in the wide portion 160b8, the inclination of the coupling 150 to the rotational force transmitting angular position from the pre-engagement angular position is permitted. The portion-to-be-
20 regulated 150j is regulated by contacting to the wall 160b4 of the narrow portion 160b7. In the case where the portion-to-be-regulated 150j is positioned in the permitting portion 160b2, the coupling 150 is revolvable. In other words the coupling 150 can be
25 revolved relative to the axis L4. In the state that the coupling 150 is revolvable, the portion-to-be-regulated 150j is in the wide portion 160b8, and does

not contact to the wall 160b3.

The peripheral surface of the groove 160g is surrounded by the circular bearing portion (circular portion) 160a. The bearing portion 160a engages
5 rotatably with the gear 147 (rotatable member) which has the development gear portion (first gear portion) 147a, and the supplying roller gear portion (second gear portion) 147b. The coupling 150 is mounted to the inside of the gear 147, and in the case where the
10 coupling 150 (portion-to-be-regulated 150j) is positioned in the permitting portion 160b2, the coupling 150 is revolvable substantially.

As has been described hereinbefore, in the regulation member 160 of the present embodiment, even
15 if it is before the cartridge B is mounted to the rotary member C, the coupling 150 can be maintained in the pre-engagement angular position (second angular position). In other words even in the case where the cartridge B is in the free state, the coupling 150 can
20 be maintained in the pre-engagement angular position (second angular position). Therefore, in transporting the cartridge B, for example, the inadvertent movement of the coupling 150 can be prevented.

Referring to Figures 14 and 15, the description
25 will be made as to a coupling elastic material (urging member) for moving the coupling to the pre-engagement angular position. Figure 14 is a perspective view

illustrating the state that the elastic material 159 is mounted to the supporting member 157. Figure 15 is a perspective view of the cartridge B in the state that the urging member 159 is mounted to the
5 supporting member 157.

As shown in Figure 14, a lateral surface 157i of the supporting member (mounting member) 157 is provided with a spring mounting portion 157e1 and a spring rotation-stopper 157e2. A coil part (end) 159b
10 of a torsion coil spring (urging member and elastic material) 159 is fixed to the mounting portion 157e1. A rotation-stopper arm 159c for a spring 159 contacts to the spring rotation-stopper e2. As shown in Figure 15, a contact portion 159a of the spring 159 contacts
15 to the intermediate portion 150c of the coupling 150. In this state, the spring 159 is twisted to produce the elastic force. By this, the axis L2 of the coupling 150 inclines relative to the axis L4 (Figure 15). In other words the coupling 150 inclines to the
20 pre-engagement angular position. The a contact position of the spring 159 relative to the intermediate portion 150c is in the upstream side from the center of the driving portion 150b of the coupling 150 in the rotational direction X4. For this reason,
25 the axis, l2 inclines relative to the axis L4, so that the driven portion (150a) side moves toward the downstream side with respect to the rotational

direction X4. The rotational direction X4 shows the rotational direction of the rotary member C.

In this embodiment, although the torsion coil spring is used as the spring 159, this is not
5 restrictive in the present invention. For example, it may be another elastic material (urging member), for example, leaf spring, rubber, sponge. However, a certain amount of stroke is required in order to incline the axis L2. For this reason, it preferably
10 has a certain stroke. In order to make the coupling 150 be positioned in the pre-engagement angular position (first angular position), the spring (urging member and elastic material) 159 urges the coupling 150 by the elastic force thereof so that the coupling
15 150 is positioned in the regulating portion 160b1. By urging the coupling by the elastic force of the spring (urging member, and elastic material), the coupling 150 can be maintained in the pre-engagement angular position (first angular position) more assuredly. In
20 other words by the spring (urging member, and elastic material) 159, the coupling 150 elastically urges to the positioning portion (regulating portion) 160b1.

When the rotary member C rotates, the coupling 150 contacts to the drive shaft 180 by the movement of
25 the cartridge B. By this, the coupling 150 moves to the permitting portion 160b2 from the regulating portion 160b1 against the elastic force of the spring

(elastic material) 159. With this movement, the coupling 150 moves from the pre-engagement angular position to the rotational force transmitting angular position. By this, the coupling 150 opposes to the drive shaft 180 to receive the rotational force from the drive shaft 180. When the rotary member C further rotates from the position in which the coupling 150 opposes to the drive shaft 180, the coupling 150 moves from the rotational force transmitting angular position to the disengaging angular position against the elastic force of the spring 159, in accordance with the movement of the cartridge B. By this, the coupling 150 disengages from the drive shaft 180.

(7) assembly of coupling to cartridge frame

Referring to Figures 16A-16E, the method of assembling the coupling 150 to the developing device frame (cartridge frame) will be described. Figure 16A is a perspective view of the cartridge B before the gear 147 including the coupling 150 and the retaining member 156, the supporting member (rotatable member) 147, and the spring 159 are mounted. Figure 16B is a perspective view of the cartridge B before mounting a mounting member 157, and spring 159. Figure 16C is a perspective view of the cartridge B before mounting the spring 159. Figure 16D is a perspective view of the cartridge B after the completion of the mounting. Figure 16E is an exploded perspective view of the

cartridge B in the longitudinal direction after the completion of the mounting with the positional relation in the direction perpendicular to the longitudinal direction unchanged.

5 The bearing 138 provided with the regulation member 160, the developing roller 110 and the developer supply roller 115 are mounted to the developing device frame 113 (cartridge frame). A developing roller gear 145 for transmitting the
10 rotational force from the gear 147 to the developing roller 110 is mounted to the developing roller 110. A developer supply roller gear 146 for transmitting the rotational force from the gear 147 to the developer supply roller 115 is mounted to the developer supply
15 roller 115.

The bearing 138 is mounted by a screw 138a to the one longitudinal end portion of the developing device frame 113 (Figures 16A and B).

First, drive unit U (the gear 147 which is
20 provided with the coupling 150 and the retaining member 156) is mounted to the regulation member 160 (Figures 16A and 16B). At this time, the circular column portion as the portion-to-be-regulated (projection) 150j is accommodated by the groove as the
25 accommodating portion 160b (Figure 13B). The inner surface 147i engages with a circular outer surface of the bearing portion (circular portion) 160a. By this,

the gear 147 is mounted rotatably to the bearing
portion 160a (Figures 16A and 16B). In this state, the
gear portion 147a of the gear 147 is engaged with the
developing roller gear 145 to transmit the rotational
5 force to the developing roller 110. A supplying roller
gear portion 147b of the gear 147 engages with the
developer supply roller gear 146, to transmit the
rotational force to the roller 115. The coupling 150
is freely movable in the range in which the portion-
10 to-be-regulated 150j does not interfere with the wall
of the accommodating portion 160b in the regulation
member 160. The bearing portion 160a as the circular
portion surrounds the groove 160g (Figures 12A - 12C).

Then, the supporting member 157 is mounted to
15 the developing device frame 113 (Figure 16D). In the
case of the mounting, the coupling 150 passes through
an opening 157j of the supporting member 157, and the
bearing 138, and the supporting member 157 contact to
each other. The supporting member 157 has a
20 positioning portion (unshown) at a position, and a
rotation stopper (unshown) at a position relative to
the developing device frame 113. The supporting member
157 is positioned with respect to the widthwise
direction of the developing device frame 113. The gear
25 147 is supported rotatably by the bearing portion 160a
as a gear supporting portion. The disengagement of the
retaining member (retention ring) 156 from the gear

147 is prevented by the retaining portion 157k 157l.
The supporting member 157 is mounted to the developing device frame 113 by screws 157a, 157b. The method for the mounting of the bearing 138, and the supporting
5 member 157 to the developing device frame 113 is properly selected by the person skilled in the art. Finally, the spring 159 is mounted to a spring supporting portion 157e1 of the supporting member 157 (Figure 16D). At this time, the intermediate portion
10 150c of the coupling 150 is contacted to the urging direction downstream of the contact portion 159a of the spring 159. In this state, the coupling 150 inclines toward the downstream with respect to the rotational direction X4 of the rotary member C by the
15 spring 159. In this state, the portion-to-be-regulated 150j contacts to the positioning portion 160b1. The positioning portion 160b1 has the shape of V, and the portion-to-be-regulated 150j is contacted to the V-shaped groove portion 160b4. In other words the
20 coupling 150 is positioned at the pre-engagement angular position.

As for the mounting method described above, the order of the steps may be changed, for example, after mounting the gear 147 to the supporting member
25 (rotatable member) 157, these are mounted to the developing device frame 113.

As has been described hereinbefore, the

peripheral surface of the groove 160g is surrounded by the circular bearing portion (circular portion) 160a. The bearing portion 160a as the circular portion engages rotatably with the gear (rotatable member) 147 which is provided with the first gear portion 147a, and the second gear portion 147b. In the case that the coupling 150 is mounted to the inside of the gear 147, and the portion-to-be-regulated 150j is positioned in the permitting portion 160b2 the coupling 150 is revolvable substantially.

While the portion-to-be-regulated 150j is positioned in the permitting portion 160b2, in the coupling 150, a gap is provided between the pin (rotational force transmitting part) 155, and the rotational force reception surface (rotational force transmitted portion) 147h for receiving the rotational force from the pin 155 so that it is revolvable substantially. The pin 155 is movable relative to the receiving surface 147h. In the rotational direction of the coupling 150, the pin 155, and the receiving surface 147h contact with each other. The coupling 150 is provided at the end of the cartridge B.

More particularly, in the coupling 150, a gap is provided between the pin (rotational force transmitting part) 155, and the rotational force reception surface (rotational force transmitted portion) 147h so that it is revolvable substantially

in the state that the portion-to-be-regulated 150j is positioned in the permitting portion 160b2. The pin (rotational force transmitting part) 155 is movable relative to the rotational force reception surface (rotational force transmitted portion) 147h. In the rotational direction in which the coupling 150 rotates, the pin 155, and a rotational force reception surface 147h contact to each other. The pin 155 transmits the rotational force received from the drive shaft 180 to the developing roller 110 through the rotational force reception surface (rotational force receiving portion) 150e. The pin 155 is provided on the coupling 150. The rotational force reception surface 147h is provided inside of the gear 147 as the rotatable member.

(8) Mounting and demounting method of developing cartridge relative to color electrophotographic image forming apparatus main assembly

Referring to Figures 17-19, the mounting and dismounting operation of the cartridge B relative to the main assembly A will be described.

Figure 17 is a sectional view illustrating a developing cartridge mounting and demounting waiting position (waiting position) HP that the rotary member C is shifted by a predetermined angle phase from a developing position DP. The rotary member C takes the waiting position HP (home position) except during the

developing operation, and the mounting and dismounting operation of cartridge B (B1-B4) is also carried out in the position. In this embodiment, only a position About 45-degrees upstream of the developing position
5 DP is the waiting position H.

The mounting and demounting operation of the cartridge B relative to the rotary member C is carried out by the user in the state that the rotary member C is rest at the waiting position H.

10 In the mounting and demounting of cartridge B (B1-B4) relative to the rotary member C, a cover 13 is first opened. By this, the user can mount and demount cartridge B (B1-B4) relative to the rotary member C. Figure 17 is a sectional view illustrating the state
15 that a yellow cartridge B1 among the four cartridge s B is positioned in the waiting position H. The cover 13 is opened. The cover 13 is operated interrelatedly with an interlocking SW (unshown). More particularly by releasing the cover 13, the interlocking SW is
20 rendered into OFF state to stop the drive in the main assembly A. Designated by 19 is a cartridge releasing members (Figure 4, Figure 17). The releasing member 19 operates a locking member (unshown) for locking the cartridge B in the rotary member C. More particularly
25 the locking member (unshown) engages by the releasing member 19 with a guide portion (portion-to-be-locked) 60b (Figure 19), by which, the cartridge B is locked

by the rotary member C. A guide portion 60b is provided in the cartridge B. By releasing the cover 13, the releasing member 19 moves the locking member (unshown) to the position which is not engaged with the guide portion 60b. By this, only in the cartridge B1 which is positioned in the waiting position HP, the engagement with the rotary member C is released. Therefore, the user can dismount the cartridge B1 from the rotary member C (Figure 17, Figure 18). As has been described hereinbefore, the cartridge B has the guide portion 60b for being guided in the direction perpendicular to the direction of the axis L1 of the developing roller 110 (longitudinal direction of developing roller 110).

As shown in Figure 4, when the user shuts the cover 13, the projection 13a provided on the cover 13 rotates the releasing member 19 counterclockwisely. By this, the releasing member 19 engages the locking member (unshown) with the guide portion 60b. Accordingly, when the cover 13 is shut, the cartridge B is locked to the rotary member C. When interlocking SW is in the ON state, all of the cartridges B (B1-B4) mounted to the rotary member C are locked. For this reason, the trouble that the driving mechanism of the main assembly A unintentionally starts can be avoided assuredly with cartridge B (B1-B4) unlocked.

The mounting of the cartridge B to the main

assembly A will be described.

As shown in Figure 18, when the user grips the handle 54, an orientation of the cartridge B is determined in general by a gravity center of the cartridge. This orientation is near to the orientation required when the cartridge B passes through the opening 30 provided in an upper portion of the main assembly A.

The cartridge, b is provided with an elongated cartridge side guide 60b, and a shaft portion 60a at the end with respect to the longitudinal direction of cartridge B (developing roller 110,) (Figure 2). The cartridge B is provided with an elongated cartridge side guide 61b, and a shaft portion 61a at the other longitudinal end (Figure 3). The shaft portions 60a, 61a are co-axial with the axis L1 of the developing roller 110. The shaft portions 60a and the guide 60b are provided on the outside surface of the supporting member 157. The shaft portion 61a and the guide 61b are provided on the outside surface of a side member 139.

The rotary member C is provided with a rotary member side guide C2 at the one longitudinal end portion, and the other end where the cartridge B is mounted.

The main assembly A is provided with the main assembly guide 17 (Figure 19, (a) and (b)). The main

assembly guide 17 is omitted for the sake of simplicity in Figure 4, and Figure 17.

In mounting the cartridge B to the rotary member C, the shaft portion 60a fixed to the opposite
5 ends of the cartridge B is guided on the regulation rib 17a of the main assembly guide 17, and the shaft portion 61a is guided on the regulation rib 17b of the main assembly guide 17 (Figure 19 (a)). As shown in Figure 19 (a), and, when the cartridge B moves into
10 the rotary member C from a guide 17, the free ends of the guide 60b, 61b bring into engagement with the guide grooves C2 (Figure 19 (b)) of the rotary member C. In this state, when the user imparts the force in a mounting direction, the cartridge B is moved into the
15 rotary member C. In this manner, the cartridge B is mounted to a mount position. In this case, the shaft portion 60a and the shaft portion 61a are positioned to the positioning portion (unshown) of the rotary member C. In other words the cartridge B is positioned
20 to the main assembly A on the basis of the developing roller 110.

In the case where the cartridge B is dismounted from the main assembly A, the reverse operation is carried out.

25 By the structure described above, the cartridge B is mounted in the direction crossing with the longitudinal direction of the cartridge B to rotary

member C (accommodating portion 130a). The drive shaft 180 is disposed at the longitudinal end of the rotary member C. Therefore, the drive shaft 180 and the coupling 150 engage and disengage the cartridge B mounted to rotary member C (accommodating portion 130a) relative to each other, and by moving in the direction substantially perpendicular to the direction of the axis L3 of the drive shaft 180 in response to the rotation of the rotary member C.

In addition, the rotation axis of the rotary member C of the present embodiment is swingable.

(9) Switching structure of developing cartridge (developing device)

Then, referring to Figure 20-Figure 23, the structure of the rotary member C will be described.

The Figure 20, Figure 22 and Figure 23 are front views (a) of the drive transmission mechanism, as seen from the drive shaft (180) side. (a) of Figure 20 illustrates the state that the developing roller 110-1 of the cartridge B1 is positioned in the developing position DP which opposes to the photosensitive drum 107. Figure 21 is a right side view of the cartridge shown in (a) of Figure 20. In (a) of Figure 22 and (a) of Figure 23, by the rotation of the rotary C in the direction X4 from the state shown in Figure 20, the cartridge B1 is in a post-development retracted position 18Y, and a pre-

development retracted position 18Z, respectively. The frame 171 shown in Figure 21 is not illustrated in (a) of Figure 20, (a) of Figure 22, and (a) of Figure 23. The transfer belt 104a, the transfer roller 104j, the coupling 150, and the drive shaft 180 shown in (a) of Figure 20, (a) of Figure 22, and (a) of Figure 23 are not illustrated in Figure 21.

(b) of Figure 20, (b) of Figure 22, and (b) of Figure 23 are perspective views, as seen from the drive shaft (180) side in the states of (a) of Figure 20, (a) of Figure 22, and (a) of Figure 23, respectively. In these views, the relation among the coupling 150, the regulating portion 160, and the drive shaft 180 is shown.

The drive transmission mechanism shown in Figure 20-Figure 23 sequentially moves the each of four cartridges B1-B4 supported on the rotary member C to the developing position DP which opposes to a photosensitive drum 2 by rotating the rotary member C. The structure of the drive transmission mechanism will be described.

A driving gear 172 is supported on a shaft 107 supported rotatably by the main assembly A rotatably. A gear 172 receives the rotational force from motor M (driving source) to rotate.

The a rotational-driving-force-transmitting mechanism M1 for transmitting the rotational force to

the gear 172 from the motor M is a gear train, for example, a belt with the gear tooth, but any structure that can transmit the rotational force is usable.

An arm 103 is a swingable member swingably
5 supported by the main assembly A. More particularly the one-end portion of the arm 103 is supported rotatably by the shaft 107 provided on the body frame 171. The one-end portion of an arm spring (compression
10 spring, for example), and (elastic material) 104 is mounted to the free end of the other end portion of the arm 103 which supports the rotary member C rotatably, and the other end portion of the arm spring 104 is fixed to the main assembly A. By this, the arm 103 receives an urging force (elastic force, and
15 rotational force) about the axis of the shaft 107 by the elastic force of an arm spring 104 in the direction (Figure 20, Figure 22, Figure 23) of the arrow A.

As has been stated in the foregoing, the rotary
20 member C supports four cartridges B (B1-B4), and is supported rotatably on the arm 103. In this manner, the cartridge B is mounted to the rotary member C. The coupling 150 (150-1-150-4) of the cartridge B (B1-B4) which the rotary member C supports projects from the
25 rotary member C (Figure 20, Figure 22, Figure 23). By this, the rotational force is transmitted from the drive shaft 180 unintegral with the rotary member C to

the coupling 150 (150-1-150-4). More particularly, the transmission of the rotational force is possible from the drive shaft 180 to cartridge B (B1-B4). The cartridge B1 is provided with a coupling 150-1. The
5 cartridge B-2 is provided with a coupling 150-2, a cartridge B3 is provided with a coupling 150-3, and a cartridge B4 is provided with a coupling 150-4. The couplings have the structures similar to the coupling 150 described above.

10 The rotary member C is provided with a gear portion (rotatable supporting member gear) 102a, which is extended along the circumferential direction which is the rotary member C. The gear portion 102a engages with the driving gear 172. In other words, the rotary
15 member C is rotated in the direction of the arrow X4 by the rotation, in the direction (Figure 20, Figure 22, and Figure 23) of the arrow A, of the driving gear 172. And, the rotary member C is stopped by the stoppage of the rotation of the gear 172.

20 A regulation roller 105 is supported rotatably by a roller holder 106 provided on the main assembly A. The regulation roller 105 is a regulation member for regulating the swinging motion of the rotary member C. The noise reduction, and the assured rotation because
25 of a high friction coefficient can be accomplished if the surface layer of the regulation roller 105 is a rubber layer which has elasticity.

A roller 105 has an elasticity, and is supported rotatably by a shaft 106a securedly fixed in the main assembly A. The shaft 106a supporting the roller 105 is extended in parallel with the rotation
5 axis of the rotary member C. When the rotary member C rotates, the roller 105 is contacted to a contact portion 101e-101h of the cam 101 as will be described hereinafter to be rotated.

A cam (rotatable member) 101 is rotated
10 integrally with the rotary member C (guiding member). The cam 101 includes the contact portion 101e-101h contactable to the roller 105, and the spacing portion (contact releasing portion) 101a-101d which is not contacted to the roller 105. The spacing portion 101a-
15 101d is a recess which has the substantially same configuration as an outer configuration of the roller 105. The contact portion 101e-101h, and the spacing portion (recess) 101a-101d are alternately disposed along the outer surface of the cam 101 at the
20 substantially regular angle intervals as seen from a rotation axis 101i of the cam 101. The cam 101 is provided at the end with respect to the longitudinal direction of the cartridge B1-B4 supported on the rotary member C, and it is integral with the rotary
25 member C.

The spacing portion 101a-101d is provided as a recess in each of two or more positions along the

rotational direction X4 (Figure 20, Figure 22, Figure 23) of the cam 101. The recess is provided with an inclined surface 101m which ascends toward an upstream side from a downstream side, in the upstream side with respect to the rotational direction X4. By providing the inclined surface 101m (Figure 20, Figure 22, Figure 23), when the cartridge B1-B4 separates in the direction crossing with the rotational direction in accordance with the rotation of the rotary member C, the operation is carried out smoothly. More particularly, in response to the rotation of the rotary member C, when the cartridge B1-B4 separates in the radial direction (radial direction) of the rotary member C from the developing position DP, the smooth movement is carried out.

Similarly, the recess is provided with an inclined surface 101n (Figure 20, Figure 22, Figure 23) lowered toward the upstream side from the downstream side, in the downstream side with respect to the rotational direction X4. By providing the inclined surface 101n, when the cartridge B1-B4 moves in the direction crossing with the rotational direction X4 toward the developing position DP in accordance with the rotation of the rotary member C, it can be moved smoothly. In other words when the cartridge B1-B4 moves in the radial direction (radial direction) of the rotary member C toward the

developing position DP in accordance with the rotation of the rotary member C, the smooth movement is carried out.

The cam 101 is rotated integrally with the
5 rotary member C. By the contact portion 101e contacting to a regulation roller (regulation member) 105, the developing roller 110-1 of the cartridge B1 is spaced from the photosensitive drum 107. When another contact portion 101f - 101h contacts to the
10 regulation roller 105, it separates from the developing roller (110-1-110-4) of the cartridge (B1-B4) photosensitive drum 107 (Figure 22, Figure 23).

As shown in Figure 21, the cam (rotatable member) 101 rotary member (rotatable supporting
15 member) C, the arm (swingable member) 103, and the regulation roller (regulation member) 105 are disposed at each of the one longitudinal end portion, and the other longitudinal end portion of the cartridge B1.

The states shown in Figures 22 and 23 are the
20 states in which the rotary member C rotates as will be described hereinafter. However, in addition, the states shown in Figures 22 and 23 are the state that the rotation of the rotary member C is at rest is in † retracted position. Here, the retracted position is
25 the position in which none of the cartridges B1-B4 carries out the developing operation. As shown in Figures 22 and 23, in this state, any of developing

rollers 110-1-110-4 do not contact to the photosensitive drum 107. For example, in Figure 22, the developing roller 110-1 is in the retracted position 18Y at the downstream side of the roller 105.

5 Similarly, in Figure 23, the developing roller 110-1 is in the retracted position 18Z at the upstream side of the roller 105. In the retracted position, the roller 105 supports the lower portion of the rotary member C in the one-end portion. In addition, the

10 roller 105 supports the lower portion of the rotary member C in the other end portion. By this, the rotary member C which supports the cartridges B1-B4 is restricted in the swinging motion by the roller 105. The retracted position 18Z is the position which is

15 the same as the waiting position HP described above.

As shown in Figure 20, on the other hand, and the roller 105 opposes in the state that it separates from the bottom surface of the recess (spacing portion) 101a in the state that the developing roller

20 110-1 contacts to the photosensitive drum 107. This state is the state that the cartridge B1 is positioned in the developing position DP. In this state, a developing roller 110-2 contacts to the photosensitive drum 107, and the roller 105 separates from the bottom

25 surface of a recess 101b. Similarly, the roller 105 separates from the bottom surface of a recess 101c in this state. In addition, the roller 105 separates from

the bottom surface of a recess 101d in this state. In other words the cam 101 spaces from the regulation roller 105.

Figures 20 and 21 illustrate the state during development, wherein the roller 105 is positioned adjacent to a recess 101a (- 101d). And, the recess 101a (- 101d) is positioned so that the roller 105, and the cam 101 do not contact with each other. Accordingly, the arm 103 urged by the elastic force of the spring 104 urges the rotary member C. And, this urging force (elastic force) provides a contact pressure between each of the developing rollers (110-1- 110-4) and the photosensitive drum 107.

The driving gear 172 receives the rotational force from the motor M to rotate in the direction of the arrow A. Then, as has been described hereinbefore, the rotary member C is rotated in the direction of the arrow X4. The cam 101 provided on the rotary member C is also rotated in the direction of the arrow X4 integrally with the rotary member C. Figures 22 and 23 show the state in which the rotary member C rotates by receiving the rotational force of the driving gear 172. In Figure 22, the developing operation finishes in the cartridge B1, the cartridge B1 retracts from the developing position DP to the post-development retracted position 18Y, and the cartridge B-2 moves toward the developing position DP from the pre-

development retracted position 18Z. Similarly, in Figure 23, the development finishes in the cartridge B4, the cartridge B4 retracts from the developing position DP to the post-development retracted position 18Y, and the cartridge B1 moves toward the developing position DP from the pre-development retracted position 18Z.

In addition, the rotary member C is provided with the gear portion (rotatable supporting member gear) 102a on the outer periphery. A driving gear (swingable member gear) 172 is provided co-axially with the rotation axis 103a of the arm 103. By this, the gear 172, and the gear portion 102a are engaged with each other. Therefore, even while the arm 103 swings, the gear 172, and the gear portion 102a are always in the engaging state with each other.

The rotation axis 103a is the axis of a shaft 172a which supports the gear 172 rotatably. The shaft 172a is securedly fixed to the body frame 171. The end of the arm 103 is mounted rotatably to the shaft 172a.

As has been described in the foregoing with Figures 20, 22 and 23, the elastic force (urging force) of the spring 104 press-contacts the developing roller 110-1 to the photosensitive drum 107. By the rotary member C rotating from this state, a press-contact state between the developing roller 110-1, and the photosensitive drum 107 is released. And, when the

press-contact state is released, the urging force of the spring 104 press-contacts the cam 101 to the roller 105. By this, the cam 101 can be assuredly contacted to the roller 105.

5 The outer surface other than the spacing portion (recess) 101a-101d 101 is the contact portion 101e-101h contacted by the roller 105 as described above. In the state that the contact portion 101e-101h contacts to the roller 105, the cartridge B1-B4 does
10 not contact to the photosensitive drum 107. Accordingly, the cartridge B1-B4 can sequentially be moved, without the influence to the photosensitive drum 107, to the developing position. The contact portion 101e-101h, and the spacing portion 101a-101d
15 are alternately disposed along the rotational direction of the cam 101 (rotary member C). A distance L10 between the spacing portion 101a-101d, and the rotation axis 101i of the cam 101 is shorter than a distance L2 between the contact portion 101e-101h, and
20 the rotation axis 101i of the cam 101 (Figure 22, Figure 23). When the cartridge (B1-B4) is moved to the developing position DP, a controller (unshown) blocks the rotational force of the driving gear 172 so that the rotary member C stops the rotation. The cartridge
25 B1 reaches the developing position DP. The developing roller 110-1 (- 110-4), and the photosensitive drum 107 press-contact to each other in this developing

position DP. As shown in Figure 20, in this state, the roller 105 opposes in the state of being away from the spacing portion (recess) 101b (-101d) of the cam (101). In other words the spacing portion 101b (- 101d), and
5 the roller 105 are spaced. While repeating such an operation, the cartridges B1-B4 sequentially move to the developing position DP. In this embodiment, a gap G (Figure 2) between the roller 105 and the bottom surface of the recess 101b as the spacing portion is
10 approx. 1.5mm.

In this manner, in this embodiment, the rotary member C is provided with the cam 101 which has the contact portion 101e-101h, and the spacing portion 101a-101d integrally, and the main assembly A is
15 provided with the roller 105. By this, only by rotating the rotary member C, cartridge B1-B4 (developing roller 110-1-110-4) can be contacted, and spaced relative to the photosensitive drum 107 while carrying out the planet movement of the cartridge B1-
20 B4.

Here, referring to Figures 20, 22 and 23, the description will be made as to the operation of the coupling 150.

In the case where the cartridge B is in the
25 pre-development retracted position 18Z (Figure 23), the coupling 150 is in the pre-engagement angular position by the elastic force of the spring 159

described above (Figure 23). As shown in (b) of Figure 23, at this time, the portion-to-be-regulated 150j contacts to the positioning portion 160b1 of the accommodating portion 160b so that the angular position of the coupling 150 is restricted. In other words the coupling 150 is restricted to the pre-engagement angular position. In this manner, the intermediate portion 150c of the coupling 150 is urged by the elastic force of the spring 159. In this manner, the coupling 150 is urged so that the portion-to-be-regulated 150j contacts to the positioning portion 160b1 by the elastic force of the spring 159. And, the inclining direction of the coupling 150 is restricted toward the pre-engagement angular position in the state that the portion-to-be-regulated 150j is positioned by the positioning portion 160b1. Therefore, the coupling 150 inclines to the pre-engagement angular position by the elastic force (Figure 23).

In this state, the rotary member C rotates in the direction X4, and the cartridge B1 in the process in which it moves from the pre-development retracted position 18Z (Figure 23) to developing position DP (Figure 20), the coupling 150 is brought into engagement with the drive shaft 180. And, the coupling 150 is moved from the pre-engagement angular position (Figure 23) to the rotational force transmitting angular position (Figure 20).

In the case where the cartridge B1 is positioned in the developing position DP (Figure 20), the coupling 150 is in the rotational force transmitting angular position, and is in engagement
5 with the drive shaft 180. The coupling 150 receives the rotational force from the drive shaft 180. As shown in Figure 20 (b), at this time, the portion-to-be-regulated 150j is in the permitting portion 160b2 of the accommodating portion 160b without contacting
10 to the wall 163b3. And, the position of the coupling 150 is determined by the engagement with the drive shaft 180.

With the operation of engaging with the drive shaft 180 while the rotary member C rotates in the
15 direction X4, the coupling 150 is moved from the pre-engagement angular position to the rotational force transmitting angular position. With this, the portion-to-be-regulated 150j is moved in the permitting portion 160b2 from the position of contacting to the
20 positioning portion 160b1 against the elastic force of the spring 159. The portion-to-be-regulated 150j is not contacted to the wall 163b3 of the permitting portion 160b2.

By this, the coupling 150 becomes in the state
25 revolvable substantially from the state of being in the pre-engagement angular position.

The rotary member C is stopped in the state

that the coupling 150 is in engagement with the drive shaft 180. In other words the drive shaft 180 is provided, so that it engages with the coupling 150 at the stop position of the rotary member C in the
5 developing position DP.

In the state shown in Figure 20, the rotary member C rotates in the direction X4. In the process in which the cartridge B moves from developing position DP (Figure 20) to the post-development
10 retracted position 18Y (Figure 22), the coupling 150 is moved from the rotational force transmitting angular position ((b) of Figure 20) to the disengaging angular position ((b) of Figure 22). With this, the engagement between the coupling 150 and the
15 drive shaft 180 is released, and the transmission of the rotational force to the coupling 150 from the drive shaft 180 is released. By this, the coupling 150 is disengaged from the drive shaft 180.

Immediately after the coupling 150 disengaged
20 from the drive shaft 180, the coupling is in the disengaging angular position (Figure 22). As shown in Figure 22 (b), at this time, the portion-to-be-regulated 150j is in the permitting portion 160b2 of the accommodating portion 160b without contacting to
25 the inner wall 163b3. And, the coupling 150 is in the disengaging angular position (Figure 22 (b)) for disengaging from the drive shaft 180.

When the position that the coupling 150 which is in the disengaging angular position does not interfere with the drive shaft 180 is reached, it is moved toward a pre-engagement angular position by the functions of the regulation member 160, and the spring 159. In other words the coupling 150 inclines to the pre-engagement angular position. As shown in Figure 23 (b), and, the portion-to-be-regulated 150j contacts to the positioning portion 160b1, so that the angular position of the coupling 150 becomes the pre-engagement angular position. This has been described hereinbefore.

With the rotation in the X4 direction, the rotary member C is moved also in the direction perpendicular to X4, i.e., the radial direction of the rotary member C, by the functions of the cam 101, and the roller 105 described above. Therefore, the cartridge B is moved not only in the rotational direction X4 of the rotary member C, but also in the radial direction of the rotary member C, in the case where the cartridge B moves to the rotational force transmitting angular position from the pre-engagement angular position, and in the case where it moves from the rotational force transmitting angular position to the disengaging angular position. The movement of the cartridge B to the rotational force transmitting angular position from the pre-engagement angular

position is the movement of the cartridge B to developing position DP (Figure 20) from the pre-development retracted position 18Z (Figure 23). The movement of the cartridge B to the disengaging angular position from the rotational force transmitting angular position is the movement of the cartridge B to the post-development retracted position 18Y (Figure 22) from developing position DP (Figure 20).

Here, the driving portion 150b of the coupling 150 is moved along a locus provided by the combination of the movement in a circumferential direction X4 of the rotary member C, and the movement in the radial direction of the rotary member C perpendicular thereto, similarly to the cartridge B. On the other hand, and the driven portion 150a of the coupling 150 is moved following the drive shaft 180. Therefore, a pivoting locus of the coupling 150 differs from the mere interrelation between the driving portion 150b which is the pivoting fulcrum thereof, and the driven portion 150a which is the end of the pivoting. More particularly, the driving portion 150b which is the pivoting fulcrum thereof, and the driven portion 150a which is the end of the pivoting do not operate interrelatedly with each other in the pivoting locus (movement locus) of the coupling 150. At this time, the portion-to-be-regulated 150j for regulating a pivoting direction of the coupling 150 is in the

permitting portion 160b2. Therefore, the portion-to-be-regulated 150j can freely move without interference with the wall 160b3 thereof. In other words the coupling 150 is revolvable substantially. More particularly, the configuration of the accommodating portion 160b is, such that in the case where the coupling 150 is in the position other than the pre-engagement angular position, the pivoting is not prevented, and only in the case where the coupling 150 is in the pre-engagement angular position, the inclining direction of the coupling 150 is regulated. By this, the stress imparted on the portion-to-be-regulated 150j can be minimized.

In other words, in the case where the coupling 150 is in the pre-engagement angular position, the pre-engagement angular position is determined by the regulating portion 150j and the positioning portion 160b1. By this, the inclining direction of the coupling 150 is determined. In the case where the coupling 150 carries out the engagement and disengagement operation relative to the drive shaft 180, the portion-to-be-regulated 150j is in the permitting portion 160b2, and the operation thereof is not regulated. In this manner, the coupling 150 is revolvable substantially in the case where the portion-to-be-regulated 150j is positioned in the permitting portion 160b2. Therefore, the coupling 150

can be engaged and disengaged relative to the drive shaft 180 without imparting large stress to the coupling 150.

As has been described hereinbefore, the
5 rotation axis 101i of the rotary member C of the present embodiment is swingable. Also in such a rotary member C, the cartridge B of the present embodiment is assured in the engagement between the drive shaft 180 and the coupling 150. In addition, the disengagement
10 between the drive shaft 180 and the coupling 150 is also assured.

This is one of the remarkable effects of the present embodiment.

As has been described hereinbefore, the
15 coupling 150 is revolvable (swingable) over the full-circumference thereof substantially relative to the axis L4. More particularly, the coupling 150 is pivotable substantially in all directions relative to the axis L4.

20 Here, a revolution of the coupling is that a coupling itself does not rotate about the axis L2 of the coupling, and the axis L2 which inclined rotates about the axis L4 (the state of the revolution is shown in Figure 13F). However, it does not exclude the
25 case in which the coupling itself rotates about the axis L2 in the range of play or a gap provided positively.

In addition, it has been described hereinbefore that the axis L2 is inclinable in any directions relative to the axis L1. However, the coupling 150 is not necessarily inclinable linearly to the
5 predetermined angle in any of the direction in 360 degrees.

In addition, as has been described hereinbefore, the coupling is revolvable substantially. More particularly, as for the coupling, the cotton is
10 pivotable in all directions substantially. The coupling is revolvable substantially, and therefore, when a user mounts the cartridge B to the main assembly A, the coupling can move (pivot) to the rotational force transmitting angular position
15 irrespective of the stoppage phase of the drive shaft which has the rotational force applying portion.

In addition, when the user dismounts the cartridge from the main assembly A, the coupling can move (pivot) to the disengaging angular position
20 irrespective of the stoppage phase of the drive shaft.

In addition, the gap is provided between the pin (rotational force transmitting part) 155, and the rotational force reception surface (rotational force transmitted portion) 147h in the coupling 150 (Figure
25 8C) so that it is inclinable in all directions substantially relative to the axis L4. In this manner, the coupling 150 is mounted to the longitudinal end

portion of the cartridge B. Therefore, the coupling 150 is inclinable in all directions substantially relative to the axis L4.

In addition, in this embodiment, as has been
5 described heretofore, the engaging operation between the drive shaft 180 and the coupling 150 is completed while the rotary member C rotates or immediately after the rotary member C stops. And, the rotation of the developing roller 110 is enabled.

10 More particularly, before the coupling 150 starts the engagement with the drive shaft 180, the coupling 150 starts the rotation simultaneously with the engagement with the drive shaft 180. By this, the developing roller 110 begins the rotation. In addition,
15 in the case where the drive shaft 180 is at rest, the coupling 150 is at rest, without rotating even after the completion of the engagement between the coupling 150, and the drive shaft 180. And, when the drive shaft 180 begins the rotation, the coupling 150 begins
20 the rotation. Furthermore, the developing roller 110 also begins the rotation.

In any case, according to this embodiment, it is not necessary to make the member for transmitting the rotational force of the main assembly side (main
25 assembly side coupling, for example) advance, and retract in the axial direction thereof. Therefore, the time required for an image forming operation

(development) can be shortened. In this embodiment, before the engaging operation, with the drive shaft 180, of the coupling 150 starts, the drive shaft 180 is rotated. Therefore, the image forming operation can
5 be started promptly. Accordingly, as compared with the case where the drive shaft 180 is at rest, the time required for the image formation can further be shortened.

In this embodiment, in the state that the drive
10 shaft 180 rotates, the coupling 150 can be disengaged from the drive shaft 180.

Therefore, according to the present embodiment, the developing roller 110 can be contacted to the photosensitive drum 107 while rotating the developing
15 roller 110, even in the case where the movement, in the direction perpendicular to the rotation axis thereof, of the drive shaft 180 is prohibited. In addition, even in the case where the drive shaft 180 is fixed to the main assembly in this manner, the
20 developing roller 110 can be disengaged from the photosensitive drum 107 while rotating the developing roller 110. This is because the coupling 150 receives the drive from the drive shaft 180 within the predetermined angle range (angle range in which the
25 rotational force transmission is possible) toward the both sides from the rotational force transmitting angular position (the angular position which the

developing roller 110, and the photosensitive drum 107 contact to each other). By this, the load imparted to the photosensitive drum 107 can be reduced at the time of the contact, and spacing of the developing roller
5 110.

In this embodiment, the stoppage of the drive shaft 180 may not be carried out in order to engage the coupling 150 with the drive shaft 180 or in order to disengage it from the drive shaft 180.

10 More particularly, according to the coupling 150 of the present embodiment, the engagement with the drive shaft 180 or the disengagement from the drive shaft 180 is possible while the drive shaft 180 rotates.

15 This is one of the remarkable effects of the present embodiment.

In this embodiment, the rotary member C is operated through the following step. The rotary member C swings toward a photosensitive drum 107 in the
20 radial direction thereof; a yellow image forming operation is carried out; the rotary member C swings in the direction away from the photosensitive drum 107 in the radial direction; and a rotation of the developing roller 110 stops. The swinging of the
25 rotary member C toward the direction of the photosensitive drum 107 in the radial direction is the swinging in the direction of contacting the developing

roller 110 to the photosensitive drum 107. In addition, the swinging of the rotary member C away from the direction of the photosensitive drum 107 in the radial direction is the swinging in the direction of
5 separating the developing roller 110 from the photosensitive drum 107. Simultaneously with the start of the rotation of the rotary member C, the coupling 150 is disengaged from the drive shaft 180, and the developing operation for a second color is prepared.

10 In this embodiment, the operations of the engagement and disengagement of the coupling relative to the drive shaft 180 are operated interrelatedly with the rotation of the rotary member C 150. Therefore, the time required between the development
15 for the first color, and development for the second color Development can be shortened. Similarly, reduction can be accomplished between the development for the second color, and the development for a third color, between the development for the third color,
20 and the development for a fourth color, between the home position and the development for the first color, and between the development for the fourth color and the home position. Therefore, the time required to produce the one color image can be shortened.

25 This is one of the remarkable effects of the present embodiment.

The present embodiment is applicable also to

the case where the rotary member C rotates in the opposite direction from the rotational direction X4.

In the case where the rotary member C rotates in the opposite direction from the rotational direction X4 in the state shown in Figure 20, the engagement and disengagement between the coupling 150, and the drive shaft 180 are possible in the process that the cartridge B1 moves from developing position DP (Figure 20) to the pre-development retracted position 18Z (Figure 23). More particularly, the coupling 150 can disengage from the drive shaft 180 by an inverse rotation of the rotary member C. In this case, the coupling 150 is moved from a drive transmission angular position to the pre-engagement angular position in the process of disengaging from the drive shaft 180. By rotating thereafter the rotary member C in a direction of the rotational direction X4, the coupling 150 becomes engageable with the drive shaft 180.

(10) Engaging operation, rotational force transmitting operation, and Disengaging operation of Coupling

As has been described in the foregoing, the coupling 150 engages with the drive shaft 180 (from Figure 23 to Figure 20) immediately before the cartridge B stops at the predetermined position of the main assembly A or substantially simultaneously with the stoppage at the predetermined position. After the

rotation of the coupling 150 for predetermined time,
the coupling 150 is disengaged from the drive shaft
180 (from Figure 20 to Figure 22) when the cartridge B
moves from the predetermined position in the main
5 assembly A.

Referring to Figure 24-Figure 28, the
description will be made as to the engaging operation
of the coupling with the drive shaft 180, the
rotational force transmitting operation, and the
10 disengaging operation.

Figure 24 is a longitudinal sectional view
illustrating the drive shaft 180, the coupling 150,
and the gear 147. Figure 25 is a longitudinal
sectional view illustrating a phase difference among
15 the drive shaft 180, the coupling 150, and the gear
147. Figure 27 is a longitudinal sectional view
illustrating the drive shaft 180, the coupling 150,
and the gear 147. (a) of Figure 28 is a front view of
the coupling 150, the developing roller 110 and a RS
20 roller 115 in the case where the coupling 150 is in
the pre-engagement angular position, as seen from the
drive shaft (180) side. (b) of Figure 28 is a front
view of the coupling 150, the cartridge B, and the
rotary member C in the case of the coupling 150 being
25 in the pre-engagement angular position, as seen from
the drive shaft (180) side.

In the process that the cartridge B moves to

the developing position DP by the rotation of the rotary member C, the coupling 150 is in the pre-engagement angular position. More particularly, the coupling 150 is inclined by the spring (urging member, and elastic member) 159, so that the driven portion 150a is positioned in the downstream side with respect to the rotational direction X4, relative to the axis L4, of the gear 147. More particularly, in the pre-engagement angular position, the driven portion 150a is positioned in the downstream side, with respect to the rotational direction X4, of the driving portion 150b. In this embodiment, in the case where the coupling 150 is in the pre-engagement angular position, the axis L2 of the coupling 150 is positioned between the line L5, and the line L6 as seen from the drive shaft (180) side, (Figure 28 (a)). Here, the line L5 is a line through the center (axis L4) of the gear 147, and the center of the developing roller 110 (axis L1). The line L6 is a line through the center of the gear 147, and the center of the supplying roller 115. Therefore, the axis L2 is positioned between the developing roller 110, and the developer supply roller 115 ((a) of Figure 28). And, the axis, 12 is in the downstream side with respect to the rotational direction X4 of the rotary member C relative to a tangent line L5 of a circle C3 which is concentric with the rotary member C, and which passes along the

center of the driving portion 150b, and faces the outside with respect to the radial direction of the rotary member C, (Figure 28 (b)). By an inclination of the coupling 150, the a downstream free end position 150A1 with respect to the rotational direction X4 of the rotary member C is nearer than the free end 180b3 of the drive shaft to the gear 147 in a direction of the axis L4. In addition, the upstream free end position 150A2 with respect to the direction X4 is nearer than the free end 180b3 of the drive shaft to the pin 182 in the direction of the axis L1, ((a) and (b) of Figure 24). Here, the free end position is remotest from the axis, L2 in the nearest side to the drive shaft with respect to the direction of the axis L2 in the driven portion 150a, shown in (a), and Figure 7C. In other words, it is either an edge line of the driven portion 150a or an edge line of the driven projection 150d (in Figure 7A and Figure 7C, 150A) depending on the rotational phase of the coupling 150.

First, in the rotational direction (X4) of the rotary member C, the downstream free end position 150A1 passes an end 180b3 of an axis. And, after the coupling 150 passes the drive shaft 180, the conical receiving surface 150f or the projection 150d of the coupling 150 is brought into contact to the free end portion 180 or the pin 182 of the drive shaft 180.

In response to the rotation of the rotary member C, it is inclined (Figure 24 (c)) so that the axis L2 is parallel to the axis L4. Here, the rotary member C stops the rotation temporarily in the state of Figure 24 (c). At this time, the coupling 150 is between the pre-engagement angular position, and the drive transmission angular position. And, the coupling 150 is in the angular position where the rotational force can be transmitted if the two projections 150d and pins 182 contact to each other. When the rotary member C is at rest, the drive shaft 180 is rotated, and the gap between the pin 182 which is positioned in the entrance portion 150k and the projection 150d is reduced. Depending on a rotational phase difference between the coupling 150, and the drive shaft 180, the transmission of the rotational force to the coupling 150 from the drive shaft 180 is started during the temporary stop. And, the transmission of the rotational force is started from the drive shaft 180 to the coupling 150 by the time of reaching the stop position (Figure 24 (c)) of the rotary member C as will be described below.

And, finally the position of the cartridge B is determined relative to the main assembly A. In other words the rotary member C stops the rotation. At this time, the drive shaft 180, and the gear 147 are substantially co-axial with each other. More

particularly, the coupling 150 is moved pivoted, swung, revolved from the pre-engagement angular position to the rotational force transmitting angular position so as to permit the free end position 150A1 to circumvent
5 the drive shaft 180. And, the coupling 150 inclines toward the rotational force transmitting angular position from the pre-engagement angular position where the axis L2 is substantially co-axial with the axis L1. And, the coupling 150, and the drive shaft
10 180 are engaged with each other (Figure 24 (c)). In other words, a part of the driven portion 150a moves to a position behind the drive shaft 180 as seen along the movement direction. More particularly, the recess 150z covers the free end portion 180b. By this, the
15 stabilized rotational force is transmitted from the drive shaft 180 to the coupling 150. At this time, the pin 155 is positioned in an opening 147g. The pin 182 is positioned in the entrance portion 150k.

In this embodiment, the drive shaft 180 is
20 already rotated at the time when the coupling 150 starts the engagement relative to the drive shaft 180. For this reason, the coupling 150 begins the rotation immediately.

As has been described in the foregoing,
25 according to this embodiment, the coupling 150 is inclinable relative to the axis L4. In the case where the portion-to-be-regulated 150j is positioned in the

permitting portion 160b2, the coupling 150 is
revolvable substantially relative to the axis L4.
Therefore, in accordance with the rotation of the
rotary member C, the coupling 150 can be engaged
5 relative to the drive shaft 180 without interfering
with the drive shaft 180 by the coupling 150 itself
inclining.

Furthermore, in this embodiment, as has been
described hereinbefore, the drive shaft 180 always
10 rotates. For this reason, at the time of an engaging
operation, the rotational phase of the drive shaft 180
is always changing, and the phase relation between the
drive shaft 180 and the coupling 150 is not constant.
Even in such a case, the engaging operation of the
15 coupling 150 described above is possible irrespective
of the phase difference between the drive shaft 180
and the coupling 150. Referring to Figure 25, the
description will be made as to this engagement. Figure
25 is a view illustrating the phases of the coupling
20 150 and the drive shaft 180. (a) of Figure 25 is a
view in the state where the pin 182, and the driving
shaft receiving surface 150f opposes to each other in
the upstream side with respect to the rotational
direction X4, of the rotary member C. The pin 182 and
25 the projection 150d of the coupling 150 face to each
other in (b) of Figure 25. (c) of Figure 25 is a view
in the state where the free end portion 180b of the

drive shaft and the projection 150d of the coupling 150 oppose to each other. (c) of Figure 25 is a view in the state where the free end portion 180b and the receiving surface 150f opposes to each other. As shown

5 in Figure 10A1-A5, 10B1-B5, the coupling 150 is inclinable in all directions relative to the gear 147. More particularly, the coupling 150 is revolvable substantially. As shown in Figure 25, for this reason, the coupling 150 can incline in a mounting direction

10 X4 irrespective of the phase of the gear 147 relative to the rotational direction X4. Independently from the phases of the drive shaft 180, and the coupling 150, the downstream free end position 150A1 with respect to the rotational direction X4 of the rotary member C is

15 nearer than the free end 180b3 of the drive shaft to a cartridge B, and it is in the downstream side with respect to the rotational direction X4, of the rotary member C. The upstream free end position 150A2 with respect to the rotational direction X4 is near than

20 the free end 180b3 of the drive shaft to the pin 182, by setting the inclination angle of the coupling 150. With such a setting, in response to a rotating operation of the rotary member, c, the downstream free end position 150A1 with respect to the rotational

25 direction X4, passes by the free end 180b3, of the drive shaft. And, in the case of (a) of Figure 25, the driving shaft receiving surface 150f contacts to the

pin 182. In the case shown in (b) of Figure 25, the projection 150d contacts to the pin 182. In the case shown in (c) of Figure 25, the projection 150d contacts to the free end portion 180b. In the case shown in (c) of Figure 25, the receiving surface 150f contacts to the free end portion 180b. By a contact force (urging force) produced when the rotary member C rotates, the axis L2 approaches to the position in parallel with the axis L4, and they engage with each other. Therefore, they can be engaged with each other, irrespective of the phase difference between the drive shaft 180 and the coupling 150 or the phase difference between the coupling 150 and the gear 147.

Referring to Figure 26, the rotational force transmitting operation at the time of rotating the developing roller 110 will be described.

By the rotational force received from the motor (unshown) the drive shaft 180 is rotated with the gear (helical gear) 181 in the X8 direction in the Figure. And, the pin 182 integral with the drive shaft 180 contacts to a rotational force reception surface 150e1, 150e2 of the coupling 150 to rotate the coupling 150. As has been described hereinbefore, the coupling 150 can transmit the rotational force to the developing roller 110 through the gear 147. For this reason, by the rotation of the coupling 150, the rotational force is transmitted to the gear 145 mounted to a shaft 110b

of the developing roller 110 through the gear 147. By this, the developing roller 110 is rotated.

Because the coupling 150 inclines slightly, the coupling can be rotated without applying a large load
5 to the developing roller 110 or the drive shaft 180.

This is one of the remarkable effects of the embodiment.

Referring to Figure 27, the description will be made as to the disengaging operation from the drive
10 shaft 180 of the coupling 150 in accordance with the movement from the predetermined position (developing position DP) of the cartridge B by the unidirectional rotation of the rotary member C.

First, the position of the rotational force
15 transmitting pin at the time of the cartridge B moving from the predetermined position will be described. When the image formation finishes, as will be apparent from the foregoing description, the pins 182 are positioned in the entrance portions 150k1, 150k2. And,
20 the pins 155 are positioned in the opening 150g 1 or 150g2.

The disengaging operation of the coupling 150 from the drive shaft 180 will be described in interrelation with the operation (Figure 20-Figure 22)
25 for changing to the next developing cartridge B, after the cartridge B finishes an image forming operation.

In the state in which the image forming

operation has finished, the coupling 150 is in the rotational force transmitting angular position where the axis L2, and the axis are substantially co-axial ((a) of Figure 27). The gear 147 moves in the

5 rotational direction X4 with the cartridge B. The upstream receiving surface 150f or projection 150d contacts to the free end portion 180b of the drive shaft 180, or the pin 182 in the rotational direction X4. And, the axis, l2 starts the inclination toward

10 the upstream side with respect to the rotational direction X4, (Figure 27 (b)). The inclining direction at this time is opposite, with respect to the gear 147, to the engaging direction with the drive shaft 180. In other words the inclining direction is away from the

15 pre-engagement angular position beyond the axis L4. By the rotating operation of the rotary member, c, the upstream side free end portion 150A2 moves with respect to the rotational direction X4 while

20 contacting to the free end portion 180b, of the drive shaft 180. And, the axis L2 inclines to the disengaging angular position (Figure 27 (c)), such that the upstream side free end portion 150A2 reaches the free end 180b3. In this state, while contacting to the free end 180b3, the coupling 150 passes by the

25 free end 180b3 (Figure 27 (c)). More particularly, the coupling 150 is moved from the rotational force transmitting angular position to the disengaging

angular position, so that the a part of coupling 150 (upstream free end position 150A2) which is in the upstream side of the drive shaft 180 with respect to the rotational direction X4, circumvents the drive shaft 180. In other words, a part of driven portion 150a behind the drive shaft 180 as seen in the direction opposite the rotational direction x4 retracts from behind the drive shaft 180, and moves to the downstream side of the drive shaft 180 in the rotational direction X4. Thereafter, the cartridge B moves in accordance with the rotation of the rotary member C so that the state becomes as shown in Figure 22.

Furthermore, by the time the rotary member, c carries out one full turn, the coupling 150 is inclined by the urging member 159 described above, so that the axis L2 thereof inclines toward the downstream side with respect to the rotational direction X4. In other words, the coupling 150 is moved from the disengaging angular position to the pre-engagement angular position. By doing so, after the rotary member C carries out the one full turn, the coupling 150 is engageable again with the drive shaft 180.

As will be apparent from the foregoing description, the angle, at the pre-engagement angular position, of the coupling 150 relative to the axis L4

is larger than the angle at the disengaging angular position. This is because, the pre-engagement angular position is set beforehand, such that at the time of an engagement of the coupling, the distance between
5 the upstream free end position 150A1, and the free end portion 180b3 of the drive shaft is relatively large with respect to the rotational direction X4((b) of Figure 24). By this, dimensional tolerances of the parts are provided. On the contrary, at the time of a
10 coupling disengagement, the axis L2 inclines in interrelation with the rotation of the rotary member C in the disengaging angular position. For this reason, the free end portion 180b3 of the drive shaft is substantially the same as the downstream free end
15 position 150A2 with respect to the rotational direction X4, in the direction of the axis L1, ((c) of Figure 27).

Also when the coupling 150 disengages from the drive shaft 180, the coupling 150 can be disengaged
20 from the drive shaft 180, irrespective of the phase difference between the coupling 150 and the pin 182.

The rotational force transmitting angular position of the coupling 150 is such an angular position of the coupling 150 relative to the gear axis
25 L4 that the cartridge B is in the predetermined position, and can be rotated by the coupling 150 receiving the rotational force from the drive shaft

180. Here, the predetermined position is the position (developing position DP) which opposes to the photosensitive drum. More particularly, the rotational force transmitting angular position is such an angular position relative to the axis L4 that the coupling 150 can be rotated by receiving the rotational force from the drive shaft 180. The pre-engagement angular position of the coupling 150 is such an angular position of the coupling 150 relative to the axis L4 that immediately before the coupling 150 engages with the drive shaft 180 in the process that the cartridge B moves to the predetermined position in accordance with the rotation of the rotary member C. More particularly, the pre-engagement angular position is an angular position relative to the axis L4 immediately before the coupling 150 engages with the drive shaft 180. The disengaging angular position of the coupling 150 is such a angular position of the coupling 150 relative to the axis L4 that when the coupling 150 disengages from the drive shaft 180 in the process that the cartridge B moves from the predetermined position in response to the rotation of the rotary member C. More particularly, the disengaging angular position is an angular position relative to the axis L4 in the case the coupling 150 disengages from the drive shaft 180.

In the engagement angular position, and the

disengaging angular position, the angles β_2 , β_3
(Figure 24, Figure 27) between the axis L2 and the
axis L4 is larger than the angle between the axis L2
and the axis l1 β_1 in the rotational force
5 transmitting angular position. The angle β_1 is
preferably 0 degree. The angles β_2 and β_3 are
preferably 20 degrees - 60 degrees. The angle range in
which the rotational force transmission is possible
described above β_4 is approx. 20 degrees - 40 degrees
10 toward the both sides of the rotational force
transmitting angular position.

In this embodiment, the pre-engagement angular
position is between the rotation axis of the
developing roller 110, and the rotation axis of the
15 supplying roller 115. More particularly, in this
embodiment, the inclining direction of the coupling
150 which is in the pre-engagement angular position is
between the rotation axis of the developing roller 110,
and the rotation axis of the supplying roller 115.

20 By this, according to this embodiment, the
coupling 150 can be assuredly engaged with the drive
shaft 180 also in the rotary member having the
swinging rotation axis 101i.

According to the embodiment described above,
25 the drive shaft 180 and the coupling 150 are engaged
and disengaged relative to each other in the cartridge
B mounted to the rotary member C by moving in the

direction substantially perpendicular to the direction of the axis L3 by the rotation of the rotary member C. The cartridge B is mounted to the accommodating portion 130a provided in the rotary member C.

5 The substantial perpendicularity will be described here.

Between the cartridge B and the rotary member C, a small gap is provided in order to mount and demount the cartridge B smoothly. More specifically, the small
10 gap is provided, for example, between the guide 60b, and the guide C2, and between the guide 61b and the guide C2 with respect to the longitudinal direction. Therefore, when the cartridge B is mounted to the rotary member C, the whole cartridge B may slightly be
15 slanting within the limits of the gaps. In addition, when the rotary member C rotates, a small positional deviation may happen. Therefore, the engagement and disengagement between the drive shaft 180, and the coupling 150 may not be carried out by the movement of
20 the cartridge B in the strictly orthogonal direction. However, even in such a case, the present invention properly works as has been described hereinbefore. Therefore, also in the case where the cartridge B is slightly inclined, the state is substantial
25 perpendicularity.

(12) Coupling engaging operation and rotational force transmission

As has been described in the foregoing, the coupling 150 of the cartridge B is brought into engagement with the drive shaft 180 immediately before positioning to the predetermined position of the main assembly A or substantially simultaneously with the positioning to the predetermined position. More particularly, the coupling 150 is in the rotational force transmitting angular position. Here, in the state that the cartridge B is positioned in the predetermined position, the coupling 150 engages with the drive shaft 180.

As has been described hereinbefore, when the rotary member C rotates the coupling 150 is contacted to the drive shaft 180 in response to the movement of the cartridge B. By this, the portion-to-be-regulated 150j is moved to the permitting portion 160b2 from the regulating portion 160b1, in other words, the coupling 150 is moved to the rotational force transmitting angular position from the pre-engagement angular position. And, in the state that the coupling 150 is in the rotational force transmitting angular position, the coupling 150 transmits the rotational force received from the drive shaft 180 to the developing roller 110. By this, the developing roller 110 rotates.

When the rotary member C rotates furthermore, the coupling 150 is moved from the rotational force transmitting angular position to the disengaging

angular position in accordance with the movement of the cartridge B. By this, the coupling 150 disengages from the drive shaft 180.

As has been described hereinbefore, the
5 coupling 150 is mounted for inclining motion relative to the axis L4 of the gear, and it is inclined, without interfering with the drive shaft 180 in responses to the rotating operation of the rotary member C. By this, the coupling 150 can be disengaged
10 from the drive shaft 180.

Another embodiment will be described.

Referring to Figure 29 and Figure 30, another embodiment will be described.

In this embodiment, the other mounting
15 structure of the elastic material (urging member) 159 will be described. According to this embodiment, the coupling 150 can be further assuredly inclined in the direction of the pre-engagement angular position.

(a) of Figure 29 and (b) of Figure 29 are
20 perspective views illustrating the state of mounting the elastic material (urging member) 159 to the supporting member 157. (a) of Figure 30 is a perspective view of a cartridge drive portion. (b) of Figure 30 illustrates the example of the supporting
25 member 157 which has another configuration. In addition, in the examples shown in (a) of Figure 29, (b) of Figure 29 and (a) of Figure 30, the lateral

surface 157i of the supporting member 157 is provided with a projection 157n in addition to the structure of the embodiment described above. Furthermore, the projection 157n is provided with a recess 157n1

5 constituted by a surface 157n2, a surface 157n3, a surface 157n4 and a surface 157n5 (four surfaces). And, the free end portion (other end) 159a1 of the contact portion 159a of the spring 159 is accommodated in the recess 157n1, and is restricted in the movement toward

10 the axis L4 by the surface 157n2 and the surface 157n4. More particularly, the free end portion (other end) 159a1 enters in the recess 157n1, and is movable along the recess 157n1. The free end portion (other end) 159a1 is in engagement movably with the recess 157n1.

15 In addition, the lateral surface 157i of the supporting member 157 is provided with a projection 157o. In the case where the coupling 150 is in the pre-engagement angular position, the driven portion 150a of the coupling 150 contacts to the projection

20 157o. By this, the inclination angle position of the coupling 150 is determined. Here, the configuration of the recess 157n1 is as follows. More particularly, the recess 157n1 is extended along the locus of a free end portion 159a1 when the contact portion 159a moves in

25 the direction perpendicular to the axis L4, with the movement between the pre-engagement angular position and the disengaging angular position of the coupling

150.

The recess 157n1 does not prevent the movement of the free end portion 159a1 in the direction perpendicular to the axis L4. However, the movement of
5 the free end portion 159a1 in the direction of the axis L4 is restricted by the surface 157n2 and the surface 157n4.

When the coupling 150 is in the pre-engagement angular position, and the spring 159 elastically urges
10 the coupling 150 by the contact portion 159a, the contact portion 159a receives a reaction force F including a force $F1$ in the direction of the axis L4 from the coupling 150. (a) of Figure 30 shows this state. However, the free end portion 159a1 is
15 restricted in the movement in the direction of the axis L4 by the surface 157n4 of the recess 157n1. By this, the contact portion 159a does not tilt in the direction of the axis L4 by the force $F1$. Similarly, in the case where the coupling 150 is in the angular
20 position other than the pre-engagement angular position, even if the contact portion 159a receives the force in the direction of the axis L4, the tilting of the contact portion 159a in the direction of the axis L4 can be prevented by the surface 157n2 of the
25 recess 157n1 or the surface 157n4.

By the above-described structure, when the coupling 150 takes various angular positions, the

contact portion 159a receives the force in the direction of the axis L4. However, the free end portion 159a1 is regulated in the movement of the in the direction of the axis L4 by the surfaces 157n2 and 5 157n4 of the recess 157n1. By this, the tilting of the contact portion 159a in the direction of the axis L4 can be prevented. By this, the contact portion 159a can be assuredly contacted to the intermediate portion 150c of the coupling 150. Therefore, the spring 159 10 can elastically be assuredly urged toward the pre-engagement angular position (first angular position) in the coupling 150.

As has been described hereinbefore, the coil part (end) 159b at the end of the spring (elastic 15 material) 159 is fixed to the mounting portion 157e1. More particularly, the coil part (end) 159b is fixed to the supporting member 157. This is because the mounting portion 157e1 is securedly fixed to the supporting member 157. The free end portion (other 20 end) 159a1 of the spring 159 is movably engaged with the recess 157n1 for restricting the movement in the axial direction of the drive shaft 180. More particularly, the other end 159a1 is movably engaged with the recess 157n1 provided in the supporting 25 member 157.

The configurations of the projection 157n and the recess 157n1 are not limited to the above

described ones if the surface 157n2 and the surface 157n4 satisfy the functions described above. For example, the configuration shown in (b) of Figure 30 can be employed. More particularly, in the embodiment
5 shown in (b) of Figure 30, the configurations of the projection 157n and the recess 157n1 are linear.

In the examples shown in Figure 29 and Figure 30, the recess 157n1 is a hole penetrating in the direction crossing with the longitudinal direction of
10 the coupling 150 which is in the rotational force transmitting angular position. In this embodiment, the recess 157n1 is a through-hole, and therefore, the resin molding is made easy. However, it is not limited to the through-hole, but a suitable recess recessed in
15 the direction crossing with the direction can be used. Therefore, the recess includes a through-hole, a groove, and so on. Here, the longitudinal direction of the coupling 150 is the direction toward the free end of the projection 150d from the free end of the
20 portion-to-be-regulated 150j. In this embodiment, the through-hole as the recess 157n1 extends in the direction perpendicular to the longitudinal direction of the coupling 150 which is in the rotational force transmitting angular position. By this, the effects
25 described above are provided further assuredly.

However, the present invention is not limited to this.

In this embodiment, the structure shown in

Figure 29 is made of the resin material except for the spring 159.

The longitudinal direction of the coupling 150 which is in the rotational force transmitting angular position is the same as the longitudinal direction of developing cartridge B (developing roller 110).

According to the embodiment shown in Figure 29 and Figure 30, the coupling 150 can be assuredly inclined toward the pre-engagement angular position.

As has been described hereinbefore, the embodiments described above are as follows.

Even in the structure in which the cartridge B moves in the direction substantially perpendicular to the direction of the axis L3 of the drive shaft 180, the coupling 150 can engage with the drive shaft 180, and can disengage from the drive shaft 180. In addition, the cartridge B is moved in the direction substantially perpendicular to the direction of the axis L3 of the drive shaft 180 in accordance with the rotation of the rotary member C. This is because as described above, the coupling 150 can take the rotational force transmitting angular position (first angular position), the pre-engagement angular position (second angular position), and the disengaging angular position (third angular position). The rotational force transmitting angular position is the angular position for transmitting the rotational force from

the main assembly A to the developing roller 110. The pre-engagement angular position is the angular position inclined from the rotational force transmitting angular position before the coupling 150 engages with the drive shaft 180. The rotational force transmitting angular position to the pre-engagement angular position of the disengaging angular position is the angular position inclined toward the opposite side in order to disengage the coupling 150 from the drive shaft 180.

As has been described hereinbefore, the rotational force transmitting angular position (first angular position) is the angular position of the coupling 150 for transmitting the rotational force for rotating the developing roller 110 to the developing roller 110.

The pre-engagement angular position (second angular position) is the angular position of the coupling 150 inclined from the rotational force transmitting angular position before the coupling 150 engages with the drive shaft.

In addition, the disengaging angular position (third angular position) is the angular position of the coupling 150 inclined toward the side opposite from the pre-engagement angular position from the rotational force transmitting angular position in order to disengage the coupling 150 from the drive

shaft 180.

According to the embodiment described in the foregoing, a developing device (developing cartridge) is provided which is usable even with the main
5 assembly which is not provided with the mechanism for moving the main assembly side coupling member in the axial direction thereof by solenoid or the like. More particularly, by moving the developing device (developing cartridge) in the direction substantially
10 perpendicular to the axial direction of the drive shaft, the coupling member provided on the developing device (developing cartridge) is engageable with the drive shaft. And, a rotational force transmitting part usable for the developing device (developing
15 cartridge) is provided. In addition, an electrophotographic image forming apparatus usable with the developing device (developing cartridge) is provided.

According to the embodiment described in the foregoing, a developing device (developing cartridge)
20 can be provided which can be engaged with the drive shaft in the direction substantially perpendicular to the axial direction of the drive shaft provided in the main assembly of the electrophotographic image forming
25 apparatus. And, a rotational force transmission article usable for the developing device (developing cartridge) can be provided. In addition, an

electrophotographic image forming apparatus usable with the developing device (developing cartridge) can be provided.

According to the embodiment described in the foregoing, a developing device (developing cartridge) can be provided, wherein the developing roller can be rotated smoothly as compared with the case where the operative connection between the main assembly and the developing device (developing cartridge) is effected by the gear-to-gear. And, a rotational force transmission article usable with the developing device (developing cartridge) can be provided. In addition, an electrophotographic image forming apparatus usable with the developing device (developing cartridge) can be provided.

According to the embodiment described in the foregoing, a developing device (developing cartridge) can be provided, wherein it can engage with the drive shaft in the direction substantially perpendicular to the direction of the axis of the drive shaft provided in the main assembly, and the developing roller can be rotated smoothly. And, a rotational force transmitting part usable with the developing device (developing cartridge) can be provided. In addition, an electrophotographic image forming apparatus usable with the developing device (developing cartridge) can be provided.

According to the embodiment described in the foregoing, a developing device (developing cartridge) can be provided which can be engaged, and disengaged in the direction substantially perpendicular to the axial direction relative to the drive shaft provided in the main assembly of the electrophotographic image forming apparatus by the movement (rotation) of the movable member (rotary member). And, a rotational force transmitting part usable with the developing device (developing cartridge) can be provided. In addition, an electrophotographic image forming apparatus usable with the developing device (developing cartridge) can be provided.

According to the embodiment described in the foregoing, a developing device (developing cartridge) can be provided which can be engaged and disengaged in the direction substantially perpendicular to the direction of the axis of the drive shaft relative to the device side drive shaft by the movement (rotation) of the movable member (rotary member), and which can rotate the developing roller smoothly. The rotational force transmitting part usable for the developing device (developing cartridge) can be provided. In addition, an electrophotographic image forming apparatus usable with the developing device (developing cartridge) can be provided.

According to the embodiment described in the

foregoing, a developing device (developing cartridge) can be provided which is usable with the movable member (developing rotary member) which has the rotation axis which swings, wherein the developing
5 device (developing cartridge) moves in the direction perpendicular to the axial direction of the drive shaft in response to the rotation of the movable member (developing rotary member). More particularly, according to the embodiment described above, even in
10 the above described case, the developing device (developing cartridge) is assuredly engaged and disengaged relative to the main assembly side drive shaft, and the developing roller is rotated smoothly. And, a rotational force transmitting part usable with
15 the developing device (developing cartridge) can be provided. In addition, an electrophotographic image forming apparatus usable with the developing device (developing cartridge) can be provided.

As has been described hereinbefore, according
20 to the embodiment described above, the coupling member can take the state that it is revolvable substantially, and in addition the state of regulating the inclining direction of the coupling member is in the predetermined direction. By this, according to the
25 embodiment described above, the state that the coupling member is kept stable in the pre-engagement angular position can be maintained. As has been

described hereinbefore, according to the regulation member 160 of the present embodiment, even before the developing cartridge is mounted to the rotary member, the coupling member can be maintained at the pre-
5 engagement angular position (second angular position). More particularly, the coupling member can be maintained at the pre-engagement angular position (second angular position) even in the free state of the developing cartridge. Therefore, in the case of
10 the transportation of the cartridge B, for example, the unintended movement of the coupling member can be prevented. The present invention can be applied to a developing device, a developing cartridge, a rotational force transmitting part, and an
15 electrophotographic image forming apparatus.

[INDUSTRIAL APPLICABILITY]

According to the present invention, it is possible to provide a developing device, a developing
20 cartridge, and an electrophotographic image forming apparatus usable with the developing device or the developing cartridge, which are improved to avoid the problem of the prior art.

While the invention has been described with
25 reference to the structures disclosed herein, it is not confined to the details set forth, and this application is intended to cover such modification or

changes as may come within the purposes of the improvements or the scope of the following claims.

CLAIMS

1. A developing device usable with an electrophotographic image forming apparatus, said apparatus including a driving shaft rotatable by a motor and having a rotating force applying portion, and a movable member, said developing device being mountable to the movable member, and said developing device being movable in a direction substantially perpendicular to an axial direction of the driving shaft in response to movement of the movable member in one direction with said developing device mounted to the movable member, wherein said driving shaft is not movable in a direction perpendicular to an axis thereof, said developing device comprising:

i) a developing roller for developing an electrostatic latent image formed on an electrophotographic photosensitive drum, said developing roller being rotatable about an axis, wherein said developing roller is contacted to and separated from said electrophotographic photosensitive member drum in response to movement of said movable member; and

ii) a coupling member for transmitting a rotating force to said developing roller, said coupling member including, a rotating force receiving portion engageable with the rotating force applying

portion to receive a rotating force from the driving shaft, and a rotating force transmitting portion for transmitting the rotating force received through said rotating force receiving portion to said developing roller, said coupling member being capable of taking a rotational force transmitting angular position for transmitting the rotational force for rotating said developing roller to said developing roller, a pre-engagement angular position which is taken before said coupling member is engaged with the rotating force applying portion and in which said coupling member is inclined away from said rotational force transmitting angular position, and a disengaging angular position which is taken for said coupling member to disengage from the driving shaft and in which said coupling member is inclined away from the rotational force transmitting angular position in a direction opposite to said pre-engagement angular position,

wherein in response to a movement of said developing device when the movable member moves in said one direction, said coupling member moves from the pre-engagement angular position to the rotational force transmitting angular position, and wherein when the movable member makes a further movement in said one direction, in response to the further movement, said coupling member is moved from said rotational force transmitting angular position to said

disengaging angular position to disengage said coupling member from said driving shaft, and

wherein said developing roller is contacted to said electrophotographic photosensitive member in response to the movement of said developing device in a state that developing roller is being rotated through engagement between said coupling member and said rotating force applying portion.

10 2. A device according to Claim 1, wherein said coupling member moves from said rotational force transmitting angular position to said disengaging angular position by the movement of the movable member in said one direction so that part of said coupling member circumvents the driving shaft in response to movement of said developing device in the direction substantially perpendicular to the axis of said developing roller.

20 3. A device according to Claim 1 or 2, wherein said coupling member has a recess in which a rotational axis of said coupling member extends, and said recess is over a free end of said driving shaft by movement of said coupling member from said pre-engagement angular position to said rotational force transmitting angular position.

4. A device according to Claim 1, 2 or 3, wherein when said coupling member is in said rotational force transmitting angular position, said rotating force receiving portion is engaged, in a direction of
5 rotation of said coupling member, with the rotating force applying portion which is projected in a direction perpendicular to the axial direction of said driving shaft said coupling member by which said coupling member receives a rotating force from the
10 driving shaft to rotate.

5. A device according to Claim 4, wherein said coupling member moves from said rotational force transmitting angular position to said disengaging
15 angular position to disengage from the driving shaft by the further movement of the movable member in said one direction so that part of said coupling member circumvents the driving shaft in response to movement of said developing device in the direction
20 substantially perpendicular to the axis of said developing roller.

6. A device according to any one of Claims 1 - 5, wherein a plurality of such rotational force receiving
25 portions are provided on a phantom circle having a center on the rotational axis of said coupling member at positions substantially diametrically opposite to

each other.

7. A device according to any one of Claims 1 - 6,
wherein said rotational force receiving portion is
5 provided projected at each of two positions of an edge
portion of said flat portion interposing the central
portion, wherein the rotational force applying portion
is provided projected in a direction perpendicular to
the axis of the driving shaft at each of two positions
10 opposite to each other, and wherein said coupling
member receives a rotational force from the driving
shaft to rotate by one of said rotational force
receiving portions engaging to one of the rotational
force applying portion and by the other of rotational
15 force receiving portions engaging to the other of the
rotational force applying portions, said one of said
rotational force receiving portions being opposed to
the other of said rotational force receiving portions,
and said one of said rotational force applying
20 portions being opposed to the other of said rotational
force applying portions.

8. A device according to any one of Claims 1 - 8,
wherein said coupling member has a circular flat
25 portion at a free end thereof, and said recess is
disposed at a central portion of said circular flat
portion, said recess includes an expanding portion

expanding toward a free end thereof.

9. A device according to Claim 8, further comprising an elastic member for elastically urging
5 said coupling member with such an elastic force as to permit said coupling member to move from said pre-engagement angular position to said rotational force transmitting angular position to maintain said coupling member at said pre-engagement angular
10 position and as to permit said coupling member to moves from said rotational force transmitting angular position to said disengaging angular position.

10. A device according to any one of Claims 1 - 9,
15 wherein said coupling member is provided in a position away from said axis of said developing roller with respect to a direction perpendicular to said axis of said developing roller.

20 11. A device according to Claim 9, wherein said rotating force transmitting portion is disposed in a side opposite from said rotating force receiving portion, and wherein the rotating force received by said rotating force transmitting portion is
25 transmitted to said developing roller through said rotating force receiving portion and said driving force transmission member.

12. A device according to any one of Claims 1 - 11,
wherein said developing device contains a yellow color
developer, a magenta color developer, a cyan color
5 developer or a black color developer, and is a
developing cartridge detachably mountable to said
movable member in the form of a developing rotary.

13. An electrophotographic image forming apparatus
10 for forming an image on a recording material, said
electrophotographic image forming apparatus
comprising:

i) a driving shaft rotatable by a motor and
having a rotating force applying portion, wherein said
15 driving shaft is not movable in a direction
perpendicular to an axis thereof;

ii) a movable member;

iii) a developing device which is movable in a
direction substantially perpendicular to an axial
20 direction of the driving shaft in response to movement
of the movable member in a state that developing
device is mounted to said movable member, in response
to the moment of said movable member, said developing
roller including

25 a developing roller for developing an
electrostatic latent image formed on an
electrophotographic photosensitive drum, said

developing roller being rotatable about an axis,
wherein said developing roller is contacted to and
separated from said electrophotographic photosensitive
member drum in response to movement of said movable
5 member;

iv) a coupling member for transmitting a
rotating force to said developing roller, said
coupling member including, a rotating force receiving
portion engageable with the rotating force applying
10 portion to receive a rotating force from the driving
shaft, and a rotating force transmitting portion for
transmitting the rotating force received through said
rotating force receiving portion to said developing
roller, said coupling member being capable of taking a
15 rotational force transmitting angular position for
transmitting the rotational force for rotating said
developing roller to said developing roller, a pre-
engagement angular position which is taken before said
coupling member is engaged with the rotating force
20 applying portion and in which said coupling member is
inclined away from said rotational force transmitting
angular position, and a disengaging angular position
which is taken for said coupling member to disengage
from the driving shaft and in which said coupling
25 member is inclined away from the rotational force
transmitting angular position in a direction opposite
to said pre-engagement angular position to disengage

from the driving shaft,

wherein in response to a movement of said developing device when the movable member moves in said one direction, said coupling member moves from
5 the pre-engagement angular position to the rotational force transmitting angular position, and wherein when the movable member makes a further movement in said one direction, in response to the further movement, said coupling member is moved from said rotational
10 force transmitting angular position to said disengaging angular position to disengage said coupling member from said driving shaft, and

wherein said developing roller is contacted to said electrophotographic photosensitive member in
15 response to the movement of said developing device in a state that developing roller is being rotated through engagement between said coupling member and said rotating force applying portion.

20 14. An apparatus according to Claim 13, wherein said coupling member moves from said rotational force transmitting angular position to said disengaging angular position by the movement of the movable member in said one direction so that part of said coupling
25 member circumvents the driving shaft in response to movement of said developing device in the direction substantially perpendicular to the axis of said

developing roller.

15. An apparatus according to Claim 13 or 14,
wherein said coupling member has a recess in which a
5 rotational axis of said coupling member extends, and
said recess is over a free end of said driving shaft
by movement of said coupling member from said pre-
engagement angular position to said rotational force
transmitting angular position.

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16. An apparatus according to Claim 13, 14 or 15,
wherein when said coupling member is in said
rotational force transmitting angular position, said
rotating force receiving portion is engaged, in a
15 direction of rotation of said coupling member, with
the rotating force applying portion which is projected
in a direction perpendicular to the axial direction of
said driving shaft said coupling member by which said
coupling member receives a rotating force from the
20 driving shaft to rotate.

17. An apparatus according to Claim 16, wherein
said coupling member moves from said rotational force
transmitting angular position to said disengaging
25 angular position to disengage from the driving shaft
by the further movement of the movable member in said
one direction so that part of said coupling member

circumvents the driving shaft in response to movement of said developing device in the direction substantially perpendicular to the axis of said developing roller.

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18. An apparatus according to any one of Claims 13 - 17, wherein a plurality of such rotational force receiving portions are provided on a phantom circle having a center on the rotational axis of said coupling member at positions substantially diametrically opposite to each other.

19. An apparatus according to any one of Claims 13 - 18, wherein said rotational force receiving portion is provided projected at each of two positions of an edge portion of said flat portion interposing the central portion, wherein the rotational force applying portion is provided projected in a direction perpendicular to the axis of the driving shaft at each of two positions opposite to each other, and wherein said coupling member receives a rotational force from the driving shaft to rotate by one of said rotational force receiving portions engaging to one of the rotational force applying portion and by the other of rotational force receiving portions engaging to the other of the rotational force applying portions, said one of said rotational force receiving portions being

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opposed to the other of said rotational force receiving portions, and said one of said rotational force applying portions being opposed to the other of said rotational force applying portions.

5

20. An apparatus according to any one of Claims 13 - 19, wherein said coupling member has a circular flat portion at a free end thereof, and said recess is disposed at a central portion of said circular flat portion, said recess includes an expanding portion
10 expanding toward a free end thereof.

21. An apparatus according to Claim 20, further comprising an elastic member for elastically urging
15 said coupling member with such an elastic force as to permit said coupling member to move from said pre-engagement angular position to said rotational force transmitting angular position to maintain said coupling member at said pre-engagement angular
20 position and as to permit said coupling member to moves from said rotational force transmitting angular position to said disengaging angular position.

22. An apparatus according to any one of Claims 13
25 - 21, wherein said coupling member is provided in a position away from said axis of said developing roller with respect to a direction perpendicular to said axis

of said developing roller.

23. An apparatus according to Claim 21, wherein
said rotating force transmitting portion is disposed
5 in a side opposite from said rotating force receiving
portion, and wherein the rotating force received by
said rotating force transmitting portion is
transmitted to said developing roller through said
rotating force receiving portion and said driving
10 force transmission member.

24. An apparatus according to any one of Claims 13
- 23, wherein said developing device contains a yellow
color developer, a magenta color developer, a cyan
15 color developer or a black color developer, and is a
developing cartridge detachably mountable to said
movable member in the form of a developing rotary.

25. A developing device usable with an
20 electrophotographic image forming apparatus, said
apparatus including a driving shaft rotatable having a
rotating force applying portion, and a rotatable
rotary, said developing device being movable in a
direction substantially perpendicular to an axial
25 direction of the driving shaft in response to rotation
of said rotary with said developing device mounted to
said rotary, said developing device comprising:

i) a developing roller for developing an electrostatic latent image formed on an electrophotographic photosensitive member drum;

ii) a developer accommodating portion for
5 accommodating a developer for use by said developing roller to developing the electrostatic latent image;

iii) a coupling member for transmitting a rotating force to said developing roller in a state that developing cartridge is mounted to said rotary,
10 said coupling member including a rotating force receiving portion for engaging with the rotating force applying portion to receive said driving shaft the rotating force from the driving shaft, wherein the driving shaft is not movable in a direction
15 substantially perpendicular to an axial direction of said driving shaft;

iv) a regulating member including a regulating portion for regulating said coupling member at a pre-engagement angular position before engagement with the
20 driving shaft, and including a permitting portion for permitting said coupling member to revolve substantially;

v) an elastic member for elastically urging said coupling member to position said coupling member
25 at the regulating portion,

wherein when said rotary rotates, said coupling member moves from the pre-engagement angular position

to a rotational force transmitting angular position
the response to movement of said coupling member from
the regulating portion To the permitting portion
against an elastic force of said elastic member by
5 said coupling member contacting said driving shaft
member with movement of said developing cartridge, and
when said rotary further rotates, said coupling member
moves from the rotational force transmitting angular
position to a disengaging angular position to
10 disengage said coupling member from the driving shaft
against an elastic force of said elastic member.

26. A device according to Claim 25, wherein said
regulating portion is provided with a relatively
15 narrow portion, and said permitting portion is
provided with a relatively wide portion, wherein said
coupling member is provided with a projection at a
trailing end which is opposite from said rotating
force receiving portion, and wherein when said
20 projected portion is in said narrow portion, an
inclining direction of said coupling member is
regulated at the pre-engagement angular position, and
when said projected portion in the wide portion, said
coupling member is substantially revolvable.

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27. A device according to Claim 26, further
comprising a developer supplying roller for supplying

to said developing roller a developer accommodated in
said developer accommodating portion, wherein said
grooves are surrounded by a circular portion, wherein
said circular portion is provided with a rotatable
5 member rotatably engaged therewith, said rotatable
member being provided with a first gear portion for
transmitting the rotating force receiving from the
driving shaft to said developing roller, a second gear
portion for transmitting the rotating force to said
10 developer supplying roller, and a wherein said
coupling member is substantially revolvably to an
inside of said rotatable member.

28. A device according to Claim 25, 26 or 27,
15 wherein said coupling member is provided, at a free
end side where said rotating force receiving portion
is provided, with a circular flat portion and a
circular recess provided at a center of said flat
portion, wherein said recess is engaged with the free
20 end of the driving shaft in a state that coupling
member is in the rotational force transmitting angular
position, and wherein said rotating force receiving
portion is projected from an edge of said flat portion
and is provided at each of the positions opposed to
25 each other interposing the center of said flat portion.

29. A device according to Claim 27, wherein said

coupling member is provided, at a rear end side which is opposite from the free end side, a spherical configuration portion which is revolvably mounted to an inside of said rotatable member such that coupling member is confined from movement toward the free end side in a longitudinal direction of said coupling member, thus preventing said coupling member from disengaging from said rotatable member, and wherein rotating force transmitting portion is projected from said spherical configuration portion in a direction perpendicular to the longitudinal direction.

30. A device according to any one of Claims 25 - 29, further comprising a developer supplying roller for supplying to said developing roller a developer Accommodated in said developer accommodating portion, wherein a direction of inclination of said coupling member in said pre-engagement angular position is between a rotation axis of said developing roller and a rotation axis of said developer supplying roller.

31. A device according to Claim 27 or 29, wherein when said coupling member is in the permitting portion, a gap is provided between a rotating force transmitting portion of said coupling for transmitting the rotating force received from said rotating force receiving portion to said developing roller and a

rotating force receiving portion of said rotatable member for receiving the rotating force from said rotating force transmitting portion so that coupling member is substantially revolvable, wherein said
5 rotating force transmitting portion is movable relative to said rotating force receiving portion, and said rotating force transmitting portion and said rotating force receiving portion are contacted to each other with respect to a rotational direction of said
10 coupling member.

32. An electrophotographic image forming apparatus for forming an image on a recording material, said apparatus comprising:

15 i) a driving shaft including a rotating force applying portion;

ii) a rotatable rotary;

a developing cartridge movable in a direction substantially perpendicular to an axial direction of
20 the driving shaft in response to rotation of said rotary with said developing device mounted to said rotary;

a developing roller for developing an electrostatic latent image formed on an
25 electrophotographic photosensitive member drum;

a developer accommodating portion for accommodating a developer for use by said developing

roller to developing the electrostatic latent image;

iii) a coupling member for transmitting a rotating force to said developing roller in a state that developing cartridge is mounted to said rotary, said coupling member including a rotating force receiving portion for engaging with the rotating force applying portion to receive said driving shaft the rotating force from the driving shaft, wherein the driving shaft is not movable in a direction substantially perpendicular to an axial direction of said driving shaft;

iv) a regulating member including a regulating portion for regulating said coupling member at a pre-engagement angular position before engagement with the driving shaft, and including a permitting portion for permitting said coupling member to revolve substantially; and

v) an elastic member for elastically urging said coupling member to position said coupling member at the regulating portion,

wherein when said rotary rotates, said coupling member moves from the pre-engagement angular position to a rotational force transmitting angular position the response to movement of said coupling member from the regulating portion To the permitting portion against an elastic force of said elastic member by said coupling member contacting said driving shaft

member with movement of said developing cartridge, and when said rotary further rotates, said coupling member moves from the rotational force transmitting angular position to a disengaging angular position to
5 disengage said coupling member from the driving shaft against an elastic force of said elastic member.

33. An apparatus according to Claim 32, wherein said regulating portion is provided with a relatively
10 narrow portion, and said permitting portion is provided with a relatively wide portion, wherein said coupling member is provided with a projection at a trailing end which is opposite from said rotating force receiving portion, and wherein when said
15 projected portion is in said narrow portion, an inclining direction of said coupling member is regulated at the pre-engagement angular position, and when said projected portion is in the wide portion, said coupling member is substantially revolvable.

20

34. An apparatus according to Claim 33, further comprising a developer supplying roller for supplying to said developing roller a developer accommodated in said developer accommodating portion, wherein said
25 grooves are surrounded by a circular portion, wherein said circular portion is provided with a rotatable member rotatably engaged therewith, said rotatable

member being provided with a first gear portion for transmitting the rotating force receiving from the driving shaft to said developing roller, a second gear portion for transmitting the rotating force to said developer supplying roller, and a wherein said coupling member is substantially revolvably to an inside of said rotatable member.

35. An apparatus according to Claim 32, 33 or 34, wherein said coupling member is provided, at a free end side where said rotating force receiving portion is provided, with a circular flat portion and a circular recess provided at a center of said flat portion, wherein said recess is engaged with the free end of the driving shaft in a state that coupling member is in the rotational force transmitting angular position, and wherein said rotating force receiving portion is projected from an edge of said flat portion and is provided at each of the positions opposed to each other interposing the center of said flat portion.

36. An apparatus according to Claim 34, wherein said coupling member is provided, at a rear end side which is opposite from the free end side, a spherical configuration portion which is revolvably mounted to an inside of said rotatable member such that coupling member is confined from movement toward the free end

side in a longitudinal direction of said coupling member, thus preventing said coupling member from disengaging from said rotatable member, and wherein rotating force transmitting portion is projected from
5 said spherical configuration portion in a direction perpendicular to the longitudinal direction.

37. An apparatus according to any one of Claims 32 -36, further comprising a developer supplying roller
10 for supplying to said developing roller a developer Accommodated in said developer accommodating portion, wherein a direction of inclination of said coupling member in said pre-engagement angular position is between a rotation axis of said developing roller and
15 a rotation axis of said developer supplying roller.

38. An apparatus according to any one of Claims 32 - 37, wherein when said coupling member is in the permitting portion, a gap is provided between a
20 rotating force transmitting portion of said coupling for transmitting the rotating force received from said rotating force receiving portion to said developing roller and a rotating force receiving portion of said rotatable member for receiving the rotating force from
25 said rotating force transmitting portion so that coupling member is substantially revolvable, wherein said rotating force transmitting portion is movable

relative to said rotating force receiving portion, and
said rotating force transmitting portion and said
rotating force receiving portion are contacted to each
other with respect to a rotational direction of said
5 coupling member.

39. An apparatus according to Claim 32, wherein
said rotary has a rotation axis which is single.

10 40. An apparatus according to Claim 25, wherein
said elastic member is mounted to a mounting portion
at its one end and is movably engaged with a recess
for regulating the other end from moving in the axial
direction of the driving shaft at the other end
15 thereof.

41. An apparatus according to Claim 40, wherein
said developing cartridge includes a developer
supplying roller for supplying to said developing
20 roller a developer accommodated in said developer
accommodating portion, wherein said one end of said
elastic member is mounted to a supporting member
supporting a rotatable member provided with a first
gear portion for transmitting the rotating force
25 receiving from the driving shaft to said developing
roller, a second gear portion for transmitting the
rotating force to said developer supplying roller, and

said other end is movably engaged with a recess provided in said supporting member.

42. An apparatus according to Claim 31, wherein
5 said coupling member is made of polyacetal resin material.

43. A rotating force transmitting part usable with a developing cartridge, said developing cartridge
10 being mountable to a main assembly of an electrophotographic image forming apparatus including a driving shaft, and movable in a direction substantially perpendicular to an axial direction of the driving shaft, developing cartridge being provided
15 with a regulating member including a permitting portion and a regulating portion, said rotating force transmitting part comprising:

a recess provided at one longitudinal end of said rotating force transmitting part and engageable
20 with the driving shaft when said developing cartridge is mounted to the main assembly of the apparatus;

a spherical portion provided at the other end;

a plurality of projections interposing a center of said recess and projected away from said spherical
25 portion in a longitudinal direction of said rotating force transmitting part for receiving the rotational force from the driving shaft which is provided in the

main assembly of the apparatus such that it does not move in a direction substantially perpendicular to the axial direction of said driving shaft in a state that developing cartridge is mounted to the main assembly
5 of the apparatus;

a first projected portion projected from said spherical portion away from said one end, said projected portion being revolvable between said permitting portion for permitting substantial
10 revolution of said rotating force transmitting part and said regulating portion for regulating an inclination angle position of said rotating force transmitting part in a state that rotating force transmitting part is mounted to said developing
15 cartridge; and

a plurality of second projected portions provided between said projections and said first projected portion and interposing said spherical portion, said second projected portions being
20 projected outwardly from spherical portion, said second projected portions are effective to transmit the rotational force received from the driving shaft by the projections to the developing roller.

25 44. A rotating force transmitting part according to Claim 43, further comprising a circular flat portion at a free end side where said projection is

provided, wherein said recess is provided at a center of said flat portion, said projections project from an edge of said flat portion and are opposed to each other interposing the center of said flat portion.

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45. A rotating force transmitting part according to Claim 44, wherein said projections are provided on a phantom circle about the center.

10 46. A rotating force transmitting part according to Claim 45, wherein said first and second projected portions have columnar shapes.