DESCRIPTION

[TITLE OF THE INVENTION] PROCESS CARTRIDGE AND ELECTROPHOTOGRAPHIC IMAGE FORMING APPARATUS

[TECHNICAL FIELD]

[0001] The present invention relates to a process cartridge and an electrophotographic image forming apparatus using the same.

[0002] Here, the process cartridge is a cartridge which is integrally formed with a photosensitive member and a process means actable on the photosensitive member so as to be dismountably mounted to a main assembly of the electrophotographic image forming apparatus.

[0003] For example, a photosensitive member and at least one of a developing means, a charging means and a cleaning means as the process means are integrally formed into a cartridge. Also, the electrophotographic image forming apparatus forms an image on a recording material using an electrophotographic image forming process.

[0004] Examples of the electrophotographic image forming apparatus include an electrophotographic copying machine, an electrophotographic printer (LED printer, laser beam printer, etc.), a facsimile machine, a word processor, and the like.

[BACKGROUND ART]

[0005] In an electrophotographic image forming apparatus (hereinafter also simply referred to as "image forming apparatus"), a drum type electrophotographic photosensitive member as an image bearing member, that is, a photosensitive drum (electrophotographic photosensitive drum) is uniformly

charged. Subsequently, the charged photosensitive drum is selectively exposed to form an electrostatic latent image (electrostatic image) on the photosensitive drum. Next, the electrostatic latent image formed on the photosensitive drum is developed as a toner image with toner as developer. Then, the toner image formed on the photosensitive drum is transferred onto a recording material such as recording sheet, plastic sheet, and so on, and heat and pressure are applied to the toner image transferred onto the recording material to fix the toner image on the recording material, so that image recording is carried out.

[0006] Such an image forming apparatus generally requires toner replenishment and maintenance of various process means. In order to facilitate toner replenishment and maintenance, process cartridges dismountably mountable to the image forming apparatus main assembly have been put into cartridges by integrating photosensitive drums, charging means, developing means, cleaning means and the like in the frame.

[0007] With this process cartridge system, a part of the maintenance operation of the apparatus can be carried out by the user him/herself without relying on a service person in charge of after-sales service. Therefore, it is possible to improve the usability of the apparatus remarkably, and it is possible to provide an image forming apparatus excellent in usability. For this reason, this process cartridge system is widely used with image forming apparatus.

[0008] As described in JP H08-328449 (page 20, Figure 16), a well-known image forming apparatus of the type described above includes a drive transmission member having a coupling at the free end thereof for transmitting drive to the process cartridge from the main assembly of the image forming apparatus, which is spring biased toward the process cartridge.

[0009] When an opening and closing door of the image forming apparatus main assembly is closed, the drive transmission member of this image forming

apparatus is pressed by the spring and moves toward the process cartridge. By doing so, the drive transmission member engages (couples) with the coupling of the process cartridge and the drive transmission to the process cartridge is enabled. Also, when the opening/closing door of the image forming apparatus main assembly is opened, the drive transmission member moves in a direction away from the process cartridge against the spring by a cam. By this, the drive transmitting member disestablishes the engagement (coupling) with the coupling of the process cartridge, so that the process cartridge can be dismounted from the main assembly of the image forming apparatus.

[SUMMARY OF THE INVENTION]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

[0010] The object of the present invention is to further develop the aforementioned prior art.

[MEANS FOR SOLVING THE PROBLEM]

[0011] Typical structure of the invention of this application is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, said process cartridge comprising a photosensitive member; a coupling portion provided at an end portion of said photosensitive member and including a driving force receiving portion for receiving a driving force for rotating said photosensitive member, from an outside of said process cartridge; and a gear portion including gear teeth for receiving a driving force from an outside of said process cartridge, independently from said coupling portion, wherein said gear teeth include an exposed portion exposed to an outside of said process cartridge, wherein at least a part of said exposed portion (a) faces an axis of said photosensitive member, (b) is disposed outside of

said driving force receiving portion in an axial direction of said photosensitive member, and (c) is in a neighborhood of a peripheral surface of said photosensitive member.

[0012] Another structure is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, said main assembly including a drive output member having an output gear portion and an output coupling portion which are coaxial with each other, said process cartridge comprising a photosensitive member; an input coupling portion provided at an end portion of said photosensitive member and capable of coupling with the output coupling portion; and an input gear portion capable of meshing engagement with said output gear portion; wherein said input gear portion is configured such that said input gear portion and said output gear portion attract toward each other by rotations thereof in the state that said input gear portion and said output gear portion are in meshing engagement with each other.

[0013] A further structure is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, said process cartridge comprising a photosensitive member; a coupling portion provided at an end portion of said photosensitive member and including a driving force receiving portion for receiving a driving force for rotating said photosensitive member, from an outside of said process cartridge; and a gear portion including a gear tooth for receiving, independently of said coupling portion, a driving force from a outside of said process cartridge; wherein said gear tooth is a helical gear tooth, and includes an exposed portion exposed to an outside of said process cartridge, wherein at least a part of said exposed portion is disposed outside of said driving force receiving portion in an axial direction of said photosensitive member and is faced to an axis

of said photosensitive member.

[0014] A further structure is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, said process cartridge comprising a photosensitive member; a coupling portion provided at an end portion of said photosensitive member and including a driving force receiving portion configured to receive a driving force for rotating said photosensitive member from an outside of said process cartridge; a gear portion including a gear tooth for receiving, independently of said coupling portion, a driving force from a outside of said process cartridge; and a developer carrying member configured to carry the developer to develop a latent image formed on said photosensitive member, said developer carrying member being rotatable in a clockwise direction as seen in such a direction that said gear portion rotates in the clockwise direction; wherein said gear teeth include an exposed portion exposed to an outside of said process cartridge, wherein at least a part of said exposed portion is faced to a axis of said photosensitive member and is disposed outside of said driving force receiving portion in an axial direction of said photosensitive member.

[0015] A further structure is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, said process cartridge comprising a photosensitive member; an alignment portion provided coaxially with said photosensitive member; and gear portion including a gear tooth for receiving a driving force from an outside of said process cartridge; wherein said gear teeth include an exposed portion exposed to an outside of said process cartridge, wherein at lease a part of said stopper is (a) faced to an axis of said photosensitive member, (b) is disposed outside beyond said alignment portion in the axial direction of said photosensitive member and (c) is disposed adjacent to a

peripheral surface of said photosensitive member in a plane perpendicular to the axis of said photosensitive member.

[0016] A further structure is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming operation, the main assembly including a drive output member having an output gear portion and a main assembly side alignment portion which are coaxial with each other, said process cartridge comprising a photosensitive member; a cartridge side alignment portion engageable with the main assembly side alignment portion to effect alignment between said photosensitive member and the drive output member; and an input gear portion capable of meshing engagement with said output gear portion; wherein said input gear portion is configured such that said input gear portion and said output gear portion attract toward each other by rotations thereof in the state that said input gear portion and said output gear portion are in meshing engagement with each other.

[0017] A further structure is,

A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, said process cartridge comprising a photosensitive member; an alignment portion provided coaxially with said photosensitive member; and a gear portion including a gear tooth for receiving a driving force from an outside of said process cartridge, wherein said gear tooth is a helical gear tooth, and includes an exposed portion exposed to an outside of said process cartridge, wherein at least a part of said exposed portion is disposed outside of said alignment portion in an axial direction of said photosensitive member and is faced to the axis of said photosensitive member.

[0018] A further structure is,

A process cartridge detachably mountable to a main assembly of an

electrophotographic image forming apparatus, said process cartridge comprising a photosensitive member; an alignment portion provided coaxially with said photosensitive member; a gear portion including a gear tooth configured to receive a driving force from an outside of said process cartridge; and a developer carrying member configured to carry the developer to develop a latent image formed on said photosensitive member, said developer carrying member being rotatable in a clockwise direction as seen in such a direction that said gear portion rotates in the clockwise direction, wherein said gear teeth include an exposed portion exposed to an outside of said process cartridge, and wherein at least a part of said exposed portion is faced to the axis of said photosensitive member and is disposed outside of said alignment portion in the axial direction of said photosensitive member.

[EFFECT OF THE INVENTION]

[0019] It is possible to further develop the aforementioned prior art.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0020] Figure 1 is an illustration of a drive transmitting portion of a process cartridge according to Embodiment 1.

[0021] Figure 2 is a sectional view of the image forming apparatus main assembly and the process cartridge of the electrophotographic image forming apparatus according to Embodiment 1.

[0022] Figure 3 is a sectional view of the process cartridge according to Embodiment 1.

[0023] Figure 4 is a perspective view of the image forming apparatus main assembly in a state in which the opening and closing door of the electrophotographic image forming apparatus according to Embodiment 1 is

opened.

[0024] Figure 5 is a perspective view of the process cartridge and the driving side positioning portion of the image forming apparatus main assembly in a state in which the process cartridge is mounted on the electrophotographic image forming apparatus main assembly according to Embodiment 1.

[0025] Figure 6 is an illustration of a link portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0026] Figure 7 is an illustration of a link portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0027] Figure 8 is a sectional-viewed of a guide portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0028] Figure 9 is an illustration of a drive chain of the electrophotographic image forming apparatus according to Embodiment 1.

[0029] Figure 10 is an illustration of a positioning portion for positioning in a longitudinal direction in the electrophotographic image forming apparatus according to Embodiment 1.

[0030] Figure 11 is a positioning portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0031] Figure 12 is a sectional view of a drive transmitting portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0032] Figure 13 is a perspective view of a drive transmitting portion on the electrophotographic image forming apparatus according to Embodiment 1.

[0033] Figure 14 is a perspective view of a developing roller gear of the electrophotographic image forming apparatus according to Embodiment 1.

[0034] Figure 15 is a perspective view of a drive transmitting portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0035] Figure 16 is a sectional view of a drive transmitting portion of the

electrophotographic image forming apparatus according to Embodiment 1.

[0036] Figure 17 is a sectional view around a drum of the electrophotographic image forming apparatus according to Embodiment 1.

[0037] Figure 18 is a sectional view of a drive transmitting portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0038] Figure 19 is a perspective view of a drive transmitting portion of a process cartridge according to Embodiment 1.

[0039] Figure 20 is a sectional view of the drive transmitting portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0040] Figure 21 is a perspective view of a developing roller gear of the process cartridge according to Embodiment 1.

[0041] Figure 22 is an illustration of a drive train of a process cartridge according to Embodiment 1.

[0042] Figure 23 is an illustration of the drive transmitting portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0043] Figure 24 is an illustration of the regulating portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0044] Figure 25 is a cross-sectional view of the drive transmitting portion of the process cartridge according to Embodiment 1.

[0045] Figure 26 is a perspective view of the regulating portion of the process cartridge according to Embodiment 1.

[0046] Figure 27 is an illustration of the regulating portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0047] Figure 28 is an illustration of the drive transmitting portion of the electrophotographic image forming apparatus according to Embodiment 1.

[0048] Figure 29 is a perspective view of the regulating portion of the electrophotographic image forming apparatus according to Embodiment 2.

[0049] Figure 30 is an illustration of the regulating portion of the electrophotographic image forming apparatus according to Embodiment 2.

[0050] Figure 31 is an illustration of the regulating portion of the electrophotographic image forming apparatus according to Embodiment 2.

[0051] Figure 32 is an illustration of the regulating portion of the electrophotographic image forming apparatus according to Embodiment 2.

[0052] Figure 33 is an illustration of the process cartridge according to Embodiment 1.

[0053] Figure 34 is an illustration of the process cartridge according to Embodiment 1.

[0054] Figure 35 is an illustration of a modified example of Embodiment 1.

[0055] Figure 36 is an illustration of a modified example of Embodiment 1.

[0056] Figure 37 is a perspective view illustrating a gear portion and a coupling portion in Embodiment 1.

[0057] Figure 38 is a perspective view illustrating a modification of Embodiment 1.

[0058] Figure 39 is an illustration of the device according to Embodiment 2.

[DETAILED DESCRIPTION OF THE INVENTION]

<Embodiment 1>

[0059] Embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0060] A rotational axis direction of an electrophotographic photosensitive drum is defined as the longitudinal direction.

[0061] In the longitudinal direction, the side at which the electrophotographic photosensitive drum receives the driving force from the main assembly of the image forming apparatus is a driving side and the opposite side thereof is a non-

driving side.

[0062] Referring to Figure 2 and Figure 3, the overall structure and the image forming process will be described.

[0063] Figure 2 is a cross-sectional view of the main assembly of the electrophotographic image forming apparatus (the electrophotographic image forming apparatus main assembly, the image forming apparatus main assembly) An and the process cartridge (hereinafter referred to as cartridge B) of the electrophotographic image forming apparatus according to an embodiment of the present invention.

[0064] Figure 3 is a cross-sectional view of cartridge B.

[0065] Here, the apparatus main assembly A is a part of the electrophotographic image forming apparatus excluding the cartridge B.

<Entire Configuration of Electrophotographic Image Forming Apparatus>

[0066] An electrophotographic image forming apparatus (image forming apparatus) shown in Figure 2 is a laser beam printer using an electrophotographic process in which the cartridge B is dismountably mounted to the apparatus main assembly A, An exposure device 3 (laser scanner unit) for forming a latent image on the electrophotographic photosensitive drum 62 as the image bearing member of the cartridge B at the time when the cartridge B is mounted in the apparatus main assembly An is provided. Also, below the cartridge B, there is provided a sheet tray 4 containing recording materials (hereinafter referred to as a sheet material PA) to be subjected to image formation. The electrophotographic photosensitive drum 62 is a photosensitive member (electrophotographic photosensitive member) used for forming an electrophotographic image.

[0067] Further, in the apparatus main assembly A, a pickup roller 5a, a pair of feeding rollers 5b, a pair of feeding rollers 5c, a transfer guide 6, a transfer roller

7, a feeding guide 8, a fixing device 9, a pair of discharge rollers 10, a discharge tray 11, and so on are sequentially arranged. In addition, the fixing device 9 comprises a heating roller 9a and a pressure roller 9b.

<Image Forming Process>

[0068] Next, the image forming process will be briefly explained. Based on the print start signal, the electrophotographic photosensitive drum (hereinafter referred to as photosensitive drum 62 or simply drum 62) is rotationally driven in the direction of an arrow R at a predetermined circumferential speed (process speed).

[0069] The charging roller (charging member) 66 to which the bias voltage is applied contacts with the outer peripheral surface of the drum 62 to uniformly charge the outer peripheral surface of the drum 62.

[0070] The exposure device 3 outputs a laser beam L in accordance with image information. The laser beam L passes through the laser opening 71h provided in the cleaning frame 71 of the cartridge B and scans and is incident on the outer peripheral surface of the drum 62. By this, an electrostatic latent image corresponding to the image information is formed on the outer peripheral surface of the drum 62.

[0071] On the other hand, as shown in Figure 3, in the developing unit 20 as a developing device, the toner T in the toner chamber 29 is stirred and fed by the rotation of the feeding member (stirring member) 43 to a toner supply chamber 28.

[0072] The toner T is carried on the surface of the developing roller 32 by the magnetic force of the magnet roller 34 (stationary magnet). The developing roller 32 is a developer carrying member which carries a developer (toner T) on the surface thereof in order to develop a latent image formed on the drum 62.

[0073] While the toner T is triboelectrically charged by the developing blade 42, the layer thickness on the peripheral surface of the developing roller 32 as the developer carrying member is regulated.

[0074] The toner T is supplied to the drum 62 in accordance with the electrostatic latent image to develop the latent image. By this, the latent image is visualized into a toner image. The drum 62 is an image bearing member for carrying the latent image and the image (toner image, developer image) formed with toner on the surface thereof. Also, as shown in Figure 2, the sheet material PA stored in the lower portion of the apparatus main assembly An is fed out of the sheet tray 4 in timed relation with the output of the laser beam L, By the pickup roller 5a, the feeding roller pair 5b, and the feeding roller pair 5c. Then, the sheet material PA is fed to the transfer position between the drum 62 and the transfer roller 7 along the transfer guide 6. At this transfer position, the toner image is sequentially transferred from the drum 62 to the sheet material PA.

[0075] The sheet material PA to which the toner image is transferred is separated from the drum 62 and fed to the fixing device 9 along a conveyance guide 8. And, the sheet material PA passes through the nip portion between a heating roller 9a and a pressure roller 9b which constitute the fixing device 9. Pressure and heat fixing process are performed in this nip portion, so that the toner image is fixed on the sheet material PA. The sheet material PA subjected to the fixing process of the toner image is fed to the discharge roller pair 10 and discharged to the discharge tray 11.

[0076] On the other hand, as shown in Figure 3, after the image transfer, residual toner remaining on the outer circumferential surface of the drum 62 after the transfer is removed by the cleaning blade 77 and is used again for the image forming process. The toner removed from the drum 62 is stored in a waste toner chamber 71b of the cleaning unit 60. The cleaning unit 60 is a unit including

the photosensitive drum 62.

[0077] In the above description, the charging roller 66, the developing roller 32, the transfer roller 7, and the cleaning blade 77 act as a process means acting on the drum 62.

<Entire Cartridge Structure>

[0078] Next, the overall structure of the cartridge B will be described referring to Figures 3, 4, and 5. Fig 3 is a sectional view of the cartridge B, and Figure 4 and Figure 5 are perspective views illustrating the structure of the cartridge B. In the description of this embodiment, the screws for joining the parts are omitted.

[0079] The cartridge B includes a cleaning unit (photosensitive member holding unit, drum holding unit, image bearing member holding unit, first unit) 60 and a developing unit (developer carrying member holding unit, second unit) 20.

[0080] Generally, the process cartridge is a cartridge in which at least one of the electrophotographic photosensitive member and the process means acting thereon are integrally formed into a cartridge, and the process cartridge is mountable to and dismountable from the main assembly (apparatus main assembly) of the electrophotographic image forming apparatus. Examples of process means include charging means, developing means and cleaning means.

[0081] As shown in Figure 3, the cleaning unit 60 includes a drum 62, a charging roller 66, a cleaning member 77, and a cleaning frame 71 for supporting them. On the drive side of the drum 62, the drive side drum flange 63 provided on the drive side is rotatably supported by the hole 73a of a drum bearing 73. In a broad sense, the drum bearing 73 plus the cleaning frame 71 can be called a cleaning frame.

[0082] As shown in Figure 5, on the non-driving side, the hole portion (not

shown) of the non-driving side drum flange is rotatably supported by the drum shaft 78 press-fitted in the hole portion 71c provided in the cleaning frame 71 and is constituted to be supported.

[0083] Each drum flange is a supported portion rotatably supported by the bearing portion.

[0084] In the cleaning unit 60, the charging roller 66 and the cleaning member 77 are disposed in contact with the outer peripheral surface of the drum 62.

[0085] The cleaning member 77 includes a rubber blade 77a which is a blade-shaped elastic member formed of rubber as an elastic material, and a support member 77b which supports the rubber blade. The rubber blade 77a is counterdirectionally in contact with the drum 62 with respect to the rotational direction of the drum 62. In other words, the rubber blade 77a is in contact with the drum 62 so that the tip portion thereof faces the upstream side in the rotational direction of the drum 62.

[0086] As shown in Figure 3, the waste toner removed from the surface of the drum 62 by the cleaning member 77 is stored in the waste toner chamber 71b formed by the cleaning frame 71 and the cleaning member 77.

[0087] Also, as shown in Figure 3, a scooping sheet 65 for preventing the waste toner from leaking from the cleaning frame 71 is provided at the edge of the cleaning frame 71 so as to be in contact with the drum 62.

[0088] The charging roller 66 is rotatably mounted in the cleaning unit 60 by way of charging roller bearings (not shown) at the opposite end portions in the longitudinal direction of the cleaning frame 71.

[0089] Furthermore, the longitudinal direction of the cleaning frame 71 (the longitudinal direction of the cartridge B) is substantially parallel to the direction (the axial direction) in which the rotational axis of the drum 62 extends. Therefore, in the case of simply referring to the longitudinal direction or merely

the axial direction without particular notice, the axial direction of the drum 62 is intended.

[0090] The charging roller 66 is pressed against the drum 62 by the charging roller bearing 67 being pressed toward the drum 62 by the biasing member 68. The charging roller 66 is rotationally driven by the drum 62.

[0091] As shown in Figure 3, the developing unit 20 includes a developing roller 32, a developing container 23 which supports the developing roller 32, a developing blade 42, and the like. The developing roller 32 is rotatably mounted in the developing container 23 by bearing members 27 (Figure 5) and 37 (Figure 4) provided at the opposite ends.

[0092] Also, inside the developing roller 32, a magnet roller 34 is provided. In the developing unit 20, a developing blade 42 for regulating the toner layer on the developing roller 32 is provided. As shown in Figure 4 and Figure 5, the gap maintaining member 38 is mounted to the developing roller 32 at the opposite end portions of the developing roller 32, and the gap maintaining member 38 and the drum 62 are in contact with each other, so that the developing roller 32 is held with a small gap from the drum 62. Also, as shown in Figure 3, a blowing prevention sheet 33 for preventing toner from leaking from the developing unit 20 is provided at the edge of the bottom member 22 so as to be in contact with the developing roller 32. In addition, in the toner chamber 29 formed by the developing container 23 and the bottom member 22, a feeding member 43 is provided. The feeding member 43 stirs the toner accommodated in the toner chamber 29 and conveys the toner to the toner supply chamber 28.

[0093] As shown in Figures 4 and 5, the cartridge B is formed by combining the cleaning unit 60 and the developing unit 20.

[0094] In the first step to join the developing unit and the cleaning unit with each other, the center of the developing first support boss 26a of the developing

container 23 with respect to the first hanging hole 71i on the driving side of the cleaning frame 71, and the center of the developing second supporting boss 23b with respect to the second suspending hole 71j on the non-driving side are aligned with each other. More particularly, by moving the developing unit 20 in the direction of the arrow G, the first developing supporting boss 26a and the second developing supporting boss 23b are fitted in the first hanging hole 71i and the second hanging hole 71j. By this, the development unit 20 is movably connected to the cleaning unit 60. More specifically, the developing unit 20 is rotatably (rotatably) connected to the cleaning unit 60. After this, the cartridge B is constructed by assembling the drum bearing 73 to the cleaning unit 60.

[0095] Also, the first end portion 46 La of the driving side biasing member 46 L is fixed to the surface 23c of the developing container 23, and the second end portion 46 Lb abuts against the surface 71k which is a part of the cleaning unit.

[0096] Also, the first end 46 Ra of the non-driving side biasing member 46 R is fixed to the surface 23k of the developing container 23 and the second end 46Rb is in contact with the surface 71l which is a part of the cleaning unit.

[0097] In this embodiment, the driving side urging member 46L (Figure 5) and the non-driving side urging member 46R (Figure 4) comprises compression springs, respectively. The urging force of these springs urges the developing unit 20 against the cleaning unit 60 to urge the developing roller 32 reliably toward the drum 62 by the driving side urging member 46L and the non-driving side urging member 46R. Then, the developing roller 32 is held at a predetermined distance from the drum 62 by the gap maintaining members 38 mounted to opposite end portions of the developing roller 32.

<Cartridge mounting>

[0098] Next, referring to part (a) and (b) of Figure 1, part (a) of Figure 6, part

(b) of Figure 6, part (c) of Figure 6, part (a) and part (a) of Figure 8, Part (b) of Figure 8, Part (a) of Figure 9, Part (a) of Figure 10 and part (b) of Figure 10, Part (a) of Figure 11, Part (a) and part (b) of Figure 12, part (a) of Figure 13, part (b) of Figure 13, Figure 14, Figure 15, Figure 16, and Figure 17, the mounting of the cartridge will be described in detail. Parts (a) and part (b) of Figure 1 are perspective views of cartridges for explaining the shape around the drive transmission part. Part (a) of Figure 6 is a perspective view of a cylindrical cam, part (b) of Figure 6 is a perspective view of the driving side plate as viewed from the outside of the apparatus main assembly A, and part (c) of Figure 6 is a sectional view in which a cylindrical cam is mounted to the driving side plate (The direction indicated by the arrow in part (b) of Figure 6). Part (a) of Figure 7 is a cross-sectional view of the image forming apparatus link portion for explaining the link structure, and part (b) of Figure 7 is a cross-sectional view of the image forming apparatus drive unit for explaining the movement of the drive transmission member. Part (a) of Figure 8 is a cross-sectional view of the driving side guide portion of the image forming apparatus for explaining the mounting of the cartridge, and Part (b) of Figure 8 is a cross-sectional view of the non-driving side guide portion of the image forming apparatus for explaining the mounting of the cartridge. Figure 9 is an illustration of the image forming apparatus driving train portion for explaining the positional relationship of the drive train before closing the opening/closing door. Part (a) of Figure 10 is an illustration just before engagement of the image forming apparatus positioning portion for explaining the positioning of the process cartridge B in the longitudinal direction. Part (b) of Figure 10 is an illustration after engagement of the image forming apparatus positioning portion for explaining the positioning of the process cartridge B in the longitudinal direction. Part (a) of Figure 11 is a drive-side cross-sectional view of the image forming apparatus for explaining the

positioning of the cartridge. Part (b) of Figure 11 is a non-driving side sectional view of the image forming apparatus for explaining the positioning of the cartridge. Part (a) of Figure 12 is a cross-sectional view of the image forming apparatus link portion for explaining the link structure, and Part (b) of Figure 12 is a cross-sectional view of the image forming apparatus drive portion for explaining the movement of the drive transmission member. Part (a) of Figure 13 is a perspective view of the drive transmission member for explaining the shape of the drive transmission member. Part (b) of Figure 13 is an illustration of the drive transmitting portion of the main assembly A for explaining the drive transmitting portion. Figure 15 is a perspective view of a drive unit of the image forming apparatus for explaining the engagement space of the drive transmitting portion. Figure 16 is a cross-sectional view of the drive transmission member for explaining the engagement space of the drive transmission member. Figure 17 is a sectional view around the drum 62 of the apparatus main assembly A for explaining the arrangement of the developing roller gear. Figure 18 is a cross-sectional view of the drive transmission member for explaining the engagement of the drive transmission member.

[0099] First, a state in which the opening/closing door of the apparatus main assembly A is opened will be described. As shown in part (a) of Figure 7, in the main assembly An of the apparatus, an opening/closing door 13, a cylindrical cam link 85, a cylindrical cam 86, cartridge pressing members 1, 2, cartridge pressing springs 19, 21 and a front plate 18 are provided. Also, as shown in part (b) of Figure 7, in the main assembly An of the device, there are provided a drive transmission member bearing 83, a drive transmission member 81, a drive transmission member biasing spring 84, a driving side plate 15, and a non-driving side plate 16 (part (a) of Figure 10)

[0100] The opening/closing door 13 is rotatably mounted on the driving side plate 15 and the non-driving side plate 16. As shown in part (a) of Figure 6, part (b) of Figure 6, and part (c) of Figure 6, the cylindrical cam 86 is rotatable on the drive side plate 15 and movable in the longitudinal direction AM, and it has two inclined surface portions 86a, 86b, and furthermore, it has one end portion 86c continuous with the slope on the non-driving side in the longitudinal direction. The driving side plate 15 has two inclined surface portions 15d and 15e opposed to the two inclined surface portions 86a and 86b and an end surface 15f opposed to the one end portion 86c of the cylindrical cam 86. As shown in part (a) of Figure 7, the cylindrical cam link 85 is provided with bosses 85a, 85b at the opposite ends. The bosses 85a, 85b are rotatably mounted to the mounting hole 13a provided in the opening/closing door 13 and the mounting hole 86e provided in the cylindrical cam 86, respectively. When the opening and closing door 13 is rotated and opened, the rotating cam link 85 moves in interrelation with the opening/closing door 13. The cylindrical cam 86 is rotated by the movement of the rotating cam link 85, and the inclined surfaces 86a, 86b first contact the inclined surface portions 15d, 15e provided on the driving side plate 15. When the cylindrical cam 86 further rotates, the inclined surface portions 86a, 86b slide along the inclined surface portions 15d, 15e, whereby the cylindrical cam 86 moves to the driving side in the longitudinal direction. Finally, the cylindrical cam 86 moves until the one end portion 86c of the cylindrical cam 86 abuts against the end surface 15f of the driving side plate 15.

[0101] Here, as shown in part (b) of Figure 7, the drive transmission member 81 is fitted to the drive transmission member bearing 83 at one end (fixed end 81c) on the drive side in the axial direction, and is supported so as to be rotatable and movable in the axial direction. Also, in the drive transmission member 81, the central portion 81d in the longitudinal direction has a clearance M relative to

the drive side plate 15. Also, the drive transmission member 81 has an abutment surface 81e, and the cylindrical cam 86 has the other end portion 86d opposite to the abutment surface 81e. The drive transmission member spring 84 is a compression spring, wherein one end portion 84a is in contact with a spring seat 83a provided on the drive transmission member bearing 83, and the other end portion 84b is in contact with a spring seat 81f provided on the drive transmission member 81. By this, the drive transmission member 81 is urged toward the non-drive side in the axial direction (left side in part (b) of Figure 7). By this urging, the abutment surface 81e of the drive transmission member 81 and the other end portion 86d of the cylindrical cam 86 are in contact with each other.

[0102] When the cylindrical cam 86 moves in the longitudinal direction toward the driving side (the right side in part (b) of Figure 7), the drive transmission member 81 is pushed by the cylindrical cam 86 and moves toward the drive side as described above. This causes the drive transmission member 81 to be in the retracted position. In other words, the drive transmission member 81 retracts from the movement path of the cartridge B, thereby securing the space for mounting the cartridge B in the image forming apparatus main assembly A.

[0103] Next, the mounting of the cartridge B will be described. As shown in part (a) of Figure 8 and part (b) of Figure 8, the driving side plate 15 has an upper guide rail 15 g and a guide rail 15h as a guide means, and the non-driving side plate 16 has a guide rail 16d and a guide rail 16e. Also, the drum bearing 73 provided on the driving side of the cartridge B has a guided portion 73 g and a rotation stopped portion 73c. In the mounting direction of the cartridge B (arrow C), the guided portion 73 g and the rotation stopping portion 73c are disposed on the upstream side of the axis of the coupling projection 63b (see part (a) of Figure 1, details will be described later) (Arrow AO side in Figure 16).

[0104] The direction in which the cartridge B is mounted is substantially perpendicular to the axis of the drum 62. In the case that upstream or downstream in the mounting direction is referred to, upstream and downstream are defined in the movement direction of the cartridge B just before the mounting to the apparatus main assembly A is completed.

[0105] Further, the cleaning frame 71 is provided with positioned portion (a portion to be positioned) 71d and a rotation stopped portion 71g on the non-driving side in the longitudinal direction. When the cartridge B is mounted through the cartridge inserting port 17 of the apparatus main assembly A, the guided portion 73g and the rotated stop portion 73c of the driven side of the cartridge B is guided by the guide rail 15g and the guide rail 15h of the main assembly A. In the non-driving side of the cartridge B, the positioned portion 71d and the rotation stopped portion 71g are guided by the guide rail 16d and the guide rail 16e of the apparatus main assembly A. By this, the cartridge B is mounted in the apparatus main assembly A.

[0106] Here, a developing roller gear (developing gear) 30 is provided at the end portion of the developing roller 32 (Figure 9 and part (b) of Figure 13). That is, the developing roller gear 30 is mounted on the shaft portion (shaft) of the developing roller 32.

[0107] The developing roller 32 and the developing roller gear 30 are coaxial with each other and rotate about the axis Ax2 shown in Figure 9. The developing roller 32 is disposed such that the axis Ax2 thereof is substantially parallel to the axis Ax1 of the drum 62. Therefore, the axial direction of the developing roller 32 (developing roller gear 30) is substantially the same as the axial direction of the drum 62.

[0108] The developing roller gear 30 is a drive input gear (a cartridge side gear, a driving input member) to which a driving force is inputted from the

outside of the cartridge B (that is, the apparatus main assembly A). The developing roller 32 is rotated by the driving force received by the developing roller gear 30.

[0109] As shown in parts (a) and part (b) of Figure 1, an open space 87 is provided on the side of the driving side of the cartridge B on the drum 62 side of the developing roller gear 30, so that the developing roller gear 30 and the coupling projection 63b is exposed to the outside.

[0110] The coupling projection 63b is formed on the drive side drum flange 63 mounted on the end of the drum (Figure 9). Coupling projection 63b is a coupling portion (drum side coupling portion, cartridge side coupling portion, photosensitive member side coupling portion, input coupling portion, drive input portion) (Figure 9), To which A driving force is inputted from the outside of the cartridge B (that is, the apparatus main assembly A). The coupling projection 63b is disposed coaxially with the drum 62. In other words, the coupling projection 63b rotates about the axis Ax1.

[0111] The driving side drum flange 63 including the coupling projection 63b may be referred to as a coupling member (a drum side coupling member, a cartridge side coupling member, a photosensitive member side coupling member, a drive input coupling member, a input coupling member) is there.

[0112] Also, in the longitudinal direction of the cartridge B, the side on which the coupling projection 63b is provided is the drive side, and the opposite side corresponds to the non-drive side.

[0113] Also, as shown in Figure 9, the developing roller gear 30 has a gear portion (input gear portion, cartridge side gear portion, developing side gear portion) 30a and an end surface 30a1 on the driving side of the gear portion (Parts (a), part (b) thereof, and Figure 9 in Figure 1). Teeth (gear teeth) formed on the outer periphery of the gear portion 30a are helical teeth inclined with respect to

the axis of the developing roller gear 30. In other words, the developing roller gear 30 is a helical tooth gear (part (a) in Figure 1).

[0114] Here, helical tooth also includes a shape in which a plurality of projections 232a are arranged along a line inclined with respect to the axis of the gear to substantially form the helical tooth portion 232b (Figure 14). In the structure shown in Figure 14, the gear 232 has a large number of projections 232b on its circumferential surface. And the set of five projections 232b can be regarded as forming a row inclined with respect to the axis of the gear. Each of the rows of these five projections 232b corresponds to the tooth of the aforementioned gear portion 30a.

[0115] The drive transmission member (drive output member, main assembly side drive member) 81 has a gear portion (main assembly side gear portion, output gear portion) 81a for driving the developing roller gear 30. The gear portion 81a has an end surface 81a1 at the end on the non-driving side (parts (a), part (b) thereof of Figure 13).

[0116] The teeth (gear teeth) formed on the gear portion 81a are also helical teeth inclined with respect to the axis of the drive transmission member 81. In other words, the helical gear portion is also provided on the drive transmission member 81.

[0117] Also, the drive transmission member 81 is provided with a coupling recess 81b. The coupling recess 81b is a coupling portion (main assembly side coupling portion, output coupling portion) provided on the device main assembly side. The coupling recess 81b is formed by forming a recess capable of coupling with a coupling projection 63b provided on the drum side, in a projection (cylindrical portion) provided at the free end portion of the drive transmission member 81.

[0118] The space (space) 87 (Figure 1) constituted so that the gear portion 30a

and the coupling projection 63b are exposed allows the gear portion 81a of the drive transmission member 81 to be placed when the cartridge B is mounted in the apparatus main assembly A. Therefore, the space 87 is larger than the gear portion 81a of the drive transmission member 81 (Figure 15).

[0119] More specifically, in the cross section of the cartridge B that passes through the gear portion 30a and that is perpendicular to the axis of the drum 62 (the axis of the coupling projection 63b), an imaginary circle having the same radius as that of the gear portion 81a is drawn about the axis of the drum 62 (the axis of the coupling projection 63b). Then, the inside of the imaginary circle is a space where no constituent element of the cartridge B exists. The space defined by this imaginary circle is included in the space 87 mentioned above. That is, the space 87 is larger than the space defined by the imaginary circle.

[0120] The following is the explanation of this another way. In the above cross section, an imaginary circle concentric with the drum 62 (coaxially) is drawn with the radius as the distance from the axis of the drum 62 to the tooth tip of the gear portion 30a of the developing roller 30. Then, the inside this imaginary circle is a space (space) where no constituent elements of cartridge B exists.

[0121] Since the space 87 exists, the drive transmission member 81 does not interfere with the cartridge B when the cartridge B is mounted to the apparatus main assembly A. As shown in Figure 15, the space 87 permits the mounting of the cartridge B to the apparatus main assembly A by placing the drive transmission member 81 therein.

[0122] Also, as sing the cartridge B along the axis line of the drum 62 (the axis of the coupling projection 63b), the gear teeth formed in the gear portion 30a are disposed in a position close to the peripheral surface of the drum 62.

[0123] As shown in Figure 16, a distance AV (the distance along the direction

perpendicular to the axis) from the axis of the drum 62 to the free end portion of the gear tooth of the gear portion 30a (tooth tip) is 90 % Or more and 110 % or less of the radius of the drum 62.

[0124] In particular, in this embodiment, the radius of the drum 62 is 12 mm, and the distance from the axis of the drum 62 to the free end portion of the gear tooth of the gear portion 30a (tooth tip) is 11.165 mm or more and 12.74 or less. In other words, the distance from the axis of the drum 62 to the free end portion of the gear tooth of the gear portion 30a (tooth tip) is within the range of 93 % to 107 % of the radius of the drum.

[0125] In the longitudinal direction, the end surface 30a1 of the gear portion 30a of the developing roller gear 30 is disposed so as to be positioned at the position closer to the driving side (outside of the cartridge B) than the leading end portion 63b1 of the coupling projection 63b of the driving side drum flange 63 (Figure 9, Figure 33).

[0126] By this, in the axial direction of the developing roller gear 30, the gear teeth of the gear portion 30a have exposed portions exposed from the cartridge B (Figure 1). Especially in this embodiment, as shown in Figure 16, the range of 64 ° or more of the gear portion 30a is exposed. In other words, When a line connecting the center of the drum 62 and the center of the developing roller gear 30 is taken as a reference line, as the cartridge B is seen from driving side, both sides of the developing roller gear 30 with respect to this reference line are exposed at least in a range of 32 degrees or more. In Figure 16, the angle AW indicates the angle from the reference line to the position where the gear portion 30a starts to be covered by the driving side developing side member 26 with the center (axis) of the developing roller gear 30 as the origin, and $AW \geqq 32^{\circ}$ is satisfied.

[0127] The total exposure angle of the gear portion 30a can be expressed as

2AW, and as described above, the relationship of 2AW $\geqq$ 64 $^{\circ}$ is satisfied.

If the gear portion 30a of the developing roller gear 30 is exposed from the driving side developing side member 26 so as to satisfy the above relationship, the gear portion 81a meshes with the gear portion 30a without interfering with the driving side developing side member 26, And therefore drive transmission is possible.

And, at least a part of the exposed portion of this gear portion 30a is disposed on more outside (drive side) of the cartridge B than the leading end 63b1 of the coupling projection 63b and faces the axis of the drum (Figure 1, Figure 9, Figure 33). In Figures 9 and 33, the gear teeth disposed on the exposed portion 30a3 of the gear portion 30a face the rotational axis Ax1 of the drum 62 (rotational axis of the coupling portion 63b) Ax1. In Figure 33, the axis Ax1 of the drum 62 is above the exposed portion 30a3 of the gear portion 30a.

[0128] In Figure 9, at least a part of the gear portion 30a projects toward the driving side beyond the coupling projection 63b in the axial direction, so that the gear portion 30a overlaps the gear portion 81a of the drive transmission member 81 in the axial direction. And, a part of the gear portion 30a is exposed so as to face the axis Ax1 of the drum 62, and therefore, the gear portion 30a and the gear portion 81a of the drive transmission member 81 can come into contact with each other in the course of inserting the cartridge B into the apparatus main assembly A.

[0129] Figure 33 shows a state in which the outer end portion 30a1 of the gear portion 30a is disposed on the arrow D1 side of the free end portion 63b1 of the coupling projection 63b. The arrow D1 extends toward the outside in the axial direction.

[0130] Because of the above-described arrangement relationship, the gear portion 30a of the developing roller gear 30 and the gear portion 81a of the drive

transmission member 81 can be brought into meshing engagement with each other in the process of mounting the above-described cartridge B to the apparatus main assembly A.

[0131] Furthermore, in the mounting direction C of the cartridge B, the center (axis) of the gear portion 30a is disposed on the upstream side (the side of the arrow AO in Figure 16) of the center (axis) of the drum 62.

The arrangement of the developing roller gear 30 will be described in more detail. As shown in Figure 17 which is a sectional view as viewed from the non-driving side, the line connecting between the center of the drum 62 and the center of the charging roller 66 is defined as a reference line (starting line) providing the angle reference (0 °). At this time, the center (axis) of the developing roller gear 30 is in the angle range of 64 ° to 190 ° from the reference line to the downstream side of the rotational direction of the drum 62 (clockwise direction in Figure 17).

Strictly speaking, the half line extending from the center of the drum 62 to the center of the charging roller 66 from the center of the drum 62 is taken as the starting line, and the rotational direction of the drum is taken as a positive direction of the angle. Then, the angle on the polar coordinate formed about the center of the developing roller satisfies the following relationship.

64 ° ≦ angle on the polar coordinates having the center of developing roller ≦ 190 ° .

[0132] There is a certain degree of latitude in the arrangement of the charging roller 66 and the arrangement of the developing roller gear 30. The angle when the charging roller 66 and the developing roller gear 30 are closest to each other is indicated by an arrow BM, and as described above, it is 64 ° in this embodiment. On the other hand, the angle when the two are most remote from each other is indicated by an arrow BN, which is 190 ° in this embodiment.

[0133] Furthermore, as described above, the unit (developing unit 20) provided with the developing roller gear 30 can move relative to the unit (cleaning unit 60) provided with the drum 62 and the coupling projection 63b. That is, The developing unit 20 is rotatable relative to the cleaning unit 60 about the development first support boss 26a and the second development support boss 23b (Figures 4, 5) as the rotation center (rotation axis). Therefore, the distance between the centers of the developing roller gear 30 and the drum 62 (the distance between the axes) is variable, and the developing roller gear 30 can move within a certain range relative to the axis of the drum 62 (the axis of the coupling projection 63b).

[0134] As shown in Figure 9, when the gear portion 30a and the gear portion 81a contact each other during the process of inserting the cartridge B, the gear portion 30a is pushed by the gear portion 81a to be away from the axis of the drum 62 (the axis of the coupling projection 63b). This weakens the impact of the contact between the gear portion 30a and the gear portion 81a.

[0135] As shown in part (a) of Figure 10 and part (b) of Figure 10, the drum bearing 73 is provided with a portion 73h to be engaged (engaged portion) as a part to be positioned (axial aligned portion) in the longitudinal direction (axial direction).

[0136] The driving side plate 15 of the apparatus main assembly A has an engaging portion 15j which can engaged with the engaged portion 73h. The engaged portion 73h of the cartridge B is engaged with the engaging portion 15j of the apparatus main assembly An in the above-described mounting process, whereby the position, in the longitudinal direction (axial direction), of the cartridge B is determined, (Part (b) of Figure 10). In addition, in this embodiment, the engaged portion 73h is in the form of a slit (groove) (part (b) of Figure 1). This slit communicates with the space 87. That is, the slit (the fitted

portion 73h) forms a space opened (open) to the space 87.

[0137] Referring to Figure 33, the position of the engaged portion 73h will be described in detail. Figure 33 is an illustration (schematic diagram) showing the arrangement of the engaged portion 73h with respect to the gear portion 30a or the coupling projection 63b. As shown in Figure 33, the slit (engaged with portion 73h) is a space formed between two portions (the outer portion 73h1 and the inner portion 73h2 of the engaged portion 73h) arranged along the axial direction the. In the axial direction, the inner end portion (the inner portion 73h2) of the engaged portion 73h is disposed inside (on the arrow D2 side) the outer end portion 30a1 of the gear portion 30a. In the axial direction, the outer end portion (outer portion 73h1) of the fitted portion 73h is disposed on the side (arrow D1 side) outer than the free end portion 63b of the coupling projection 63b.

[0138] Next, the state of closing the door 13 will be described. As shown in part (a) of Figure 8, part (b) of Figure 8, part (a) of Figure 11, part (b) of Figure 11, the driving side plate 15 has an upper positioning portion 15a, A lower positioning portion 15b, and a rotation stopper portion 15c. As a positioning part, the non-driving side plate 16 has a positioning portion 16a and a rotation stopping portion 16c. The drum bearing 73 includes an upper portion to be positioned (positioned portion) (a first portion to be positioned (positioned portion), a first projection, a first projecting portion) 73d, a lower portion to be positioned (positioned portion) (a second portion to be positioned (positioned portion), a second projection, a second overhanging portion) 73f.

[0139] Also, the cartridge pressing members 1 and 2 are rotatably mounted to the opposite axial ends of the opening/closing door 13. The cartridge pressing springs 19, 21 are mounted to the opposite ends in the longitudinal direction of the front plate provided in the image forming apparatus A, respectively. The drum bearing 73 is provided with a portion 73e to be pressed (pressed portion) as

the urging force receiving portion, and the cleaning frame 71 has a portion 71o to be pressed (pressed portion) on the non-driving side (Figure 3). By closing the door 13, the pressed portions 73e, 71o of the cartridge B are pressed by the cartridge pressing members 1, 2 urged by the cartridge pressing springs 19, 21 of the apparatus main assembly A.

[0140] By this, on the drive side, the upper positioned member 73d, the lower positioned member 73f, and the rotation stopping member 73c of the cartridge B are contacted to the upper positioning portion 15a, the lower positioning portion 15b, the rotation stopping portion 15c, respectively. By this, cartridge B and drum 62 are positioned relative to each other on the driving side. Also, on the non-driving side, the to-be-positioned portion 71d of the cartridge B and the rotation-stopped portion 71 g come into contact with the positioning portion 16a and the rotation stopper portion 16c of the apparatus main assembly A, respectively. By this cartridge B and drum 62 are positioned with each other on the non-driving side.

[0141] As shown in parts (a) and part (b) of Figure 1, the upper positioned member 73d and the lower positioned member 73f are placed in the neighborhood of the drum. Also, the upper positioned member 73d and the lower positioned member 73f are aligned along the rotational direction of the drum 62.

[0142] Also, in the drum bearing 73, it is necessary to secure a space (arcuate recess) 73l for disposing the transfer roller 7 (Figure 11) between the upper positioned portion 73d and the lower positioned portion 73f. Therefore, the upper positioned portion 73d and the lower positioned portion 73f are arranged apart from each other.

[0143] Also, the upper positioned 73d and the lower positioned portion 73f are projections projecting inward in the axial direction from the drum bearing 73.

As described above, it is necessary to secure a space 87 around the coupling projection 63b. Therefore, the upper positioning portion 73d and the lower positioning portion 73f do not project outward in the axial direction, but instead they project inward to secure the space 87.

[0144] The upper positioned portion 73d and the lower positioned portion 73f are projections arranged so as to partially cover the photosensitive drum 62. In other words, the positioned portions 73d, 73f are overhanging portions that project inward axial direction of the photosensitive drum 62. When the upper positioned portion 73d and the photosensitive drum 62 are projected on the axis of the drum 62, at least some of the projected areas of the upper positioned portion 73d and the photosensitive drum 62 overlap each other. In this regard, the lower positioned portion 73f is the same as the upper positioned portion 73d.

[0145] Also, the upper positioned portion 73d and the lower positioned portion 73f are disposed so as to partially cover the driving side drum flange 63 provided at the end of the photosensitive drum 62. When the upper positioned portion 73d and the driving side drum flange 63 are projected on the axis of the drum 62, at least parts of the projected areas of the upper positioned 73d and the driving side drum flange 63 overlap each other. In this regard, the lower positioned portion 73f is the same as the upper positioned portion 73d.

[0146] The pressed portions 73e and 71o are projecting portions of the frame of the cleaning unit arranged on one end side (drive side) and the other end side (non-drive side) of the cartridge B with respect to the longitudinal direction, respectively. Especially the pressed portion 73e is provided on the drum bearing 73. The pressed portions 73e and 71o project in a direction crossing the axial direction of the drum 62 and separating from the drum 62.

[0147] On the other hand, as shown in part (a) of Figure 12 and part (b) of Figure 12, the drive side drum flange 63 has a coupling projection 63b on the

drive side, and the coupling projection 63b has a free end portion 63b1 at the free end thereof. The drive transmission member 81 has a coupling recess 81b and a free end portion 81b1 of the coupling recess 81b on the non-driving side. By closing the opening/closing door 13, the cylindrical cam 86 is rotated along the inclined surface portions 86a, 86b along the inclined surface portions 15d, 15e of the driving side plate 15 by way of the rotating cam link 85 (the side approaching the cartridge B). By this, the drive transmitting member 81 at the retracted position moves to the non-drive side (the side approaching the cartridge B) in the longitudinal direction by the drive transmission member spring 84. Since the gear teeth of the gear portion 81a and the gear portion 30a are inclined with respect to the moving direction of the drive transmission member 81, the gear teeth of the gear portion 81a abuts to the gear teeth of the gear portion 30a by the movement of the drive transmission member 81. At this point of time, the movement of the drive transmission member 81 to the non-drive side is stopped.

[0148] Even after the drive transmission member 81 stops, the cylindrical cam 86 further moves to the non-drive side, and the drive transmission member 81 and the cylindrical cam 86 are separated.

[0149] Next, as shown in part (a) of Figure 1 and Figure 13, Figure 18, the drum bearing 73 has a recess bottom surface 73i. The drive transmitting member 81 has a bottom portion 81b2 as a positioning on the bottom of the coupling recess 81b. The coupling recess 81b of the drive transmission member 81 is a hole having a substantially triangular cross section. As viewed from the non-driving side (the cartridge side, the opening side of the recessed portion 81b), the coupling recessed portion 81b is twisted in the counterclockwise direction N as it goes to the driving side (the back side of the recessed portion 81b). The gear portion 81a of the drive transmission member 81 is a helical gear including gear teeth twisted in the counterclockwise direction N as approaching to the drive

side as viewed from the non-drive side (cartridge side). In other words, the coupling recess portion 81b and the gear portion 81a are inclined toward the rear end (fixed end 81c) of the drive transmission member 81 in a direction opposite to the rotational direction CW of the drive transmission member 81 (twisting).

[0150] The gear portion 81a and the coupling recess portion 81b are arranged on the axis of the drive transmission member 81 such that the axis of the gear portion 81a and the axis of the coupling recess portion 81b overlap each other. In other words the gear portion 81a and the coupling recess portion 81b are arranged coaxially (concentrically).

[0151] The coupling projection 63b of the driving side drum flange 63 has a substantially triangular cross-section and has a projection shape (protrusion, projection). The coupling projection 63b is twisted in the counterclockwise direction O from the drive side (the tip side of the coupling projection 63b) toward the non-drive side (the bottom side of the coupling projection 63b) (Figure 37). In other words, the coupling projection 63b is inclined (twisted) in the counterclockwise direction (the direction of rotation of the drum) as it is distant from the outside toward the inside of the cartridge in the axial direction.

[0152] Furthermore, in the coupling projection 63b, the portion (ridge line) forming the corner (the apex of the triangle) of the triangular prism is a driving force receiving portion which actually receives the driving force from the coupling recess portion 81b. The driving force receiving portion is inclined in the rotational direction of the drum as goes inward from the outside of the cartridge in the axial direction. Also, the inner surface (inner peripheral surface) of the coupling recessed portion 81b serves as a driving force applying portion for applying the driving force to the coupling projection 63b.

[0153] Furthermore, the shape of the cross-section of the coupling projection 63b and the coupling recess portion 81b is not a strict triangle (polygon) because

of the corners being beveled or rounded, but it is called a substantial triangle (polygon). In other words, the coupling projection 63b has a shape of substantially twisted triangular prism (polygonal prism). However, the shape of the coupling projection 63b is not limited to such a shape. The shape of the coupling projection 63b may be changed if it can be coupled with the coupling recess 81b, that is, if it can be engaged therewith and driven thereby. For example, three bosses 163a may be arranged at the apexes of the triangle shape, in which each boss 163a is twisted with respect to the axial direction of the drum 62 (Figure 19).

[0154] The gear portion 30a of the developing roller gear 30 is a helical gear and has a shape twisted (inclined) in the clockwise direction P from the drive side toward the non-drive side (Figure 37). In other words, the gear tooth (helical tooth) of the gear portion 30a is inclined in the clockwise direction P (the direction of rotation of the developing roller or the developing roller gear) in the axial direction of the gear portion 30a from the outside toward the inside of the cartridge (twisted). That is, the gear 30a is inclined (twisted) in the direction opposite to the rotational direction of the drum 62 as goes from the outside toward the inside in the axial direction.

[0155] As shown in Figure 13, the drive transmission member 81 is rotated by the motor (not shown) in the clockwise direction CW (reverse direction of arrow N in Figure 13) as viewed from the non-drive side (cartridge side). Then, thrust force (force generated in the axial direction) is generated by meshing engagement between the helical teeth of the gear portion 81a of the drive transmission member 81 and the gear portion 30a of the developing roller gear 30. The force FA in the axial direction (longitudinal direction) is applied to the drive transmission member 81, and the drive transmission member 81 tends to move toward the non-drive side (closer to the cartridge) in the longitudinal direction.

In other words, the drive transmission member 81 approaches and contacts to the coupling projection 63b.

[0156] In particular, in this embodiment, the gear portion 81a of the drive transmission member 81 has a tooth helicity so as to move by 5 to 8.7 mm per tooth in the axial direction (Figure 13). This corresponds to the helix angle of the gear portion 81a being 15 ° to 30 °. Further, the helix angle of the developing roller gear 30 (the gear portion 30a) is also 15 ° to 30 °. In this embodiment, 20 ° is selected as the helix angle between the gear portion 81a and the gear portion 30a.

[0157] Then, when the phases of the triangular portions of the coupling recess portion 81b and the coupling projection 63b are matched by rotation of the drive transmission member 81, the coupling projection 63b and the coupling recess portion 81b are engaged (coupled) with each other.

[0158] Then, when the projection 63b and the coupling recess portion 81b are engaged, an additional thrust force FC is produced because both the coupling recess portion 81b and the coupling projection 63b are twisted (inclined) with respect to the axis.

[0159] That is, a force FC directed toward the non-driving side in the longitudinal direction (the side approaching the cartridge) is applied to the drive transmitting member 81. This force FC and the above-described force FA together make the drive transmission member 81 move further in the longitudinal direction toward the non-drive side (approaching the cartridge). In other words, the coupling projection 63 brings the driving transmission member 81 close to the coupling projection 63b of the cartridge B.

[0160] The drive transmission member 81 attracted by the coupling projection 63b is positioned in the longitudinal direction (axial direction) by the free end portion 81b1 of the drive transmission member 81 contacting the recess bottom

surface 73i of the drum bearing 73.

[0161] Also, a reaction force FB of the force FC acts on the drum 62, and due to this reaction force (against force) FB, the drum 62 moves in the longitudinal direction toward the drive side (approaching the drive transmission member 81, the outside of the cartridge B). In other words the drum 62 and the coupling projection 63b are attracted toward the side of the drive transmission member 81. By this, the free end portion 63b1 of coupling projection 63b of the drum 62 abuts against bottom 81b2 of coupling recess 81b. By this, the drum 62 is also positioned in the axial direction (longitudinal direction).

[0162] That is, the coupling projection 63b and the coupling recess portion 81b are attracted toward each other, whereby the positions of the drum 62 and the drive transmission member 81 in the axial direction are determined.

[0163] In this state, the drive transmission member 81 is in the driving position. In other words, the drive transmission member 81 is in a position for transmitting the driving force to the coupling projection 63b and the gear portion 30b, respectively.

[0164] Also, the position of the center at the free end portion of the drive transmission member 81 is determined relative to the drive side drum flange 63 by the triangular alignment action of the coupling recess 81b. In other words, the drive transmission member 81 is aligned with the drum flange 63, and the drive transmission member 81 and the photosensitive member are coaxial. By this, the drive is transmitted from the drive transmission member 81 to the developing roller gear 30 and the driving side drum flange 63 with high accuracy.

[0165] The coupling recessed portion 81b and the coupling projection portion 63b engaging with the coupling recessed portion 81b can also be regarded as an aligning portion. That is, the engagement between the coupling recess 81b and the coupling projection 63b causes the drive transmission member 81 and the

drum to be coaxial with each other. Especially, the coupling recessed portion 81b is referred to as the main assembly side aligning portion (the aligning portion on the image forming apparatus side), and the coupling projecting portion 63b is referred to as the cartridge side aligning portion.

[0166] As explained above, the engagement of the coupling is assisted by the force FA and force FC acting on the drive transmission member 81 toward the non-drive side.

[0167] Also, by positioning the drive transmission member 81 by the drum bearing (bearing member) 73 provided in the cartridge B, it possible to improve the positional accuracy of the drive transmission member 81 relative to the cartridge B.

[0168] The positional accuracy in the longitudinal direction between the gear portion 30a of the developing roller gear 30 and the gear portion 81a of the drive transmission member 81 is improved, and therefore, the width of the gear portion 30a of the developing roller gear 30 can be reduced. It is possible to downsize the cartridge B and the apparatus main assembly A for mounting the cartridge B.

[0169] In summary of this embodiment, the gear portion 81a of the drive transmission member 81 and the gear portion 30a of the developing roller gear 30 have helical teeth. The helix teeth provide higher contact ratios of the gears than the spur teeth. By this, the rotation accuracy of the developing roller 30 is improved and the developing roller 30 rotates smoothly.

[0170] Also, the direction in which the helical teeth of the gear portion 30a and the gear portion 81a are inclined is selected so that the force (force FA and force FB) that the gear portion 30a and the gear portion 81a attract to each other is produced. In other words, by rotating in a state in which the gear portion 30a and the gear portion 81a mesh with each other, the coupling recess portion 81b provided in the drive transmission member 81 and the coupling provided in the

end portion of the photosensitive drum 62A force that brings the projection portion 63b closer to each other is generated. By this, the drive transmitting member 81 moves toward the cartridge B side, and the coupling recessed portion 81b approaches the coupling projecting portion 63b. This will assist coupling (coupling) between the coupling recess 81b and the coupling projection 63b. In other words, by the rotation in a state in which the gear portion 30a and the gear portion 81a are in meshing engagement with each other, a force is produced such that the coupling recess portion 81b provided in the drive transmission member 81 and the projection portion 63b provided in the end portion of the photosensitive drum 62 come closer to each other is produced. By this, the drive transmitting member 81 moves toward the cartridge B side, and the coupling recessed portion 81b approaches to the coupling projecting portion 63b. This assists coupling between the coupling recess 81b and the coupling projection 63b.

[0171] Also, the direction in which the coupling projection 63b (driving force receiving portion) is inclined with respect to the axis of the drum and the direction in which the helical teeth of the gear portion 30a of the developing roller gear 30 is inclined with respect to the axis of the gear portion 30a are opposite to each other (Figure 38). By this, not only by the force generated by the engagement (meshing engagement) of the gear portion 30a and the gear portion 81a but also by the force (coupling force) generated by engagement (coupling engagement) of the coupling projection 63b and the coupling recess portion 81b), The movement of the drive transmission member 81 is assisted. In other words, by the rotation of the coupling projection 63b and coupling recess 81b in the coupled state with each other, the coupling projection 63b and coupling recess 81b are attracted to each other. As a result, the coupling projection 63b and the coupling recess 81b stably engage (couple) with each

other.

[0172] The drive transmission member 81 is urged toward the coupling projection 63b by the elastic member (drive transmission member spring 84) (part (a) of Figure 7). According to this embodiment, the force of the drive transmission member spring 84 can be reduced, correspondingly to the force FA and the force FC (part (b) of Figure 13). Then, the frictional force between the drive transmission member spring 84 and the drive transmission member 81, which is produced when the drive transmission member 81 rotates, is also reduced, and therefore, the torque required to rotate the drive transmission member 81 is reduced. Additionally, the load applied to the motor for rotating the drive transmission member 81 can also be reduced. Also, sliding noise produced between the drive transmission member 81 and the drive transmission member spring 84 can also be reduced.

[0173] Furthermore, in this embodiment, the drive transmission member 81 is biased by the elastic member (spring 84), but the elastic member is not necessarily required. In other words, if the gear portion 81a and the gear portion 30a at least partly overlap in the axial direction, and the gear portion 81a and the gear portion 30a mesh with each other when the cartridges are mounted on the device main assembly, the elastic member can be eliminated. In other words in this case, when the gear portion 81a rotates, the force of attracting the coupling projection portion 63b and the coupling recess portion 81b to each other is produced by the engagement between the gear portion 81a and the gear portion 30a. That is, even if there is no elastic member (spring 84), the drive transmission member 81 approaches to the cartridge B due to the force generated by the meshing engagement between the gears. This established engagement of the coupling recess 81b with the coupling projection 63b.

[0174] In the absence of such an elastic member, the frictional force between

the elastic member and the drive transmission member 81 is not produced, and therefore, the rotational torque of the drive transmission member 81 further decreases. Also, it is possible to eliminate the sound generated by sliding motion between the drive transmission member 81 and the elastic member. Also, it is possible to reduce the number of parts of the image forming apparatus, and therefore, it is possible to simplify the structure of the image forming apparatus and to reduce the cost.

[0175] Also, the coupling projection 63b of the drive side drum flange 63 couples with the recess 81b of the drive transmission member 81 in the state that the drive transmission member 81 is rotating. Here, the coupling projection 63b is inclined (twisted) in the rotational direction of the photosensitive drum toward the inside from the outside of the cartridge with respect to the axial direction of the drum 62. In other words the coupling projection 63b is inclined (twisted) along the rotational direction of the drive transmission member 81, and therefore, the coupling projection 63b is easy to be coupled with the rotating recess portion 81b.

[0176] Furthermore, in this embodiment, the helical gear is used as the developing roller gear 30 that engages with the drive transmission member 81. However, another gear may be used as long as drive transmission is possible. For example, a thin spur tooth gear 230 that can enter the tooth gap 81e of the drive transmission member 81 is usable. The thickness of the flat teeth is set to 1 mm or less. Also in this case, the gear portion 81a of the drive transmission member 81 has helical teeth, and therefore, the force for directing the drive transmission member 81 toward the non-driving side is produced by the meshing engagement between the gear portion 81a and the spur gear 230 (Figure 21).

Furthermore, in this embodiment, as shown in parts (a) and part (b) of Figure 1, as the cartridge B is viewed from the driving side, the coupling

projection 63b (drum 62) rotates in the counterclockwise direction O, so that the developing roller gear 30 (the developing roller 32) rotates in the clockwise direction P.

[0177] However, it is also possible to employ a structure in which as viewing the cartridge B from the non-driving side, the coupling projection 63b (drum 62) rotates in the counterclockwise direction and the developing roller gear 30 (the developing roller 32) rotates in the clockwise direction. In other words, the layout of the main assembly A and cartridge B may be modified to make the directions of rotation of the coupling projection 63b (drum 62) and the developing roller gear 30 opposite to those in this embodiment. In any case, as viewing the coupling projection 63b and the developing roller gear 30 in the same direction, the coupling projection 63b and the developing roller gear 30 rotate in opposite directions. One of them rotates clockwise and the other rotates counterclockwise.

[0178] In other words, as the cartridge B is viewed in such a direction that the direction of rotation of the coupling projection 63b becomes counterclockwise (in this embodiment, the cartridge B is viewed from the driving side), the direction of the rotation of the developing roller gear 30 is clockwise.

[0179] Furthermore, in this embodiment, the developing roller gear 30 is used as the driving input gear engaging with the driving transmission member 81, but another gear may be used as the driving input gear.

[0180] Figure 22 shows the drive input gear 88 that meshes with the drive transmission member 81, the developing roller gear 80 provided on the developing roller, the idler gears 101 and 102, and the feeding gear (stirring gear, developer feeding gear) 103.

[0181] In Figure 22, the driving force is transmitted from the driving input gear 88 to the developing roller gear 80 by way of one idler gear 101. The idler

gear 101 and the developing roller gear 80 are a drive transmission mechanism (a cartridge side drive transmission mechanism, a development side drive transmission mechanism) for transmitting a driving force from the drive input gear 88 to the developing roller 32.

[0182] On the other hand, the idler gear 102 is a gear for transmitting the driving force from the drive input gear 88 to the stirring gear 103. The feeding gear 103 is mounted to the feeding member 43 (Figure 3), and the feeding member 43 is rotated by the driving force received by the feeding gear 103.

[0183] Furthermore, it is also possible to use a plurality of gears for transmitting the driving force between the driving input gear 88 and the developing roller gear 80. At this time, in order to set the rotational direction of the developing roller 32 in the direction of the arrow P (Figure 1), it is preferable to make the number of idler gears transmitting the driving force between the driving input gear 88 and the developing roller gear 80 odd. In Figure 22, to simplify the structure of the gear train, one structure of the idler gear is shown.

[0184] Furthermore, in other words regarding the number of gears, in order to provided the rotational direction of the developing roller 32 in the direction of the arrow P (Figure 1) and to transmit the driving to the developing roller 32, the cartridge B is provided with an odd number of gears. In the structure shown in Figure 22, the number of gears for transmitting the drive to the developing roller 32 is three, that is, the developing roller gear 80, the idler gear 101, and the driving input gear 88. On the other hand, in the structure shown in Figure 1, the number of gears for transmitting the drive to the developing roller 32 is one, that is, only the developing roller gears 32.

[0185] In other words, it will suffice if the cartridge B is provided with a drive transmission mechanism (a cartridge side drive transmission mechanism, a development side drive transmission mechanism) for rotating the developing

roller 32 in the same rotational direction as the drive input gear 88.

[0186] That is, as viewing the cartridge B in such a direction that the rotational direction of the driving input gear 88 becomes clockwise, the rotational direction of the developing roller 32 also rotates clockwise. In the structure shown in Figure 22, the rotational directions of the drive input gear 88 and the developing roller 32 are clockwise when the cartridge B is viewed from the driving side.

[0187] Furthermore, in the case of the structure shown in Figure 1 or the structure shown in Figure 22, the drive input gear (30, 88) is driven from the drive transmission member 81 independently from the coupling projection 63b "I" receive power. In other words, the cartridge B has two input portions (drive input portions) for receiving driving force from the outside of cartridge B (that is, apparatus main assembly A), one for the cleaning unit, and one for the developing unit.

[0188] In the structure in which the photosensitive drum (cleaning unit) and the developing roller (developing unit) independently receive drive force from the drive transmission member 81, there is an advantage that the stability of rotation of the photosensitive drum is enhanced. This is because there is no need to transmit the driving force (rotational force) between the photosensitive drum and another member (developing roller, for example), and therefore, when rotation unevenness occurs this different member (developing roller, for example), its rotation unevenness is less likely to affect the rotation of the photosensitive drum.

[0189] Also, in the structure of Figure 22, the force in the direction of the arrow FA (part (b) in Figure 13) is applied to the drive transmission member 81 to assist the coupling of the coupling recess portion 81b and the coupling projection 63b. For this, a load (torque) needs to be generated when the drive input gear 88 rotates. To say conversely, as long as a load is generated to rotate the drive input gear 88, the drive input gear 88 may not be constituted so as to

receive the driving force for rotating the developing roller 32.

[0190] For example, the driving force received by the driving input gear 88 may be transmitted only to the feeding member 43 (Figure 3) without being transmitted to the developing roller 32. However, in the case of such a structure with a cartridge including the developing roller 32, it is necessary to separately transmit the driving force to the developing roller 32. For example, a gear or the like for transmitting the driving force from the drum 62 to the developing roller 32 is required for the cartridge B.

< Coupling Engagement Condition >

[0191] Next, referring to Figure 1, part (a) of Figure 18, part (b) of Figure 24, part (a) of Figure 25, and part (b) of 25 and Figure 27, the conditions under which the coupling engages will be described. The part (a) of Figure 24 is a cross-sectional view of the image forming apparatus drive portion as viewed from the direction opposite to the mounting direction of the cartridge B in order to explain the distance of the drive transmitting portion. Part (b) of Figure 24 is a cross-sectional view of the image forming apparatus drive portion as viewed from the drive side for explaining a distance of the drive transmitting portion. Part (a) of Figure 25 is a cross-sectional view of the image forming apparatus drive portion as viewed from the drive side for explaining a gap of the coupling portion. Part (b) of Figure 25 is a cross-sectional view of the image forming apparatus drive portion as viewed from the drive side for explaining the gap of the coupling portion. Figure 27 is a sectional view of the image forming apparatus for explaining the range of a regulating portion (stopper) as viewed from the drive side.

[0192] As shown in parts (a) of Figure 1 and Figure 24 and part (b) of Figure 24, the drum bearing 73 is provided with an inclination regulating portion

(movement regulating portion, position regulating portion, stopper) 73j for regulating the movement of the drive transmission member 81 to restrict (suppress) the inclination of the drive transmission member 81

[0193] The drive transmission member 81 has a cylindrical portion 81i (part (a) of Figure 24) on the non-driving side (the side close to the cartridge B). The cylindrical portion 81i is a cylindrical portion (projection) in which the coupling recess 81b is formed.

[0194] As described above, at the stage when the drive transmission member 81 starts to rotate, the gear portion 81a of the drive transmission member 81 and the gear portion 30a of the developing roller gear 30 mesh with each other, as shown in Figure 9. On the other hand, the coupling recess 81b and the coupling projection 63b are not coupled, or the coupling therebetween is insufficient. Therefore, when the gear portion 81a transmits the driving force to the gear portion 30a, the meshing force FD (part (b) of Figure 24) is generated in the gear portion 81a by the engagement between the gears.

[0195] By the meshing force FD applied to the drive transmission member 81, the drive transmission member 81 is inclined. That is, as described above, only the fixed end 81c (see the part (a) of Figure 24: the end far from the cartridge B) of the drive transmission member 81 which is the end portion on the drive side is supported, and therefore, the drive transmission member 81 is inclined with the drive side end portion 81c (fixed end) as a fulcrum. Then, the end (free end, tip) of the drive transmission member 81 on the side where the coupling recess 81b is provided moves.

[0196] If the drive transmission member 81 is significantly inclined, the coupling recess 81b cannot be coupled with the coupling projection 63b. In order to avoid this, the restricting portion 73j is provided in the cartridge B, so that the inclination of the drive transmitting member 81 is restricted (regulated)

within a certain range. That is, when the drive transmission member 81 is inclined, the restriction portion 73j supports the drive transmission member 81, thereby suppressing the inclination thereof from increasing.

[0197] The regulating portion 73j of the drum bearing 73 has an arcuate curved surface portion provided so as to face the axis of the drum 62 (the axis of the coupling projection 63b). The restricting portion 73j can also be regarded as a projecting portion projecting so as to cover the drum axis. The structure is such that between the regulating portion 73i and the drum axis, there is provided a space in which the constituent elements of the process cartridge B are not disposed, and the drive transmission member 81 is disposed in this space. The regulating portion 73i faces the space 87 shown in Figure 1, and the regulating portion 73i forms an edge (outer edge) of the space 87.

[0198] The restricting portion 73j is disposed at a position where to suppress the movement (inclination) of the drive transmission member 81 by the meshing force FD can be suppressed.

[0199] The direction in which the meshing force FD is produced is determined by a transverse pressure angle α of the gear portion 81a (that is, the transverse pressure angle α of the developing roller gear 30). The direction in which the meshing force FD is generated is inclined relative to the direction (half line) LN extending from the center 62a of the photosensitive drum (that is, the center of the drive transmission member 81) toward the center 30b of the developing roller gear 30 by (90 + α) degrees toward the upstream AK in the rotational direction of the photosensitive drum 62.

[0200] In the twist angle helical gear with a helix angle of 20 °, the standard angle α is 21.2 °. The transverse pressure angles α of the gear portion 81a and the gear portion 30a of this embodiment are also 21.2 °. In this case, the inclination of the meshing force FD relative to the arrow LN is 111.2 °.

However, another value can be used as the transverse pressure angles of the gear portion 81a and the gear portion 30a can be employed, and the direction of the meshing force FD is also different in that case. The transverse pressure angle α also varies depending on the twist angle of the helical gear, and the transverse pressure angle α is preferably 20.6 degrees or more and 22.8 degrees or less.

[0201] In part (b) of Figure 24, when the half straight line FDa extending in the same direction as the direction of the meshing force FD is extended with the center 62a of the photosensitive drum as the start point, the restricting portion 73j is disposed so as to cross the half line FDa. Here, the half line FDa is a line provided by inclining (rotating) the half line LN by 90 + α degree toward the upstream side with respect to the rotational direction of the drum 62 with the center of the drum 62 as the origin (axis, fulcrum). In this embodiment, the half line FDa is inclined by 111.2 degrees relative to the half straight line LN.

[0202] It is not always necessary that the regulating portion 73j is disposed on this line FDa, and the regulating portion 73j is preferably disposed adjacent to the half line FDa. More specifically, it is desirable that at least a part of the regulating portion 73j is disposed somewhere in the range of plus or minus 15 ° with respect to the half line FDa. The half line FDa is a line obtained by rotating the half straight line LN toward the upstream side in the rotational direction of the drum 62 by (90 + α) degrees. Therefore, the regulating portion 73j is preferably in the range of (75 + α) degrees to (105 + α) degrees on the upstream side in the drum rotational direction with respect to the half straight line LN with the center of the drum 62 as the origin. Considering that the preferable value of the transverse pressure angle α is 20.6 degrees or more and 22.8 degrees or less, the preferable range in which the restricting portion 73j is disposed is 95.6 degrees or more and 127.8 degrees or less with respect to the half line LN. In this embodiment, the transverse pressure angle α is 21.2 degrees, and therefore,

the preferable range of the regulating portion 73j is 96.2 degrees or more and 126.2 degrees or less.

[0203] As another example of the preferable arrangement of the regulating portion 73j, a plurality of regulating portions 73j may be provided so that they are disposed separately on respective sides of the half line FDa with half line FDa interposed therebetween (Figure 26). In this case, too, the restricting portion 73j can be regarded as being disposed across the line FDa.

[0204] Further, it is preferable that the regulating portion 73j is disposed on the upstream side AO (Figure 16) of the center (axis) of the coupling projection 63b in the cartridge mounting direction C (part (a) of Figure 11). This is to prevent the restriction portion 73j from hindering the mounting of the cartridge B.

[0205] A range (region) in which the regulating portion 73j is disposed in the drum bearing 73 can also be described as follows.

[0206] In a plane perpendicular to the axis of the drum 62 (part (b) of Figure 24), a straight line LA passing through the center 62a of the drum 62 and the center 30b of the developing roller gear 30 is drawn. At this time, the restricting portion 73j is arranged on the side where the charging roller is disposed with respect to the straight line LA (that is, the side indicated by the arrow AL).

[0207] Alternatively, the restricting portion 73j is disposed in a region AL opposite to the side where the drum 62 is exposed (the side where the drum 62 faces the transfer roller 7) with respect to the line LA passing through the drum center 62a and the gear center 30b. Here, prior to mounting the cartridge B in the apparatus main assembly A, a cover or a shutter for covering the drum 62 may be provided in the cartridge B, and the drum 62 may not be exposed. In such a case, however, the side where the drum 62 is exposed means the side where the drum 62 is exposed when the cover, the shutter, and so on are removed.

[0208] Further, in the plane perpendicular to the axis of the photosensitive

drum 62, the range (region AL) in which the regulating portion 73j is arranged can also be described as follows, using the circumferential direction (rotational direction) of the photosensitive drum 62.

[0209] A half line (original line) LN extending from the center 62a of the drum 62 toward the center 30b of the gear portion 30a of the developing roller gear 30 is drawn. The region AL is a range (region) that is larger than 0 ° and does not exceed 180 ° toward the upstream side (arrow AK side) in the drum rotation direction with respect to the half line LN.

[0210] Further in other words, the range AL is in the upstream side (arrow AK side), with respect to the drum rotation direction O, of the center point MA between the drum center 62a and the developing roller gear center 3 b and is does not exceed a straight line (extension line) LA passing through the center 6 a of the drum 62 and the center 30b of the gear portion 30a of the developing roller gear 30

[0211] Further, in a state in which the opening/closing door 13 is opened and the drive transmitting member 81 is moved to the driving side, the regulating portion 73j is in a position overlapping the gear portion 81a of the drive transmission member 81 in the longitudinal direction. That is, the regulating portion 73j also overlaps the developing roller gear 30 in the longitudinal direction. As shown in Figure 34, when the developing roller gear 30 and the regulating portion 73j are projected on the axis line Ax2 of the developing roller gear 30, at least parts of their projected regions overlap each other. That is, the regulating portion 73j is close to the gear portion 81a (the gear portion 30a) where the meshing force is produced. Therefore, when the meshing force received by the drive transmission member 81 is supported by the restricting portion 73j, bending of the drive transmission member 81 is suppressed.

[0212] Also, in the axial direction, at least a part of the restricting portion 73j

is on the outer side (arrow D1 side in Figure 34) of the coupling projection 63b.

[0213] Next, the radial position of the regulating portion 73j with reference to the drum 62 will be described (part (a) of Figure 24).

[0214] The distances shown below are those (distances in the radial direction of the drum 62) measured along a direction perpendicular to the axial direction of the drum 62. Let S be the distance from the axis (center 62a) of the drum 62 to the regulating portion 73j. Let U be the radius of the tooth tip of the gear portion 81a of the drive transmission member 81. Let AC be the distance from the center 81j of the drive transmission member 81 to the radially outermost portion of the coupling recess. Let AD be the distance from the center 63d of the driving side drum flange 63 to the radially outermost portion of the coupling projection 63b. Let AA be the distance between the regulating portion 73j and the tooth tip of the gear portion 81a of the drive transmission member 81. And, let AB be an amount of deviation between the center of the coupling projection 63b and the center of the coupling recess 81b when the drive transmission member 81 is inclined by the amount of the gap relative to the regulating portion 73j (when the drive transmission member 81 is inclined and the gear portion 81a is in contact with the regulating portion 73j) (part (b) of Figure 25).

[0215] Then, a gap AA between the gear portion 81a of the drive transmission member 81 and the regulating portion 73j of the drum bearing 73 is as follows.

$$AA = S - U$$

[0216] In the following description, the distance is measured along the axial direction of the drive transmission member 81 from the fixed end 81c which is the fulcrum of the inclination of the drive transmission member 81. Let X be the distance in the axial direction from one end portion 81c of the drive transmission member 81 to the gear portion 81a. In addition, let W be the distance in the axial direction from one end portion 81c of the drive transmission

member 81 to the coupling recessed portion 81b.

[0217] The distance X and the distance W satisfy W > X.

Therefore, the misalignment amount AB between the regulating portion 73j and the gear portion 81a at the time when the drive transmission member 81 is inclined by the clearance AA is longer than the gap AA and is as follows.

AB = AA X (W / X)

[0218] Also, let V be the gap between the coupling projection 63b of the drive side drum flange 63 and the coupling recess 81a of the drive transmission member 81 in a state that there is no misalignment. Here, the gap V is the smallest value among the inter-surface distances of the two coupling portions (the distance measured along the direction perpendicular to the axis of the drum 62 and the radial distance).

[0219] In the state that the phases between the triangular shapes of the couplings are aligned, the shortest gap V is as follows.

V = AC - AD

[0220] In order for the coupling to engage even if the drive transmission member 81 is inclined by the clearance AA and the misalignment of the misalignment amount AB occurs between the couplings, the clearance V between the couplings may satisfy the following.

V = AC - AD > AB

[0221] That is, if the misalignment amount AB is smaller than the shortest gap V between the coupling projection 63b and the coupling recess portion 81b, the coupling projection 63b and the coupling recess portion 81b can tolerate the misalignment amount AB and are engaged.

[0222] If the phase of the coupling recess 81b with respect to the coupling projection 63b is different, the shortest gap V between the coupling portions also

is different. That is, if the phases of the coupling portions are not aligned, the shortest clearance V between the coupling projection 63b and the coupling recess portion 81b is smaller than (AC - AD). The gap V may be smaller than the misalignment amount AB, depending on the cases.

[0223] However, if there is at least one phase relationship satisfying "V > AB" between the two coupling portions, the coupling projection 63b and the coupling recess portion 81b are engaged. This is because the coupling recess 81b contacts the coupling projection 63b while rotating. It can be engaged (coupled) with the coupling projection 63b at the timing when the coupling recess 81b is rotated to such an angle as to satisfy "V > AB".

[0224] Further, as measuring the distance S from the center 62a of the drum 62 to the regulating portion 73i along the radial direction of the drum 62,

$$S = AA + U$$

Substituting "AB = AA x (W / X)" and "AA = S-U" for "V > AB"

$$V > (S - U) \times (W / X)$$

It will suffice if there is at least one phase relationship between the coupling projection 63b and the coupling recess 81b that satisfies this formula.

[0225] Further, the above equation is further modified and the condition of the distance S is as follows.

$$S < U + V \times (X / W)$$

In addition, it is preferable that when the drive transmission member 81 rotates, the restriction portion 73j does not contact the gear portion 81a, and therefore, it is preferable that the regulating portion 73j is separated from the tooth tip of the gear portion 81a. This is expressed as follows:

$$S > U$$

[0226] Together with the above relational expression,

$$U < S < U + V \times (X / W)$$

[0227] If the cross sectional shape of the coupling projection 63b and the cross sectional shape of the coupling recess 81b are substantially equilateral triangles as in this embodiment, the clearance V is maximized when the phases of the coupling portions are aligned. By substituting the value of V at this time into the above expression, the necessary S range is obtained.

[0228] The operation when the coupling engages will be described. Before the coupling recess 81b of the drive transmission member 81 and the coupling projection 63b of the drive side drum flange 63 are engaged with each other, the meshing force FD is applied to the drive transmission member 81. The meshing force FD is the force produced by the engagement between the gear portion 81a of the drive transmission member 81 and the gear portion 30a of the developing roller gear 30 as described above.

[0229] By the meshing force FD, the drive transmission member 81 is inclined with the drive transmission member bearing 83 as a fulcrum, in the direction FD in which the meshing force is applied, by the amount of the gap AA between the regulating portion 73j of the drum bearing 73 and the gear portion 81a. The misalignment AB of the coupling recess 81b and the coupling projection 63b provided by this inclination is smaller than the gap V between the coupling recess 81b and the coupling projection 63b in a predetermined phase. By this, when the drive transmission member 81 rotates, and the triangle phases of the coupling recess portion 81b and the coupling projection 63b become aligned with each other, the end surfaces of the couplings do not interfere with each other, so that the coupling recess portion 81b fits around the coupling projection 63b, and they are engaged with each other.

[0230] Here, an example of dimensions in which the above conditional expression is satisfied when the radius of the drum 62 is 12 mm will be described below.

[0231] In this embodiment, the dimensions of each part of the drive transmission member 81 applicable to the drum 62 having a radius of 12 mm are as follows. The distance AC from the center of the coupling recess 81b to the apex of the substantially equilateral triangular shape of the coupling recess 81b is 6.5 mm and the radius AE of the inscribed circle of substantially equilateral triangle shape of the coupling recess 81b is 4.65 mm. The substantially equilateral triangle shape of the coupling recess 81b is not a strictly equilateral triangle but its apex (corner) is beveled into an arc shape. The radius AF of the lightening portion 81b3 of the coupling recess portion is 4.8 mm, the radius U of the tip circle of the gear portion 81a of the coupling recess portion is 12.715 mm, the distance X from the one end portion 81c to the non-driving side end surface 81a1 is 30.25 mm, and the distance W from the one end portion 81c to the free end portion 81b1 of the coupling recess is 33.25 mm.

[0232] The shortest distance V between the coupling recess 81b and the coupling projection 63b satisfies the following relationship.

$$0 < V < 1.7$$

[0233] The lower limit of V occurs when the size of the triangular shape of the coupling recessed portion 81b is equal to the size of the triangular shape of the coupling projection 63b, and the lower limit value of V is "0". On the other hand, the upper limit of V occurs when the distance AC from the center of the coupling projection 63b to the apex is 4.8 mm which is the radius AF of the lightening portion of the coupling recess 81b. At this time, the clearance V (mm) between the coupling projection 63b and the coupling recess 81b is obtained as "1.7 = 6.5 - 4.8".

[0234] Substituting each value and V = 1.7 into the formula "U < S < U + V x (X / W)" previously given,

"12.715 < S < 14.262" (unit is mm).

[0235] It will be confirmed that the above is satisfied, using two examples, in the following.

[0236] First, in the first example, the dimensions are shown when the coupling projection 63b is made as large as possible within a range capable of engaging with the coupling recess 81b. At this time, the clearance V between the coupling projection 63b and the coupling recess 81b is minimum, and therefore, the allowable inclination of the drive transmission member 81 is small. Therefore, in order to reduce the inclination of the drive transmission member 81, it is necessary to make the regulating portion 73j closer to the regular position of the gear portion 81a.

[0237] On the other hand, in the second example, the dimensions are shown when the coupling projection 63b is made as small as possible within the range capable of engaging with the coupling recess 81b. At this time, the gap V between the coupling projection 63b and the coupling recess portion 81b is maximized, and therefore, even if the drive transmission member 81 is relatively greatly inclined, the coupling projection 63b and the coupling recess 81b can engage with each other. That is, the regulating portion 73j can relatively tolerate the inclination of the drive transmission member 81, and therefore, the regulating portion 73j can be relatively greatly spaced apart from the regular position of the gear portion 81a.

[0238] In the first example, the size of the coupling projection 63b is closest to the maximum and the radial direction amount of engagement between the coupling projection 63b and the coupling recess 81b (the region where both are engaged) is maximized. At this time, V (gap between couplings) approaches to the lower limit (minimum), and therefore, S (the distance from the center of the drum 62 to the regulating portion 73j) needs to approach to the lower limit (12.715 mm).

[0239] The distance AD from the center of the coupling projection 63b of the driving side drum flange 63 to the apex thereof is 6.498 mm. As described above, when the coupling projection 63b has a dimension slightly smaller than the distance 6.5 mm from the center of the coupling recess 81b to the apex of the triangle, the amount of radial direction amount of engagement between the coupling portions is substantially maximum. The radius AG of the inscribed circle inscribed in a triangle constituting the coupling projection 63b of the driving side drum flange 63 is 4.648 mm. Here, the substantially triangular shape possessed by the coupling projection 63b is not a strictly equilateral triangle but an apex (corner) is beveled into an arc shape.

[0240] At this time, the distance S from the center 62a of the drum 62 to the regulating portion 73j of the drum bearing is 12.716 mm which is slightly larger than the radius U of the addendum circle of the gear portion 81a.

[0241] By this, the clearance AA between the regulating portion 73j of the drum bearing and the gear portion 81a of the drive transmission member is 0.001 mm (= 12.716 - 12.715). Here, the misalignment amount AB between the coupling portions when the drive transmission member 81 is inclined by the gap AA relatively to the regulating portion 73j is amplified by the difference between the positions of the regulating portion 73j and the coupling portion in the longitudinal direction. The misalignment amount AB is 0.0011 mm (= 0.001 x 33.25 / 30.25). In addition, the shortest gap V between the coupling projection 63b and the coupling recess 81b when the phases of the coupling portions are aligned is 0.002 mm ("6.5 - 6.498" or "4.65 - 4.648", whichever is smaller).

[0242] Therefore, even if the drive transmission member 81 is inclined due to the meshing force, the gap V between the couplings is larger than the misalignment AB between the coupling portions, so that the engagement is possible.

[0243] As can be understood from the above description, the radial distance from the center of the drum 62 to the outermost portion of the coupling portion is preferably larger than 4.8 mm, and the radial distance from the center of the drum 62 to the regulating portion 73j is preferably larger than 12.715 mm.

[0244] In the second example, as described above, the size of the coupling projection 63b is made as small as possible and the radial amount of engagement between the coupling projection 61b and the coupling recess 81b (the region where both are engaged) is made as small as possible. At this time, V (gap between couplings) approaches the maximum (upper limit) and S (distance from the center of the drum 62 to the regulating portion 73j) can be close to the upper limit.

[0245] The distance AD between the center of the coupling projection 63b of the drive side drum flange 63 and the apex is 4.801 mm. This is a value slightly larger than the radius of 4.8 mm of the lightening 81b3 of the coupling recess 81b and is a diameter at which the amount of radial direction engagement between the couplings is almost minimum. If the distance AD of the coupling projection 63b is shorter than the radius of the lightening portion 81b3, the tip of the projection 63b does not engage with the coupling recess 81b with the result that the drive transmission is disabled.

[0246] At this time, the radius AG of the triangle inscribed circle of the coupling projection 63b is 2.951 mm.

[0247] The distance S between the center 62a of the drum 62 and the regulating portion 73j of the drum bearing is 14.259 mm.

[0248] As a result, the gap AA between the regulating portion 73j of the drum bearing 73 and the gear portion 81a of the drive transmission member 81 is 1.544 mm (= 14.259 - 12.715). Here, the misalignment amount AB between the coupling portions when the drive transmission member 81 is inclined by the

amount of the gap AA relative to the regulating portion 73j is amplified due to the positional difference in the longitudinal direction between the regulating portion 73j and the coupling portion, and it is 1.697 mm (= 1.544 x 33.25 / 30.25). In addition, the gap V between the coupling projection 63b and the coupling recess 81b when the phases of the coupling portions is in alignment with each other is 1.699 mm ("6.5 - 4.801" or "4.65 - 2.951, whichever is the smaller). Therefore, even if the drive transmission member 81 is inclined by the engagement force FD, the gap V between the couplings is larger than the misalignment AB between the coupling portions, so that the coupling projection 63b and the coupling recess 81b can be engaged.

[0249] As will be understood from the second example, it is preferable that the radial distance from the center of the drum 62 to the outermost portion of the coupling projection 63b is larger than 4.8 mm, and the radial distance from the center of the drum 62 to the restricting portion 73j is smaller than 14.262 mm.

[0250] In summary of the first and second examples, in this embodiment, the radial distance S from the center 62a of the drum 62 to the regulating portion 73j of the drum bearing is preferably larger than 12.715 mm and smaller than 14.262 mm.

[0251] Next, the case where the coupling projection 363b having a more general shape is used without limiting the shape of the coupling projection to a substantially regular triangle is taken as an example, and a preferable arrangement regarding the restricting portion 73j will be described as general. Here, the shape of the coupling recess is assumed to be a virtually strict equilateral triangle for the sake of convenience of explanation.

[0252] First, an example of a coupling projection including a general shape is shown in parts (a) and part (b) of Figure 28. The coupling projection 363b shown in parts (a) and part (b) of Figure 28 has a substantially cylindrical shape

and further has a projection 363b1 provided on the outer periphery of the column. The coupling projection 363b receives the driving force by the projection 363b1.

[0253] Referring to Figure 27, the case where the regulating portion is located most remote from the center of the drum will be described.

[0254] First, the minimum equilateral triangle BD circumscribing the coupling projection 363b is considered, and this regular triangle BD as a virtual coupling projection. Here, the center of gravity of the equilateral triangle BD is made to coincide with the center of the coupling projection 363b (the center of the drum 62), and the size of the equilateral triangle BD is minimized. After that, the arrangement of the restricting portion 73j corresponding to this virtual coupling projection (equilateral triangle DB) will be considered.

[0255] A circle inscribed in the imaginary coupling projection (regular triangle BD) is a circle BE, and the radius thereof is BA.

[0256] When the coupling recess has an equilateral triangular shape, the coupling recess needs to be larger than the equilateral triangle BD in order for the coupling recess to engage the imaginary coupling projection (equilateral triangle BD). That is, the size of the equilateral triangle BD can also be deemed as being the lower limit of the size that the coupling recess can have.

[0257] Next, the maximum shape that the coupling recess can have will be considered. First, the circle BU circumscribing the imaginary coupling projection (equilateral triangle BD) is considered, and the radius thereof is AZ. And, an equilateral triangle BQ having this circle BU as the inscribed circle is drawn. When the coupling recess has the shape of an equilateral triangle, the equilateral triangle BQ is the maximum (upper limit) of the equilateral triangle shape that can be selected as the coupling recess. If the coupling recess becomes larger than the equilateral triangle BQ, the coupling recess cannot contact with the imaginary coupling projection BD, and therefore, the drive

transmission is impossible. This equilateral triangle BQ is taken as the maximum coupling recess.

[0258] Let AY be the shortest distance between the equilateral triangles when these two equilateral triangles BD and BQ are in the same phase. Distance AY corresponds to the difference between the radius (AZ) of the inscribed circle BU inscribed in the equilateral triangle BQ and the radius (BA) of the inscribed circle BE inscribed in the equilateral triangle BD.

That is,

$$AY = AZ - BA$$

[0259] When the coupling recess is an equilateral triangle, the distance between the imaginary coupling projection and the coupling recess is the above-mentioned distance AY as the upper limit. If the misalignment distance of the coupling recess with respect to the virtual coupling projection is smaller than AY, the coupling recess can be engaged with the imaginary coupling projection.

[0260] The misalignment distance between the couplings is equal to or larger than the gap BC between the tooth tip of the gear portion 81a of the drive transmission member and the regulating portion 73j. Therefore, in order for the coupling recess to engage with the imaginary coupling projection BD, the gap BC between the gear portion 81a of the drive transmission member and the restricting portion 73j needs to be at least smaller than the distance AY. This is shown in the formula,

$$BC < AY$$

[0261] The gap BC is the difference between the distance BB from the drum center to the regulating portion 73j and the radius of the addendum circle of the gear portion 81a. As for the radius of the addendum circle of the gear portion 81a, the tooth tip of the gear portion 81a of the drive transmission member can extend to the tooth bottom of the gear portion 30a of the developing roller gear 30.

That is, the tooth tip of the gear portion 81a can be extended to such an extent that it does not reach the tooth bottom. If the shortest distance from the drum center to the bottom of the developing roller gear 30a is AX, the upper limit of the radius of the addendum circle 81a of the gear portion 81a is also AX.

[0262] Therefore, the gap BC between the tooth tip of the gear portion 81a and the regulating portion 73j is always larger than "BB-AX", that is,

BC > BB-AX The distance BB from the center of the drum to the restricting portion 73j using the relational expression of "BC > BB-AX" and the aforementioned "BC < AY" satisfies the following conditions:

BB-AX < AY

BB < AY + AX

Here,

AY = AZ - BA = BA (1 / sin 30 ° - 1) = BA

Therefore,

BB < BA + AX

[0263] As a condition necessary for the coupling to engage when the drive transmission member 81 is inclined by the meshing force between the gears, "BB < BA + AX" can be obtained with respect to the distance BB from the drum center of the regulating portion 73j.

[0264] Next, the case where the regulating portion is positioned closest to the center of the drum will be described. In order for the gear portion 81a of the drive transmission member 81 to mesh with the gear portion 30a, the radius of the addendum circle of the gear portion 81a is required to be larger than the distance BF (the distance measured in the direction perpendicular to the axis of the drum) from the center of the drum 62 to the tooth tip of the gear portion 30a of the developing roller. In addition, it is necessary that the regulating portion 73j and the tooth tips of the drive transmission member 81a do not contact with each

other during image formation. That is the distance BB (the distance measured in the direction perpendicular to the axis of the drum) from the center of the drum 62 to the regulating portion 73j is required to be larger than the distance BF (the distance measured in a direction perpendicular to the axis of the second axis) from the center of the drum 62 to the tooth tip of the gear portion 30a of the developing roller. It is necessary to satisfy the following from the above two conditions.

$$BB > BF$$

[0265] Summarized together with "BB < BA + AX" described above, it is preferable that the regulating portion 73j is disposed in a range that satisfies the following relation with respect to the center of the drum (the axis of the drum, the axis of the input coupling).

$$BF < BB < AX + BA$$

[0266] The definition of each value is summarized as follows.

BB: the distance measured from the center of the photosensitive member (the axis of the photosensitive member, the axis of the coupling projection) to the regulating portion 73j measured along the direction perpendicular to the axis of the photosensitive member:

BA: the radius of the inscribed circle inscribed in the equilateral triangle at the time when drawing the minimum equilateral triangle circumscribing the coupling projection while aligning the center of gravity of the equilateral triangle with the axial line of the drum (axial line of the coupling projection):

AX: the distance from the center of the photosensitive member (the axis of rotation of the coupling projection) to the bottom of the developing roller gear (bottom of the input gear) measured along the direction perpendicular to the axis of the photosensitive member: and

BF: the minimum distance measured from the rotation center (axis) of the photosensitive member to the tooth tip of the input gear portion (gear portion 30a) measured along the direction perpendicular to the axis of the photosensitive member.

[0267] In this embodiment, the regulating portion 73j is formed by a continuous surface. More specifically, the regulating portion 73j is a curved surface (circular arc surface) which is opened toward the axis line of the drum 62 and is curved in an arc shape. In other words, it is a bay shape (bay portion) opened toward the axis of the drum 62.

[0268] However, as shown in the perspective view of the cartridge in Figure 26, the regulating portion 89j may be formed by a plurality of portions (plural surfaces 89j) intermittent in the rotational direction of the drum 62. In this case, too, by connecting a plurality of intermittent portions, the regulating portion can be regarded as forming a bay shape (bay portion) which opens to the axis of the drum 62.

[0269] That is, there are differences in whether the regulating portion is one continuous portion or a plurality of intermittent portions, but, the restricting portion shown in Figure 1 and the restricting portion shown in Figure 26 are both deemed as having an arc shape (a bay shape, a curved surface portion, a curved portion) that opens to the axis of the drum 62.

[0270] In addition, in this embodiment, as a means for aligning the center of the drive transmission member 81 with the center of the drum 62, the triangle-shaped alignment action of the coupling projection 63b and the coupling recess portion 81b is utilized. That is, the coupling projection 63b and the coupling recess 81b are in contact at three points, so that the axis of the coupling projection 63b and the axis of the coupling recess 81b are aligned with each other. By making the drive transmission member 81 and the photosensitive drum coaxial,

the accuracy of the center-to-center distance (distance between the axes) between the gear portion 81a and the gear portion 30a can be easily maintained, and the drive is stably transmitted to the developing roller gear 30.

[0271] However, one of the drive transmission member 81 and the drive side drum flange 63 may be provided with a cylindrical boss (projection), and the other may be provided with a hole to be fitted with the boss. Even with such a structure, the axis of the drive transmission member 81 and the axis of the drum 62 can be overlapped. Figure 38 shows such a modified example. The drive transmission member 181 shown in Figure 38 has a projection (boss) 181c at the center of the coupling recess 181b. The projection 181c is provided so as to overlap with the axis of the drive transmission member 181 and is a projection projecting along its axis. On the other hand, the coupling projection shown in Figure 38 has a recess (recess) for engaging with the projection 181c at the center thereof. The recess is provided so as to overlap with the rotation axis of the drum 62 and is a recess recessed along this axis. By making the drive transmission member 81 and the photosensitive drum coaxial, the accuracy of the center-to-center distance (distance between the axes) between the gear portion 81a and the gear portion 30a can be easily maintained, and the drive is stably transmitted to the developing roller gear 30.

[0272] Next, the arrangement of the coupling projections 63b in the longitudinal direction (axial direction of the drum) will be described. As shown in Figure 18, the driving side drum flange 63 has a flange portion 63c. The cleaning frame 71 is provided with a drum regulating rib 71m (a drum regulating portion, a drum longitudinal position regulating portion, a drum axial direction position regulating portion).

[0273] The drum regulating rib 71m is provided on the non-driving side of the flange portion 63c of the driving side drum flange 63 with respect to the

longitudinal direction, and faces the flange portion 63c with a gap therebetween.

[0274] When the drum 62 moves to the non-driving side by the amount beyond this gap, the flange 63c and the drum regulating rib 71m come into contact with each other, and the movement of the drum 62 is restricted. That is, the drum 62 does not move in the longitudinal direction (axial direction) beyond a predetermined range. By this, the positional accuracy in the longitudinal direction of the coupling projection 63b of the drive side drum flange 63 before the coupling projection 63b of the driving side drum flange 63 is engaged with the coupling recess 81b is improved. Therefore, even if the amount of movement of the drive transmission member 81 in the longitudinal direction is reduced, the coupling projection 63b and the coupling recess 81b can be engaged with each other. By decreasing the amount of movement of the drive transmission member 81 in the longitudinal direction, the apparatus main assembly A can be downsized.

[0275] Next, the arrangement of the gear portion 30a of the developing roller gear 30 in the longitudinal direction (axial direction of the drum) will be described. As shown in Figure 18, the developing roller gear 30 has an end surface 30a2 on the non-driving side of the gear portion 30a. The developing container 23 is provided with a developing roller gear restricting rib 23d (a gear regulating portion, a gear longitudinal position regulating portion, a gear axial line position regulating portion).

[0276] The developing roller gear restricting rib 23d is disposed on the non-driving side in the axial direction with respect to the non-driving side end surface 30a2 of the gear portion 30a, and faces the non-driving side end surface 30a2 a gap therebetween.

[0277] By this, the developing roller gear restricting rib 23d disposed on the driving side of the cartridge B restricts the developing roller gear 30 from moving

toward the non-driving side in the longitudinal direction. By this, the positional accuracy in the axial direction of the gear portion 30a of the developing roller gear 30 before the gear portion 30a of the developing roller gear 30 meshes with the gear portion 81a of the drive transmission member 81 is improved. Therefore, the gear width of the gear portion 30a of the developing roller gear 30 can be reduced. By this, the cartridge B and the apparatus main assembly An in which the cartridge B is mounted can be downsized.

< Cartridge dismounting >

[0278] Referring to Figures 7, 24, and 25, removal of the cartridge B from the apparatus main assembly A will be described.

[0279] As shown in Figure 7, when the opening and closing door 13 is rotated and opened, the cylindrical cam 86 moves while rotating along the inclined surface portions 86a and 86b by way of the rotating cam link 85, until the end surface portion 86c of the cylindrical cam 86 and the end surface portion 15f of the drive side plate 15 abut against the drive side in the axial direction. And, as the cylindrical cam 86 moves, the drive transmission member 81 can move to the drive side in the axial direction (the side away from the cartridge B).

[0280] Here, as shown in parts (a) and part (b) of Figure 24 and part (a) of Figure 25, the radial teeth of the gear portion 81a of the drive transmission member 81 and the gear portion 30a of the developing roller gear 30 Apply the amount to be applied to the amount AH.

[0281] In order to break the engagement between the gear portion 81a and the gear portion 30a, the gear portion 81a must move in a direction away from the gear portion 30a by the amount equal to or more than the engagement amount AH between the gear portions. Therefore, the regulating portion 73j of the drum bearing 73 is provided so as not to hinder the movement of the drive transmission

member 81 when the gear portion 81a separates from the gear portion 30a. The direction in which the gear portion 81a of the drive transmission member 81 moves away from the gear portion 30a of the developing roller gear 30 is indicated by the arrow AI along the direction in which the line connecting the center 81j of the drive transmission member 81 and the center 30b of the developing roller gear 30 extends. It is preferable that the restricting portion 73j is not provided in the arrow AI direction. That is, it is preferable that the regulating portion 73j is not disposed so as to crosses the straight line LA, and the drive transmission member 81 does not contact the restricting portion 73j when the gear portion 81a disengages from the gear portion 30a.

[0282] It is preferable that when the gear portion 81a disengages from the gear portion 30a, the drive transmission member 81 does not contact the recess peripheral surface 73k of the drum bearing 73. In this state that the door 13 is open (parts (a) and part (b) of Figure 7), the drive transmission member 81 is retracted to such a position that it does not contact the recess circumferential surface 73k of the drum bearing 73.

[0283] That is, as shown in part (a) of Figure 24, the drive transmission member 81 is in the position retracted to such an extent that the coupling with the coupling projection 63b is broken. Therefore, in the longitudinal direction of the drive transmission member 81, the free end of the drive transmission member 81 is at substantially the same position as the free end of the recessed circumferential surface 73k or on the left side of the free end of the recessed circumferential surface 73k.

[0284] In this state, even if the drive transmission member 81 is inclined in an attempt to break the meshing engagement between the gear portion 81a and the gear portion 30a, the drive transmission member 81 and the recess peripheral surface 73k do not contact with each other.

[0285] It is also conceivable that the amount of movement of the drive transmission member 81 when retracting is short and the free end of the drive transmission member 81 at the retracted position is provided on the right side of the free end of the recessed circumferential surface 73k. In such a case, the contact between the drive transmission member 81 and the recess circumferential surface 73k can be avoided if the following conditions are satisfied.

[0286] Let Z be the distance in the radial direction from the center 62a of the drum 62 to the recess peripheral surface 73k of the drum bearing 73. Let Y be the radial distance from the center 81j of the drive transmission member 81 to the outer peripheral surface of the cylindrical portion 81i of the drive transmission member 81. Let AJ be the radial distance at the gap between the recess peripheral surface 73k and the cylindrical portion 81i.

At this time, the gap AJ satisfies the following.

$AJ = Z - Y$

$AJ > AH$

[0287] That is, a recess portion is provided around the drum 62. And, the drive transmission member 81 can move within the range in which the inner peripheral surface (recess peripheral surface 73k) of the recess portion does not contact the gear portion 81a.

[0288] The radial position of the recess peripheral surface 73k of the drum bearing 73 may be such that the distance Z from the center 62a of the drum 62 is satisfies the following:

$Z > AH + Y$

[0289] With the above structure, when the cartridge B is taken out from the main assembly An of the apparatus, the drive transmission member 81 can incline in the away direction AD by an amount beyond the engagement amount AH between the gear portion 81a of the drive transmission member 81 and the gear

portion 30a of the developing roller gear 30. And, disengagement between the gear portion 81a of the drive transmission member 81 and the gear portion 30a of the developing roller gear 30 is effected, so that the cartridge B can be taken out smoothly from the main assembly An of the apparatus.

[0290] As described above, the drive transmission member 81 moves toward the coupling portion on the cartridge side due to the thrust force caused by the engagement of the helical gears with each other.

[0291] Further, the drive transmission member 81 is moved (inclined) by the force produced by the meshing of the gears, but the movement amount (amount of inclination) is regulated by the restricting portion provided on the cartridge side. By this, the engagement (coupling) between the drive transmission member 81 and the coupling portion on the cartridge side is secured to assure reliable drive transmission.

[0292] Further, since the drive transmission member 81 is provided with a gap that allows the drive transmission member 81 to move in the radial direction beyond the engagement height of the gear, the disengagement between the gears when removing the cartridge B from the main assembly of the apparatus is smoothly carried out. That is, the cartridge can be easily taken out.

[0293] Further, in this embodiment, the coupling projection 63b is fixed to the drum 62, but a movable coupling projection may be provided. For example, the coupling 263b shown in Figure 20 is movable in the axial direction with respect to the drum 62, and is urged by a spring 94 toward the driving side in a state that it receives no external force. When mounting the cartridge B in the main assembly A, the end 263a of the coupling 263b comes into contact with the drive transmission member 81. The coupling projection 263b can retract to the non-drive side (the side away from the drive transmission member 81) while contracting the spring 94 by the force received from the drive transmission

member 81. With such a structure, it is not absolutely necessary to retract the drive transmission member 81 to the extent that it does not contact the coupling projection 263b. That is, the amount of withdrawal of the drive transmission member 81 interrelated with the opening of the opening/closing door 13 (Figure 2) can be reduced by an amount by which the coupling projection 263b can retract. That is, you can downsize the main assembly A.

[0294] The end portion 263a of the coupling projection 263b is an inclined portion (inclined surface, chamfered surface). With such a structure, when the end portion 263a contacts to the drive transmission member 81 at the time of mounting and dismounting the cartridge, the end portion 263a is tends to receive a force in the direction of retracting the coupling projection portion 263b. However, the present invention is not limited to such a structure. For example, the contact portion on the drive transmission member 81 side contacting the coupling projection 263b may be an inclined portion.

[0295] Another modification is shown in Figure 23. In this embodiment, the drum 62 is driven by the engagement between the drive transmission member 81 and the coupling projection 63b. However, as shown in Figure 23, the driving of the drum 62 may be performed by the gears 330b, 95b.

[0296] In the structure shown in Figure 23, the developing roller gear 330 includes not only a gear portion (input gear portion) 330a for receiving drive from the gear portion 81a of the drive transmission member 81 but also a gear portion (output gear portion) 330b for outputting a driving force toward the drum 62. In addition, the drum flange 95 fixed to the end portion of the drum 62 has a gear portion 95b (input gear portion) for receiving the driving force from the gear portion 330b instead of including the coupling projection. Further, the drum flange 95 has a cylindrical portion 95a.

[0297] In this case, the cylindrical portion 95a provided at the end portion of

the drum 62 functions as a positioning portion for positioning the drive transmission member 81 by engaging with the coupling recess portion 81b provided at the tip of the drive transmission member 81.

[0298] Both the recessed portion 81b and the cylindrical portion 95a act as an aligning portion for aligning the axes of the drive transmission member recess 81 and the drum 62 with each other. When the coupling recess 81b and the cylindrical portion 95a are engaged with each other, the axes of the drum 62 and the drive transmission member 81 are substantially overlapped, and the both are coaxially arranged. Here, the coupling recessed portion 81b may be referred to as a main assembly side aligning portion (aligning recessed portion), and the cylindrical portion 95a may be referred to as a cartridge side aligning portion (aligning projection).

[0299] Strictly speaking, the outer peripheral surface of the cylindrical portion 95a corresponds to the aligning portion on the cartridge side. In addition, the lightening portion 81b3 of the coupling projection 81b corresponds to the main assembly side alignment portion. The circular lightening portion 81b3 engages with the outer peripheral surface of the cylindrical portion 95a, thereby aligning the drum 62 and the drive transmission member 81 with each other.

[0300] In the cartridge shown in Figure 23, due to the engagement between the gear portion 30a of the gear 30 and the gear portion 81a of the drive transmission member 81, a force attracting the coupling recess portion 81b and the cylindrical portion 95a toward each other is produced, by the same action as in the above-described embodiment. By the drive transmission between the gear portion 30a and the gear portion 81a, the coupling recess portion 81b and the cylindrical portion 95a are engaged with each other. Here, an inclined portion (tapered, chamfered) 95a1 (part (b) of Figure 23) is provided on the edge of the

tip of the cylindrical portion 95a so that the coupling recessed portion 81b and the cylindrical portion 95a are easily engaged with each other. That is, the diameter of the cylindrical portion 95a decreases toward the tip thereof.

[0301] As described above, when the coupling projection 63b is provided at the end portion of the drum 62, the coupling recess portion 81b functions as a output coupling for transmitting the driving force to the coupling projection 63b. In addition, in the case where the coupling projection 63b is substantially triangular, by the coupling recess 81b being coupled to the coupling projection 63b, the drive transmission member 81 is centered. Therefore, the coupling recess 81b functions also as a centering(aligning) portion.

[0302] On the other hand, in the case where the cylindrical portion 95a is provided at the end portion of the drum 62 as in the structure shown in part (a) of Figure 23, the coupling recessed portion 81b does not serve as a coupling portion (output coupling), but serves only as a centering recess (main assembly side alignment portion).

[0303] That is, the coupling recess portion 81b serves as both the output coupling and the main assembly aligning portion (the aligning recess portion), and the function of the coupling recess portion 81b provided by the structure of the drum 62 is both or either one of the function of the coupling recess portion and the centering portion.

[0304] In addition, although the outer periphery of the aligning portion on the cartridge side shown in Figure 23 is the cylindrical portion 95a forming a complete circle, the present invention is not limited to such a structure. Figure 35 shows an example of the shape of the aligning portion as a schematic view.

[0305] Part (a) of Figure 35 shows a state in which the cylindrical portion 95a shown in Figure 23 is provided on the drum flange 63.

On the contrary, in part (b) of Figure 35, the shape of the aligning portion 95b

constitutes only a part of a circle. If the circular arc portion of the aligning portion 95b is sufficiently larger than the circular arc shape of the lightening portion 81b3, the aligning portion 95b has a centering action.

[0306] The distance (radius) from the center of the drum to the outermost portions of the aligning portions 95a, 95b corresponds to the radius of the lightening portion 81b3. The radius of the lightening portion 81b3 is 4.8 mm, and therefore, the distance (radius) from the center of the drum to the outermost portions of the aligning portions 95a, 95b, 95c is 4.8 mm or less, and the closer to 4.8 mm, the better the alignment effect is.

[0307] In this embodiment, the coupling recessed portion 81b which is the main assembly side aligning portion has a substantial triangular shape in order to transmit the drive when engaged with the coupling projection portion 63b, and an arcuate lightening portion 81b3 is provided on a part of a side of a triangular shape. However, when it is not necessary for the main assembly side alignment unit to transmit the drive to the drum 62, the main assembly side alignment portion can take another shape. For example, the main assembly side aligning portion may be a substantially circular recess portion. In the case of such a main assembly side alignment section, the alignment portion 95c as shown in part (c) of Figure 35 can be used as the alignment portion on the cartridge side. The centering portion shown in part (c) of Figure 35 has a structure in which a plurality of projections 95c are arranged in a circular shape. That is, the circumscribed circle (circle shown by a dotted line) of the projection 95c is a circle coaxial with the drum. In addition, this circumscribed circle has a size corresponding to the recess portion of the main assembly side aligning portion. That is, the radius of the circumcircle is not more than 4.8 mm.

[0308] Any of the structures shown in part (a), part (b), and part (c) of Figure 35 can be regarded as an aligning portion that is substantially coaxial with the

drum. That is, each of the aligning portions 95a, 95b, 95c is disposed so as to be centered on the axis line of the drum.

[0309] Strictly speaking, the outer peripheral surfaces of the aligning portions 95a, 95b, 95c, that is, the portions facing the opposite side of the drum axis line (in other words, the portions facing the outside in the radial direction of the drum) functions as alignment portions. The outer circumferential surface functioning as the aligning portion is extended so as to surround the axis of the drum.

[0310] Each of the aligning portions 95a, 95b, 95c is exposed toward the outside of the cartridge in the axial direction.

[0311] In addition, it is preferable that the structure of the cartridge as shown in Figure 23 also has the regulating portion 73j as described above. In addition, the positional relationship (dimensional relationship) between the developing roller gear 30 and the regulating portion 73j relative to the aligning portion may be considered similarly to the relationship (dimensional relationship) between the developing roller gear 30 and the regulating portion 73j relative to the cartridge projection 63b.

[0312] For the reason as described above, for example, for the lower limit of the distance BB from the center of the drum to the center of the regulating portion 73j, the following relationship holds.

$BF < BB$

BB: the distance measured from the center of the photosensitive member (the axis of the photosensitive member, the axis of the coupling projection) to the regulating portion 73j along the direction perpendicular to the axis of the photosensitive member.

BF: the minimum distance measured from the rotation center (axis) of the photosensitive member to the tooth tip of the input gear portion (gear portion 30a) along the direction perpendicular to the axis of the photosensitive member.

[0313] The upper limit of distance BB will be considered. It is preferable that the misalignment amount generated between the coupling recessed portion 81b and the aligning portion 95a when the movement transmitting member 81 is inclined until the gear portion 81a comes into contact with the restricting portion 73j satisfies the following relationship. That is, it is preferable that an inclined portion 95a1 (part (a) of Figure 23) is provided at the tip of the aligning portion 95a, but as the width of the inclined portion 95a is measured along the radial direction of the drum, the width of the inclined portion 95a is larger than the misalignment amount. If this relationship is satisfied, even if misalignment occurs, the inclined portion 95a1 of the aligning portion 95a comes into contact with the edge of the coupling recessed portion 81b to assist the engagement between the coupling recessed portion 81b and the aligning portion 95a.

[0314] The difference between the distance BB and the radius U of the tip circle of the gear portion 81a is "BB-U", and the misalignment amount becomes larger than "BB-U".

Therefore, at least the width BX of the inclined portion 95a needs to be larger than "BB-U". In addition, the radius U of the addendum circle of the gear portion 81a is shorter than the distance AX from the center of the drum to the root of the developing roller gear. Therefore, the width BX of the inclined portion 95a is larger than "BB-AX".

$$BX > BB-AX$$

This is modified as follows:

$$BB < BX + AX$$

BB: the distance measured from the center of the photosensitive member (the axis of the photosensitive member, the axis of the coupling projection) to the regulating portion 73j along the direction perpendicular to the axis of the photosensitive member.

BX: the width of the inclined portion 95a measured along the radial direction of the photosensitive member.

AX: the distance measured from the axis of the photosensitive member to the root of the developing roller gear along the direction perpendicular to the axis of the photosensitive member.

[0315] In summary, "BF < BB < BX + AX" holds true.

[0316] In the structure shown in Figure 23, the cylindrical portion 95a is provided on the drum 62. Alternatively, the alignment portion such as the cylindrical portion 95a may be provided on the frame of the cleaning unit 60 (that is, the drum bearing 73). That is, it is also conceivable that the drum bearing 73 covers the end portion of the drum 62, and the drum bearing 73 is provided with the aligning portion. In addition, it is also possible to use a structure of engaging with the cylindrical portion 81i (part (a) of Figure 13) of the drive transmission member 81 rather than the recess portion 81b of the drive transmission member 81, as the aligning portion on the cartridge side.

[0317] In the modification shown in Figure 36, a circular arc projection 173a for contacting the periphery of the cylindrical portion 81i is provided on the drum bearing 173. Part (a) of Figure 36 is a perspective view of the cartridge, and part (b) of Figure 36 is a sectional view illustrating a state in which the aligning portions of the cartridge and the main assembly driving member are engaged with each other. In this modified example, the projection 173a is engaged with the cylindrical portion 81i to provide an aligning portion for aligning the drive transmission member 81. More particularly, the inner circumferential surface of the projection 173a facing the axis side of the drum (in other words facing the radially inner side of the drum) is the aligning portion.

[0318] This aligning portion is provided in the drum bearing 173, not in the drum flange 195. Therefore, the drum flange 195 has a gear portion 195a for

receiving the driving force from the developing roller gear, but does not have the aligning portion.

[0319] The center of the aligning portion is disposed so as to overlap the axis line of the drum. That is, the projection 173a is disposed so as to be substantially coaxial with the drum. In other words, the inner circumferential surface of the projection 173a facing the axis line side of the drum is disposed so as to surround the axis of the drum. A taper (inclined portion) is provided on the edge of the tip of the projection 173a, so that the cylindrical portion 81i can be easily introduced into the internal space of the projection 173a when the tip of the projection 173a hits the cylindrical portion 81i.

[0320] The distance (radius) from the axis of the drum to the aligning portion (projection 173a) corresponds to the radius of the cylindrical portion 81i. If the radius of the cylindrical portion 81i is 7.05 mm, the radius of the projection 173a is preferably 7.05 mm or more.

[0321] The projection 173a also functions as a restricting portion (stopper) for suppressing inclination and movement of the drive transmission member 81 by contacting the cylindrical portion 81i. That is, the projection 173a can also serve as the restricting portion 73j (Figure 24). The structure in which the regulating portion is constituted to contact the cylindrical portion 81i will be described later in Embodiment 2. Here, an inclined portion (taper, chamfer) is provided at the tip of the projection 173a, and when the drive transmission member 81 is inclined, the tip of the cylindrical portion 81i comes into contact with the inclined portion, so that the engagement between the cylindrical portion 81i and the projection 173a is assisted. That is, the inner circumferential surface of the projection 173a has a diameter increasing toward the tip of the projection 173a.

[0322] The functions, materials, shapes and relative arrangements, and so on

of the constituent parts described in connection with this embodiment and each modification described above are not intended to limit the scope of the present invention only to theme unless otherwise specified.

<Embodiment 2>

[0323] Next, referring to Figure 29, part (a) of Figure 30, part (b) of Figure 30, part (c) of Figure 30, part (a) of Figure 31 and part (b) of Figure 31,an embodiment of Embodiment 2 of the present invention will be described. Figure 29 is a perspective view of a cartridge for explaining the regulating portion of the drive transmission member. Part (a) of Figure 30 is a cross-sectional view of the driving portion of the image forming apparatus as viewed from the opposite direction of the cartridge mounting direction to explain the regulation of the drive transmitting portion. Part (b) of Figure 30 is a cross-sectional view of the drive portion of the image forming apparatus as viewed from the drive side to explain the regulation of the drive transmitting portion. Part (c) of Figure 30 is a cross-sectional view of the driving portion of the image forming apparatus as viewed from the drive side for explaining the regulation of the drive transmitting portion. Part (a) of Figure 31 is a cross-sectional view of the driving portion of the image forming apparatus as viewed from the drive side to explain the regulation of the drive transmitting portion. Part (b) of Figure 31 is a cross-sectional view of the driving portion of the image forming apparatus as viewed from the upstream side of the process cartridge mounting direction to explain the drive transmitting portion.

[0324] In this embodiment, parts different from the above-described embodiment will be described in detail. In particular, materials, shapes and the like are the same as in the above-mentioned embodiment unless otherwise stated. For such parts, the same numbers will be assigned and detailed description

thereof will be omitted.

[0325] As shown in parts (a) of Figures 29 and 30, part (b) of Figure 30, and part (c) of Figure 30, the drum bearing 90 is provided with a recess portion around the projection portion of the coupling portion. And, a restricting portion 90k1 for restricting the movement of the drive transmission member 91 is provided as a small diameter portion (a portion where the inner diameter of the recess portion is made smaller than the other portions) within the recess peripheral surface 90k (the inner peripheral surface of the recess portion). The regulating portion 90k1 is an arcuate curved surface portion facing the axial line side of the drum.

[0326] The regulating portion 90k1 is a regulating portion (stopper) for suppressing the movement and inclination of the drive transmission member 91, and is a portion corresponding to the regulating portion 73j (Figure 1, Figure 24, and so on) in Embodiment 1. In the following, the regulating portion 90k1 in this embodiment, particularly the portions different from the restricting portion 73j in Embodiment 1 will be described in detail.

[0327] The portion which regulates the inclination of the drive transmission member 91 by the restricting portion 90k1 is a cylindrical portion (cylindrical portion) 91i provided at a free end portion of the non-drive side in the axial direction of the drive transmission member 91. The cylindrical portion 91i corresponds to a cylindrical projection in which a coupling recess is formed.

[0328] In the state that the opening and closing door 13 opens and the drive transmission member 91 moves in the driving side (direction away from the cartridge side), the regulating portion 90k1 overlaps the cylindrical portion 91i of the drive transmission member 91 in the axial direction.

[0329] As shown in Figure 39, in this embodiment, at least a part of the regulating portion 90k1 in the axial direction is located outside (on the arrow D1

side) the outer circumferential surface 63b2 of the input coupling portion (the coupling projection 63b). Here, the outer circumferential surface 63b2 is a portion (driving receiving portion) which receives the driving force from the coupling recess. In particular, at least a part of the restricting portion 90k1 is disposed outside of the leading end 63b1 of the coupling projection 63b.

[0330] Further, at least a part of the regulating portion 90k1 is disposed so as to overlap with the input coupling portion (the coupling projection 63b) in the axial direction. That is, when the coupling projection 63b and the regulating portion 90k1 are projected on the axis Ax1 of the drum, at least a part of the projected regions thereof mutually overlap each other. In other words, at least a part of the regulating portion 90k1 is disposed so as to face the input coupling portion (the coupling projection 63b) provided at the end portion of the drum.

[0331] The regulating portion 90k1 can also be regarded as a projecting portion that projects so as to cover the axis of the drum.

[0332] Here, it has been explained that in Embodiment 1 (parts (a), part (b) thereof of Figure 24, part (a) of Figure 25) the following holds.

$AB = AA \times (W / X)$

$S = AA + U$

$V > AB$

$V > (S - U) \times (W / X)$

$U < S < U + V \times (X / W)$

[0333] In this embodiment, among the dimensions shown in parts (a) of Figure 30, part (b) thereof and part (c) thereof, AU corresponds to V and AS corresponds to S.

In addition, AT corresponds to AA, and AP corresponds to U.

In addition, $W = X$, and $(W / X) = 1$.

[0334] Then, in this embodiment, when the drive transmission member 91 is

inclined until it comes into contact with the regulating portion 90k1, the conditions under which the coupling projection 63b and the coupling recess portion can be coupled with each other are as follows, on the same analysis as in Embodiment 1.

AB = AT

AS = AT + AP

AU > AT

AU > (AS-AP)

AP < AS < AP + AU

[0335] In other words, if there is at least one phase relationship satisfying "AU > AT = AS-AP" between the coupling projection and the coupling recess, the coupling portions are engaged (coupled) with each other.

Here,

AB: the amount of misalignment between couplings as measured along the direction perpendicular to the drum axis.

AT: the distance from the drive transmitting member 91 (cylindrical portion 91i) to the regulating portion 90k1 as measured along the direction perpendicular to the drum axis.

AS: the distance from the drum axis (the axis of the coupling projection) to the regulating portion 90k1, as measured along the direction perpendicular to the drum axis.

AP: the radius of the cylindrical portion 91i of the drive transmission member 91.

[0336] In Embodiment 1, the gear portion 81a of the drive transmission member 81 is regulated by the restricting portion 73j.

On the contrary, in this embodiment, the cylindrical portion 91i forming the outer peripheral surface of the coupling recess 91b is regulated by the

regulating portion 90k1.

Therefore, the positions of the regulating portion 90k1 and the coupling recess portion 91b in the axial direction are substantially the same.

[0337] As compared with the case where the gear portion 81a of the drive transmission member 81 is regulated by the restricting portion (part (a) of Figure 24), the inclination of the drive transmission member 91 can be accurately regulated, in this embodiment.

By this, even if the gap between the coupling recess 91 and the coupling projection 63b is small, they can be engaged with each other. Because the dimensions (sizes) of the coupling recess 91 and coupling projection 63b are close to each other, the accuracy of drive transmission is enhanced.

[0338] Here, an example of dimensions established when the radius of the drum 62 is 12 mm will be described below. First, the dimensions of the respective parts of the drive transmission member 91 applicable to the drum 62 having a radius of 12 mm in this embodiment are the same as those of the drive transmission member 81 in Embodiment 1, and are as follows: The distance AJ from the center of the coupling recess 91b to the apex of the substantially equilateral triangle of the recess 91b is 6.5 mm, and the radius AK of the inscribed circle of the approximately triangular shape of the coupling recess 91b is 4.65 mm. Here, the substantially equilateral triangle shape of the recessed portion 91b is not a pure equilateral triangle but the apex corner is beveled into an arc shape. In addition, the radius AN of the lightening portion 91b3 of the coupling recess 91b is 4.8 mm, and the radius AP of the cylindrical portion 91i of the drive transmission member 91 is 7.05 mm.

[0339] The shortest distance AU between the coupling recess 91b and the coupling projection 63b satisfies the following relationship.

$$0 < AU < 1.7$$

[0340] AU is the lower limit when the size of the triangular shape of the coupling recess 91b is equal to the size of the triangular shape of the coupling projection 63b. On the other hand, AU is the upper limit when the distance from the center of the coupling projection 63b to the apex is 4.8 mm which is the radius AC of the lightening portion of the coupling recess 91b. At this time, the gap AU between the coupling projection 63b and the coupling recess 81b is "1.7 = 6.5 - 4.8".

[0341] Therefore, substituting each value and AU = 1.7 into the expression "AP < AS < AP + AU" shown earlier,

"7.05 < S < 8.75".

[0342] The fact that the above equation holds will be confirmed, using two examples.

[0343] In the first example, the dimensions are shown when the coupling projection 63b is enlarged to the maximum within a range that can be engaged with the coupling recess 91b. n this case, the clearance AU between the coupling projection 63b and the coupling recess 91b approaches to the lower limit, and therefore, the allowable inclination of the drive transmission member 81 becomes small. herefore, in order to reduce the inclination of the drive transmitting member 91, it is necessary to make the regulating portion 90k1 closest to the regular position of the cylindrical portion 91i.

[0344] In the second example, the dimensions are shown when the coupling projection 63b is made smallest in the range that can be engaged with the coupling recess 91b. The gap AU between the coupling projection 63b and the coupling recess 91b approaches to the upper limit, and therefore, the coupling projection 63b and the coupling recess 91b can engage with each other even if the drive transmission member 81 is relatively largely inclined. That is, the regulating portion 73j can relatively significantly tolerate the inclination of the

drive transmission member 91, and therefore, the restricting portion 93j can be relatively largely separated from the regular position of the cylindrical portion 91i.

[0345] In the first example, the coupling projection 63b is maximized to maximize the radial amount of coupling between the coupling portions.

[0346] The distance AQ from the center of the coupling projection 63b of the drive side drum flange 63 to the apex is slightly smaller than the distance AJ (6.5 mm) from the center of the coupling recess to the apex of the triangle, which is 6.498 mm. At this time, the radius AR of the triangle inscribed circle of the coupling convexity 63b of the drive side drum flange 63 is 4.648 mm.

[0347] Also, the radius AP of the cylindrical portion 91i of the drive transmission member 91 is 7.05 mm, and therefore, the distance AS from the center of the drum 62 to the regulating portion 90k1 of the drum bearing is 7.051 mm which is slightly larger than the radius AP.

[0348] As a result, the gap AT between the regulating portion 90k1 of the drum bearing and the cylindrical portion 91i of the drive transmission member is 0.001 mm (= 7.051 - 7.05). In addition, the gap AU between the coupling projection 63b and the coupling recess 91b when the phase of the coupling portion is in alignment is 0.002 mm ("6.5 - 6.498" or "4.65 - 4.648", whichever is smaller). Therefore, even if the drive transmission member 91 is inclined due to the meshing force, the gap AU between the couplings is larger than the misalignment AT between the coupling portions, and therefore, the coupling projection 63b and the coupling recess 91b can be coupled with each other.

[0349] In the first example, it is preferable that the distance in the radial direction from the center of the drum 62 to the regulating portion 90k1 is made larger than 7.05 mm.

[0350] In the second example, the coupling projection 63b is minimized so that the amount of engagement between the coupling portions is minimum.

[0351] The distance AQ from the center to the apex of the coupling projection 63b provided on the drive side drum flange 63 is made 4.801 mm slightly larger than the radius AN of the lightening portion 91b3 of the coupling recess larger than 4.8 mm. At this time, the radius AR of the inscribed circle inscribed in the triangle shape of the coupling projection is 2.951 mm.

[0352] The distance AS of the regulating portion 90k1 of the drum bearing from the center of the drum 62 is 8.749 mm. By this, the gap AT between the regulating portion 90k1 of the drum bearing 90 and the gear portion 91a of the drive transmission member 91 is 1.698 mm (= 8.748 - 7.05). In addition, the gap AU between the coupling projection 63b and the coupling recess 91b when the phase of the coupling portion is in alignment is 1.699 mm ("6.5 - 4.801" and "4.65 - 2.951", whichever is smaller). Accordingly, even if the drive transmitting member 91 is inclined due to the meshing force, the gap AU between the couplings is larger than the misalignment AT between the coupling portions, and therefore, the coupling portions can engage with each other.

[0353] From the second example, it is understood that the radial distance from the center of the drum 62 to the regulating portion 90k1 of the drum bearing is preferably less than 8.75 mm.

[0354] In other words, it is preferable that the distance in the radial direction from the center of the drum 62 to the regulating portion 90k1 of the drum bearing is larger than 7.05 mm and smaller than 8.75 mm.

[0355] The shape of the coupling projection provided on the drum 62 is not limited to a substantially equilateral triangle, and a preferable arrangement of the regulating portion in a case of a more general shape will be considered. Here, the shape of the coupling recess is assumed to the equilateral triangle for convenience. Here, the coupling projection 363b (Figures 27 and 28) described above is used as a coupling projection having a general shape.

[0356] First, the upper limit of the distance from the drum axis to the regulating portion 90k1 is considered using the regulating portion 90k1 and the drive transmission member 191 shown in Figure 31.

[0357] The position of the restricting portion 90k1 depends on the radius of the cylindrical portion 191i of the drive transmission member 191. That is, as the radius of the cylindrical portion 191i increases, it is necessary to move the regulating portion 90k1 away from the axis of the drum. First, as shown in Figure 31, it is assumed that the diameter of the cylindrical portion 191i of the drive transmission member 191 is larger than the diameter of the gear portion (output gear portion) 191a of the drive transmission member 191. At this time, the cylindrical portion 191i is disposed so as to be sandwiched between the roller portion 132a of the developing roller 132 and the developing roller gear 30, and the cylindrical portion 191i faces the shaft portion 132b of the developing roller 132.

[0358] The distance from the center (axis) of the drum 62 to the regulating portion 90k1 is a distance BG (distance measured in the direction perpendicular to the axis of the drum). The distance from the center of the drum 62 to the axis of the developing roller is taken as the distance BK (the distance taken in the direction perpendicular to the axis of the drum).

[0359] Here, it is preferable that the cylindrical portion 191i does not interfere with the shaft portion 32b of the developing roller when the drive transmitting member 191 is inclined such that the cylindrical portion 191i comes into contact with the regulating portion 90k1. That is, it is desired to restrict the movement of the cylindrical portion 191i by the restricting portion 90k1 so that at least the cylindrical portion 191i does not incline beyond the axis of the developing roller. Therefore, it is preferable that the distance BG from the drum center to the regulating portion 90k1 is shorter than the distance BK from the drum center to

the axis of the developing roller 132.

BG < BK

Next, referring to Figure 31, the lower limit of the distance from the drum center to the regulating portion 90k1 will be considered. The smallest equilateral triangle BO circumscribing the coupling projection 363b (Figure 28) is taken as a hypothetical coupling projection. The center of gravity of the equilateral triangle BO is set to be on the center of the coupling projection 363b.

[0360] A circle inscribed in the imaginary coupling projection (regular triangle BO) is a circle BP, and radius thereof is the radius BH. Here, in order for the hypothetical coupling projection BO to engage with the coupling recess portion provided in the cylindrical portion 191i, the cylindrical portion 191i of the drive transmission member needs to be larger than this inscribed circle BP. This is because if the cylindrical portion 191i is smaller than the inscribed circle BP of the hypothetical coupling projection BO, a output coupling portion for transmitting the drive to the hypothetical coupling projection BO cannot be formed in the cylindrical portion 191i.

[0361] The distance BG from the drum center to the regulating portion 90k1 is larger than the radius of the cylindrical portion 191i, and therefore, the distance BG is larger than the radius BH of the inscribed surface BP.

[0362] Therefore, the distance BG from the drum center of the regulating portion 90k1 satisfies,

BH < BG

[0363] That is, the preferable range of the regulating portion 90k1 is as follows.

BH < BG < BK

[0364] Next, a further preferable range of the regulating portion 90k1 will be described below by using the drive transmission member 291 shown in Figure 32.

[0365] In Figure 32, the cylindrical portion 291i of the drive transmission member 291 is smaller in diameter than the gear portion 291a and disposed so as to face the developing roller gear 30. If the diameter of the cylindrical portion 191i is enlarged as shown in Figure 31, the cylindrical portion 191i cannot be disposed in the front of the developing roller gear 30, and the cylindrical portion 191i needs to be disposed to face the shaft portion of the developing roller. In such a case, it is necessary to increase the length of the shaft portion of the developing roller, or to increase the length of the drive transmission member. On the contrary, if the cylindrical portion 291i of the drive transmission member is disposed on the front side of the developing roller gear 30 as shown in Figure 32, there is no need to increase the lengths of the shaft portion 232b of the developing roller 232 and the drive transmission member 291, and therefore, it is possible to downsize cartridges and image forming apparatuses.

[0366] First, referring to Figure 32, the upper limit of the distance from the drum center to the regulating portion 90k1 will be considered.

[0367] The distance from the center of the drum 162 to the regulating portion 90k1 is a distance BG (the distance as measured in a direction perpendicular to the axis of the drum). The shortest distance from the center of the drum 162 to the tooth tip of the gear portion of the developing roller gear 30 is a distance BJ (the distance as measured in a direction perpendicular to the axis of the drum). In order to prevent the cylindrical portion 291i from interfering with the gear 30 of the developing roller when the regulating portion 90k1 contacts to the cylindrical portion 291i, it is preferable that the distance BG from the drum center to the regulating portion 90k1 is made shorter than the distance BJ from the drum center to the tooth tip of the developing roller gear.

Therefore,

$BG > BJ$

Next, the lower limit of the distance from the drum center to the regulating portion 90k1 will be considered. The minimum circle circumscribing the coupling projection 163a is BS, and its radius is the radius BL.

Here, the circle BS is provided concentrically (coaxially) with the drum 162.

[0368] Here, if the cylindrical portion 291i of the drive transmission member 291 is larger than the circle BS, a coupling recess that surrounds the entire circumference of the coupling projection 163a can be formed in the cylindrical portion 291i.

[0369] By this, the strength of the output coupling portion (coupling recess) can be enhanced, and the engagement between the couplings can be stabilized.

[0370] When the radius of the cylindrical portion 291i is larger than the radius BL of the circle BS, the distance BG from the drum center to the regulating portion 90k1 is also larger than the radius BL, and therefore,

BG < BL

[0371] That is, the range of the regulating portion 90j is as follows.

BJ < BG < BL

[0372] Together with this "BJ < BG < BL" and the aforementioned "BH < BG < BK", the preferable range regarding the regulating portion can be defined as follows:

BH < BJ < BG < BL < BK

[0373] The definition of each value is summarized as follows:

BH: the radius of the inscribed circle inscribed in the equilateral triangle, when drawing the minimum equilateral triangle circumscribing the coupling projection (input coupling portion) while aligning the center of gravity of the equilateral triangle with the axis of the drum (the axis of the coupling projection).

BJ: The shortest distance from the axis of the drum to the tooth tip of the gear portion (input gear portion) 30a as measured along the direction perpendicular to the axis of the drum.

BG: the distance from the center of the drum to the regulating portion as measured along the direction perpendicular to the axis of the drum.

BL: the radius of the circumcircle, when the minimum circumscribed circle circumscribing the coupling projection (input coupling portion) is drawn coaxially with the drum.

BK: the distance from the axis of the drum to the axis of the developing roller gear (axis of the developing roller), as measured along a direction perpendicular to the axis of the drum.

[0374] The function, material, shape and relative arrangement of the components described in the embodiments or the modifications thereof are not intended to limit the scope of the present invention only to those unless otherwise specified.

[INDUSTRIAL APPLICABILITY]

[0375] An image forming process cartridge including a structure for receiving input of a driving force from the outside is provided.

[Reference Numerals]

30: Developing roller gear

30a: Gear portion

32: Developing roller (developer carrying member)

62: Drum (electrophotographic photosensitive drum)

62a: Drum center

63: Drive side drum flange (driven transmission member)

63b: Coupling projection

WHAT IS CLAIMED IS:

1. A process cartridge comprising:

a frame;

a photosensitive drum supported by the frame, the photosensitive drum being rotatable about an axis thereof, the photosensitive drum including (i) a first end and (ii) a second end opposite to the first end;

a coupling operatively connected to the photosensitive drum such that a driving force can be transferred from the coupling to the photosensitive drum, the coupling being rotatable about an axis thereof, the coupling being positioned (i) at the first end of the photosensitive drum, (ii) coaxial with the photosensitive drum, and (iii) at a side of the process cartridge, and the coupling including a projection;

a developing roller supported by the frame, the developing roller being rotatable about an axis thereof;

a first gear operatively connected to the photosensitive drum and the developing roller such that the driving force can be transmitted from the coupling to the developing roller; and

a second gear positioned at the side of the process cartridge, the second gear being rotatable about an axis thereof, the second gear having a plurality of teeth, with at least some of the teeth being exposed teeth that are uncovered by the frame and exposed to outside of the process cartridge, and with a tip of at least one of the exposed teeth facing the axis of the photosensitive drum,

wherein, as measured in an axial direction of the photosensitive drum, at least a part of the exposed teeth of the second gear is positioned farther from the second end of the photosensitive drum than a tip of the projection of the coupling is positioned from the second end of the photosensitive drum, and

wherein, as measured along a line perpendicular to the axis of the photosensitive drum, a shortest distance from the axis of the photosensitive drum to a tip of one of the plurality of teeth is 90% to 110% of a length of a radius of the photosensitive drum.

2. A process cartridge according to claim 1, wherein the second gear is a spur gear.

3. A process cartridge according to claim 2, wherein the teeth of the spur gear are 1 mm or less in length along [[an]] the axial direction of the spur gear.

4. A process cartridge according to claim 1, wherein the teeth of the second gear are 1 mm or less in length along an axial direction of the second gear.

5. A process cartridge according to claim 1, further comprising a stopper positioned at the side of the process cartridge, the stopper having a surface extending in an axial direction of the photosensitive drum and facing the axis of the photosensitive drum.

6. A process cartridge according to claim 1, wherein the frame includes a slit at the side of the process cartridge, with the slit being open to outside of the frame (i) in a first direction that is perpendicular to the axis of the photosensitive drum and (ii) in a second direction that is perpendicular to the first direction, and

wherein, when the process cartridge is oriented such that the axis of the photosensitive drum is positioned above the axis of the second gear, the slit is open towards a top side of the process cartridge.

7. A process cartridge according to claim 6, wherein at least one of the exposed teeth faces the slit.

8. A process cartridge according to claim 6, wherein at least a part of the slit is positioned farther from the second end of the photosensitive drum than the tip of the projection of the coupling is positioned from the second end of the photosensitive drum.

9. A process cartridge according to claim 6, wherein the slit runs perpendicular to the axial direction of the photosensitive drum.

10. A process cartridge according to claim 1, wherein the second gear is a helical gear.

11. A process cartridge according to claim 1, wherein the second gear is positioned coaxial with the developing roller.

12. A process cartridge according to claim 1, wherein the frame includes:

a first frame supporting the photosensitive drum; and

a second frame supporting the developing roller.

13. A process cartridge comprising:

a frame;

a photosensitive drum supported by the frame, the photosensitive drum being rotatable about an axis thereof, the photosensitive drum including (i) a first end and (ii) a second end opposite to the first end;

a coupling operatively connected to the photosensitive drum such that a driving force can be transferred from the coupling to the photosensitive drum, the coupling being rotatable about an axis thereof, the coupling being positioned (i) at the first end of the photosensitive drum, (ii) coaxial with the photosensitive drum, and (iii) at a side of the process cartridge, and the coupling including a projection;

a developing roller supported by the frame, the developing roller being rotatable about an axis thereof;

a gear positioned at the side of the process cartridge, the gear being rotatable about an axis thereof, the gear having a plurality of teeth, with at least some of the teeth being exposed teeth that are uncovered by the frame and exposed to outside of the process cartridge, and with a tip of at least one of the exposed teeth facing the axis of the photosensitive drum, and

a stopper positioned at the side of the process cartridge, the stopper having

a surface extending in an axial direction of the photosensitive drum and facing the axis of the photosensitive drum.

wherein, as measured in [[an]] the axial direction of the photosensitive drum, at least a part of the exposed teeth of the gear is positioned farther from the second end of the photosensitive drum than a tip of the projection of the coupling is positioned from the second end of the photosensitive drum, and

wherein, as measured along a line perpendicular to the axis of the photosensitive drum, a shortest distance from the axis of the photosensitive drum to a tip of one of the plurality of teeth is 90% to 110% of a length of a radius of the photosensitive drum.

14. A process cartridge according to claim 13, wherein the gear is a spur gear.

15. A process cartridge according to claim 14, wherein the teeth of the spur gear are 1 mm or less in length along an axial direction of the spur gear.

16. A process cartridge according to claim 13, wherein the teeth of the gear are 1 mm or less in length along an axial direction of the gear.

17. A process cartridge according to claim 13, wherein the frame includes a slit at the side of the process cartridge, with the slit being open to outside of the frame (i) in a first direction that is perpendicular to the axis of the photosensitive drum and (ii) in a second direction that is perpendicular to the first direction, and

wherein, when the process cartridge is oriented such that the axis of the photosensitive drum is positioned above the axis of the gear, the slit is open towards a top side of the process cartridge.

18. A process cartridge according to claim 17, wherein at least one of the exposed teeth faces the slit.

19. A process cartridge according to claim 17, wherein at least a part of the slit is positioned farther from the second end of the photosensitive drum than the tip of the projection of the coupling is positioned from the second end of the photosensitive drum.

20. A process cartridge according to claim 17, wherein the slit runs perpendicular to the axial direction of the photosensitive drum.

21. A process cartridge according to claim 13, wherein the gear is positioned coaxial with the developing roller.

22. A process cartridge according to claim 13, wherein the frame includes:

a first frame supporting the photosensitive drum; and

a second frame supporting the developing roller.

23. A process cartridge comprising:

a frame;

a photosensitive drum supported by the frame, the photosensitive drum being rotatable about an axis thereof, the photosensitive drum including (i) a first end and (ii) a second end opposite to the first end;

a coupling operatively connected to the photosensitive drum such that a driving force can be transferred from the coupling to the photosensitive drum, the coupling being rotatable about an axis thereof, the coupling being positioned (i) at the first end of the photosensitive drum, (ii) coaxial with the photosensitive drum, and (iii) at a side of the process cartridge, and the coupling including a projection;

a developing roller supported by the frame, the developing roller being rotatable about an axis thereof; and

a gear positioned at the side of the process cartridge, the gear being rotatable about an axis thereof, the gear having a plurality of teeth, with at least some of the teeth being exposed teeth that are uncovered by the frame and

exposed to outside of the process cartridge, and with a tip of at least one of the exposed teeth facing the axis of the photosensitive drum,

wherein the frame includes a slit at the side of the process cartridge, with the slit being open to outside of the frame (i) in a first direction that is perpendicular to the axis of the photosensitive drum and (ii) in a second direction that is perpendicular to the first direction, and

wherein, when the process cartridge is oriented such that the axis of the photosensitive drum is positioned above the axis of the gear, the slit is open towards a top side of the process cartridge,

wherein, as measured in an axial direction of the photosensitive drum, at least a part of the exposed teeth of the gear is positioned farther from the second end of the photosensitive drum than a tip of the projection of the coupling is positioned from the second end of the photosensitive drum, and

wherein, as measured along a line perpendicular to the axis of the photosensitive drum, a shortest distance from the axis of the photosensitive drum to a tip of one of the plurality of teeth is 90% to 110% of a length of a radius of the photosensitive drum.

24. A process cartridge according to claim 23, wherein the gear is a spur gear.

25. A process cartridge according to claim 24, wherein the teeth of the spur gear are 1 mm or less in length along an axial direction of the spur gear.

26. A process cartridge according to claim 23, wherein the teeth of the gear are 1 mm or less in length along an axial direction of the gear.

27. A process cartridge according to claim 23, wherein at least one of the exposed teeth faces the slit.

28. A process cartridge according to claim 23, wherein at least a part of the slit is positioned farther from the second end of the photosensitive drum than

the tip of the projection of the coupling is positioned from the second end of the photosensitive drum.

29. A process cartridge according to claim 23, wherein the slit runs perpendicular to the axial direction of the photosensitive drum.

30. A process cartridge according to claim 23, wherein the gear is positioned coaxial with the developing roller.