DESCRIPTION

PROCESS CARTRIDGE AND IMAGE FORMING APPARATUS

[TECHNICAL FIELD]

The present invention relates to a process cartridge in which an electrophotographic photosensitive drum and a developing roller actable on the electrophotographic photosensitive drum which are contactable to each other and spaceable from each other, and an electrophotographic image forming apparatus to which said process cartridge is detachably mountable.

[BACKGROUND ART]

In an image forming apparatus using an electrophotographic image forming process, a process cartridge type is conventional wherein an electrophotographic photosensitive drum and a developing roller actable on the electrophotographic photosensitive drum are unified into a process cartridge detachably mountable to a main assembly of the image forming apparatus. With the process cartridge type, the maintenance operation of the apparatus can be carried out in effect without the service person. Therefore, the process cartridge type is widely used in the field of electrophotographic

image forming apparatus.

When the image forming operation is carried out, the developing roller is kept urged to the electrophotographic photosensitive drum at a predetermined pressure. In a contact developing system in which a developing roller is contacted to the photosensitive drum during the developing operation, an elastic layer of the developing roller is in contact to the surface of the photosensitive drum at the predetermined pressure.

Therefore, when the process cartridge is not used for a long term with the process cartridge kept mounted to the main assembly of the image forming apparatus, the elastic layer of the developing roller may be deformed. If this occurs, non-uniformity may result in the formed image. Since the developing roller is contacted to the photosensitive drum, a developer may be deposited from the developing roller to the photosensitive drum. Since the photosensitive drum and the developing roller are rotated in contact with each other even when the developing operation is not carried out.

As a structure for solving the problem, there is provided an image forming apparatus in which when the image forming operation is not carried out, a mechanism act on the process cartridge to space the developing roller from the electrophotographic

photosensitive drum (Japanese Laid-open Patent Application 2003-167499).

In the apparatus disclosed in this publication, four process cartridges are demountably mounted to the main assembly of the image forming apparatus. The process cartridge comprises a photosensitive member unit having a photosensitive drum, and a developing unit for supporting the developing roller swingably provided in the photosensitive member unit. By moving a spacing plate provided in the main assembly of the image forming apparatus, a force receiving portion provided in the developing unit receives a force from the spacing plate. By moving the developing unit relative to the photosensitive member unit, the developing roller moves away from the photosensitive drum.

In the conventional example, the force receiving portion for spacing the developing roller from the photosensitive drum is projected from the outer configuration of the developing unit. Therefore, when the user handles the process cartridge, and/or when the process cartridge is transported, the force receiving portion tends to be damaged. The existence of the force receiving portion may object to downsizing of the process cartridge in which the electrophotographic photosensitive drum and the developing roller are contactable to each other and

spaceable from each other and the main assembly of the image forming apparatus to which the process cartridge is detachably mountable.

[DISCLOSURE OF THE INVENTION]

Accordingly, it is a principal object of the present invention to provide a downsized process cartridge in which the electrophotographic photosensitive drum and the developing roller are contactable to each other and spaceable from each other and a downsized electrophotographic image forming apparatus to which the process cartridge is detachably mountable.

It is another object of the present invention to provide a process cartridge in which the electrophotographic photosensitive drum and the developing roller are contactable to each other and spaceable from each other with which when the process cartridge is handled , or when the process cartridge is transported, the force receiving portion is not damaged.

According to an aspect of the present invention, there is provided a process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, the main assembly including an opening, a door movable between a close position for closing the opening and an open position for

opening the opening, a first force application member movable with movement of the door from the open position to the closing position and a second force application member movable by a driving force from a driving source, said process cartridge comprising an electrophotographic photosensitive drum; a developing roller for developing an electrostatic latent image formed on said electrophotographic photosensitive drum; a drum unit containing said electrophotographic photosensitive drum; a developing unit which contains said developing roller and which is movable relative to said drum unit such that developing roller is movable between a contact position in which said developing roller is contacted to said electrophotographic photosensitive drum and a spaced position in which said developing roller is spaced from said electrophotographic photosensitive drum; and a force receiving device including a first force receiving portion for receiving a force from the first force application member by movement of said door from the open position to the close position in the state that process cartridge is mounted to the main assembly of the apparatus through the opening, and a second force receiving portion movable from a stand-by position by movement of said first force receiving portion by a force received from the first force application member, wherein said second force

receiving portion takes a projected position for receiving a force from the second force application member to move said developing unit from the contact position to the spaced position, the projected position being higher than the stand-by position.

According to another aspect of the present invention, there is provided an electrophotographic image forming apparatus for forming an image on a recording material, to which a process cartridge is detachably mountable, said apparatus comprising (i) an opening; (ii) a door movable between a close position for closing said opening and an open position for opening said opening; (iii) a first force application member movable with movement of said door from the open position to the close position; (iv) a second force application member movable by a driving force from a driving source; (v) mounting means for detachably mounting a process cartridge, said process cartridge including, an electrophotographic photosensitive drum, a developing roller for developing an electrostatic latent image formed on said electrophotographic photosensitive drum, a drum unit containing said electrophotographic photosensitive drum, a developing unit which contains said developing roller and which is movable relative to said drum unit such that developing roller is movable between a contact position in which said

developing roller is contacted to said electrophotographic photosensitive drum and a spaced position in which said developing roller is spaced from said electrophotographic photosensitive drum, and a force receiving device including a first force receiving portion for receiving a force from the first force application member by movement of said door from the open position to the close position in the state that process cartridge is mounted to a main assembly of the apparatus through the opening, and a second force receiving portion movable from a stand-by position by movement of said first force receiving portion by a force received from the first force application member, wherein said second force receiving portion takes a projected position for receiving a force from the second force application member to move said developing unit from the contact position to the spaced position, the projected position being higher than the stand-by position; and feeding means for feeding the recording material.

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

[BRIEF DESCRIPTION OF THE DRAWINGS]

Figure 1 illustrates a general arrangement of an electrophotographic image forming apparatus according to a first embodiment of the present invention.

Figure 2 is a sectional view of a process cartridge according to the first embodiment of the present invention.

Figure 3 illustrates a general arrangement of an electrophotographic image forming apparatus according to a first embodiment of the present invention.

Figure 4 illustrates exchange of a process cartridge according to the first embodiment of the present invention.

Figure 5 is a sectional view of the process cartridge as seen in the direction of an axial direction of the photosensitive drum according to the first embodiment of the present invention.

Figure 6 is a sectional view of the process cartridge as seen in the direction of an axial direction of the photosensitive drum according to the first embodiment of the present invention.

Figure 7 is a sectional view of the process cartridge as seen in the direction of an axial direction of the photosensitive drum according to the first embodiment of the present invention.

Figure 8 is a sectional view of the process cartridge as seen in the direction of an axial direction of the photosensitive drum according to the first embodiment of the present invention.

Figure 9 is a perspective view of the process cartridge as seen from drives side according to the first embodiment of the present invention.

Figure 10 is a perspective view of the process cartridge as seen from the drive side according to the first embodiment the present invention.

Figure 11 is a perspective view of the process cartridge as seen from a non-driving side according to the first embodiment the present invention.

Figure 12 is a perspective view of the process cartridge as seen from a non-driving side according to the first embodiment the present invention.

Figure 13 is a perspective view of the process cartridge as seen from a non-driving side according to the first embodiment the present invention.

Figure 14 is a perspective view of the process cartridge as seen from a non-driving side according to the first embodiment the present invention.

Figure 15 is a perspective view showing a force receiving device of the process cartridge according to the first embodiment of the present invention.

Figure 16 is a perspective view showing a force receiving device of the process cartridge according to

the first embodiment of the present invention.

Figure 17 is a perspective view showing a force receiving device of the process cartridge according to the first embodiment of the present invention.

Figure 18 is a perspective view showing a force receiving device of the process cartridge according to the first embodiment of the present invention.

Figure 19 is a perspective view showing a force receiving device of the process cartridge according to the first embodiment of the present invention.

Figure 20 is a perspective view showing a force receiving device of the process cartridge according to the first embodiment of the present invention.

Figure 21 is a perspective view showing a force receiving device of the process cartridge according to the first embodiment of the present invention.

Figure 22 illustrates a process cartridge according to the first embodiment of the present invention wherein a first force receiving member and a second force receiving member are worked on by a first force receiving member and a second force receiving member of the electrophotographic image forming apparatus.

Figure 23 is a general arrangement of the electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 24 is a general arrangement of the

electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 25 is a general arrangement of the electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 26 is a general arrangement of the electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 27 illustrates an operation of a first force application member according to the first embodiment of the present invention.

Figure 28 illustrates a second force application member operation according to the first embodiment of the present invention.

Figure 29 is a perspective view of the electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 30 is a perspective view of the electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 31 illustrates exchange of the process cartridge according to the first embodiment of the present invention.

Figure 32 illustrates exchange of the process cartridge according to the first embodiment of the present invention.

Figure 33 is a sectional view of the process

cartridge as seen in the axial direction of the photosensitive drum according to the first embodiment of the present invention, illustrating an operation of the force receiving member of the process cartridge.

Figure 34 is a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the first embodiment of the present invention, illustrating an operation of the force receiving member of the process cartridge.

Figure 35 is a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the first embodiment of the present invention, illustrating an operation of the force receiving member of the process cartridge.

Figure 36 illustrates a spacing operation in the process cartridge according to the first embodiment of the present invention.

Figure 37 illustrates a spacing operation in the process cartridge according to the first embodiment of the present invention.

Figure 38 illustrates a spacing operation in the process cartridge according to the first embodiment of the present invention.

Figure 39 is a general arrangement of an electrophotographic image forming apparatus according to a second embodiment of the present invention.

Figure 40 is a general arrangement of the

electrophotographic image forming apparatus according to the second embodiment of the present invention.

Figure 41 is a general arrangement of the electrophotographic image forming apparatus according to the second embodiment of the present invention.

Figure 42 illustrates an operation of a first force applying operation member of the electrophotographic image forming apparatus according to the second embodiment of the present invention.

Figure 43 is an illustration of an operation of the first force application member according to the second embodiment of the present invention.

Figure 44 is an illustration of an operation of the first force application member according to the second embodiment of the present invention.

Figure 45 is an illustration of an operation of the first force application member according to the second embodiment of the present invention.

Figure 46 is a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the second embodiment of the present invention.

Figure 47 illustrates a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the second embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 48 illustrates a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the second embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 49 illustrates a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the second embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 50 illustrates a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the second embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 51 is a sectional view of a process cartridge according to a third embodiment of the present invention, illustrating an operation of a force receiving member of the process cartridge.

Figure 52 is a sectional view of the process cartridge according to the third embodiment of the present invention, illustrating the operation of the force receiving member of the process cartridge.

Figure 53 is a sectional view of the process cartridge according to the third embodiment of the present invention, illustrating the operation of a force receiving member of the process cartridge.

Figure 54 is a sectional view of the process cartridge according to the third embodiment of the present invention, illustrating the operation of a force receiving member of the process cartridge.

Figure 55 is a sectional view of a process cartridge as seen in the axial direction of the photosensitive drum according to a fourth embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 56 is a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the fourth embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 57 is a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the fourth embodiment of the present invention, illustrating the force receiving device of the process cartridge.

Figure 58 is a sectional view of the process cartridge as seen in the axial direction of the photosensitive drum according to the fourth embodiment of the present invention, illustrating a force receiving device of the process cartridge.

Figure 59 is a perspective view of a process cartridge according to a fifth embodiment of the present invention, as seen from a drive side.

Figure 60 is a perspective view of the process cartridge according to a fifth embodiment of the present invention, as seen from a drive side.

Figure 61 is a sectional view of a process cartridge according to a sixth embodiment of the present invention.

Figure 62 is a sectional view of the process cartridge according to the sixth embodiment of the present invention.

Figure 63 is a sectional view of the process cartridge according to the sixth embodiment of the present invention.

Figure 64 is a sectional view of the process cartridge according to the sixth embodiment of the present invention.

Figure 65 is a perspective view of a process cartridge according to a seventh embodiment, illustrating a force receiving device of a process cartridge.

Figure 66 is a perspective view of the process cartridge according to the seventh embodiment, illustrating the force receiving device of a process cartridge.

Figure 67 is a perspective view of the process cartridge according to the seventh embodiment, illustrating the force receiving device of a process cartridge.

Figure 68 is a perspective view of the process cartridge according to the seventh embodiment, illustrating the force receiving device of a process cartridge.

[BEST MODE FOR CARRYING OUT THE INVENTION]

[First embodiment]

Referring to Figures 1 - 4, the process cartridge and the electrophotographic image forming apparatus according to the first embodiment of the present invention.

Figure 1 shows an electrophotographic image forming apparatus (main assembly of the apparatus) 100 including process cartridges (cartridges) 50y, 50m, 50c, 50k detachably mounted. The cartridges 50y, 50m, 50c, 50k contain or accommodate yellow color toner (developer), magenta color toner (developer), cyan color toner (developer) and black color toner (developer), respectively. Figure 2 is a sectional side elevation of the cartridge alone; Figures 3 and 4 are illustrations of removing the cartridges 50y, 50m, 50c, 50k from the main assembly 100 of the apparatus.

[General arrangement of electrophotographic image forming apparatus]

As shown in Figure 1, the main assembly 100 of the apparatus, the electrophotographic photosensitive drums (photosensitive drums) 30y, 30m, 30c, 30k are

exposed to the laser beams 11 modulated in accordance with the image signal by the laser scanner 10, so that electrostatic latent images are formed on the surfaces. The electrostatic latent images are developed by developing rollers 42 into toner images (developed images) on the respective surfaces of the photosensitive drums 30. By applying voltages to the transfer rollers 18y, 18m, 18c, 18k, the toner images of respective colors formed on the photosensitive drums 30y, 30m, 30c, 30k are sequentially transferred onto the transfer belt 19. Thereafter, the toner image formed on the transfer belt 19 is transferred by the transfer roller 3 onto the recording material P fed by the feeding roller 1 (feeding means). Thereafter, the recording material P is fed to the fixing unit 6 including a driving roller and a fixing roller containing a heater. Here, by applying heat and pressure on the recording material P, the toner image transferred onto the recording material P is fixed. Thereafter, the recording material having the toner image fixed thereon is discharged to a discharging portion 9 by a pair 7 of discharging rollers.

[General arrangement of process cartridge]

Referring to Figures 1, 2, 5 and 22, 29, 30, the cartridges 50y, 50m, 50c and 50k of this embodiment will be described. Since the cartridges 50y, 50m, 50c, 50k are all the same except that the colors

contained therein are different from each other, the following description will be made only as to the cartridge 50y.

The cartridge 50y includes a photosensitive drum 30, process means actable on the photosensitive drum 30. The process means includes a charging roller 32 functioning as charging means for charging electrically the photosensitive drum 30, a developing roller 42 functioning as developing means for developing a latent image formed on the photosensitive drum 30, and/or blade 33 functioning as cleaning means for removing residual toner remaining on the surface of the photosensitive drum 30. The cartridge 50y comprises a drum unit 31 and a developing unit 41.

[Structure of drum unit]

As shown in Figures 2, 10, the drum unit 31 contains the photosensitive drum 30, the charging means 32, the cleaning means 33, the residual toner accommodating portion 35, the drum frame 34, and the covering members 36, 37. One longitudinal end of the photosensitive drum 30, as shown in Figure 9, is supported rotatably by a supporting portion 36b of the covering member 36. The other longitudinal end of the photosensitive drum 30, as shown in Figure 11 - Figure 14, is rotatably supported by a supporting portion 37b of a covering member 37. The covering members 36, 37 are fixed to the drum frame 34 at the opposite

longitudinal ends of the drum frame 34. As shown in Figures 9, 10, one longitudinal end of the photosensitive drum 30 is provided with a coupling member 30a for receiving a driving force for rotating the photosensitive drum 30. The coupling member 30a is engaged with first main assembly coupling member 105 shown in Figures 4, 30 when the cartridge 50y is mounted to the main assembly 100 of the apparatus. The photosensitive drum 30 is rotated in the direction of an arrow u as shown in Figure 2 by a driving force transmitted from a driving motor (unshown) provided in the main assembly 100 of the apparatus to the coupling member 30a. The charging means 32 is supported on the drum frame 34 and is rotated by the photosensitive drum 30 to which the charging means 32 is contacted. The cleaning means 33 is supported by the drum frame 34 and is contacted to the peripheral surface of the photosensitive drum 30. The covering members 36, 37 are provided with supporting hole portions 36a, 37a for rotatably (movably) supporting the developing unit 41.

[Structure of developing unit]

As shown in Figure 2, the developing unit 41 contains the developing roller 42, the developing blade 43, the developing device frame 48, the bearing unit 45 and the covering member 46. The developing device frame 48 comprises a toner accommodating

portion 49 for accommodating the toner to be supplied to the developing roller 42, and a developing blade 43 for regulating a layer thickness of the toner of the peripheral surface of the developing roller 42. As shown in Figure 9, the bearing unit 45 is fixed to the one longitudinal end side of the developing device frame 48, and supports rotatably the developing roller 42 having a developing roller gear 69 at the end thereof. The bearing unit 45 is provided with a coupling member 67, an idler gear 68 for transmitting a driving force to the developing roller gear 69 from the coupling member 67. The covering member 46 is fixed to the longitudinally outside of the bearing unit 45 so as to cover the coupling member 67 and the idler gear 68. The covering member 46 is provided with a cylindrical portion 46b which is projected beyond the surface of the covering member 46. The coupling member 67 is exposed through an inside opening of the cylindrical portion 46b. Here, the coupling member 67 is engaged with the second main assembly coupling member 106 shown in Figure 30 to transmit the driving force from the driving motor (unshown) provided in the main assembly 100 of the apparatus when the cartridge 50y is mounted to the main assembly 100 of the apparatus.

[Assembling of drum unit and developing unit]

As shown in Figures 9, 11 to Figure 14, when

the developing unit 41 and the drum unit 31 are assembled with each other, an outside circumference of the cylindrical portion 46b is engaged with the supporting hole portion 36a at one end side, and the projected portion 48b provided projected from the developing device frame 48 is engaged with the supporting hole portion 37a at the other end side. By doing so, the developing unit 41 is rotatably supported relative to the drum unit 31. As shown in Figure 2, the developing unit 41 is urged by the urging spring 95 (elastic member) so that developing roller 42 rotates about the cylindrical portion 46b and the projected portion 48b to contact to the photosensitive drum 30. More specifically, the developing unit 41 is urged in the direction of an arrow G by the urging force of the urging spring 95 so that developing unit 41 receives a moment H about the cylindrical portion 46b and the projected portion 48b. By this, the developing roller 42 can be contacted to the photosensitive drum 30 with a predetermined pressure. The position of the developing unit 41 at this time is "contact position".

As shown in Figure 10, the urging spring 95 of this embodiment is provided on the end which is opposite the one longitudinal end provided with the coupling member 30a for the photosensitive drum 30 and with the coupling member 67 for the developing roller

gear 69. Because of such a structure, the force g (Figure 6) received by the first force receiving member 75 of a force receiving device 90 (which will be described hereinafter) which is provided on the one longitudinal end, from the first force application member 61, produces a moment about the cylindrical portion 46b in the developing unit 41. In other words, at the one longitudinal end, the moment h thus produced is effective to urge the developing roller 42 to the photosensitive drum 30 with a predetermined pressure. At the other end, the urging spring 95 functions to urge the developing roller 42 to the photosensitive drum 30 with a predetermined pressure.

[Force receiving device]

As shown in Figure 2, the cartridge 50y is provided with a force receiving device 90 for effecting contact and spacing between the developing roller 42 and the photosensitive drum 30 in the main assembly 100 of the apparatus. As shown in Figures 9, 15 and Figure 19, the force receiving device 90 includes a first force receiving member 75, a second force receiving member 70 and a spring 73 (urging means) .

As shown in Figure 9, the first force receiving portion 75 is mounted to the bearing unit 45 by engaging an engaging portion 75d of the first force receiving member with a guide portion 45b of the

bearing unit 45. On the other hand, the second force receiving member 70 is mounted to the bearing unit 45 by engaging a shaft 70a of the second force receiving member 70 with the guide portion 45a of the bearing unit 45. The bearing unit 45 thus having the first force receiving member 75 and the second force receiving member 70 is fixed to the development accommodating portion 48, and then as shown in Figure 10, the covering member 46 is fixed so as to cover the bearing unit 45 from an outside in the axial direction of the developing roller 42 of the bearing unit 45. The first force receiving member 75 and the second force receiving member 70 are disposed above the cartridge 50y in the state that cartridge 50y is mounted to the main assembly 100 of the apparatus.

The operations of the force receiving device 90 will be described in detail hereinafter.

[Drawer member of main assembly of electrophotographic image forming apparatus]

The description will be made as to a cartridge tray 13 which is a drawer member.

As shown in Figure 4, the cartridge tray 13 is movable (inserting and drawing) along a rectilinear line which is substantially horizontal (D1, D2 directions) relative to the main assembly 100 of the apparatus. More particularly, the cartridge tray 13 is movable between a mounted position in the main

assembly 100 of the apparatus shown in Figure 1 and a drawn-out position outside the main assembly 100 of the apparatus shown in Figure 4. In the state that cartridge tray 13 is at the drawn-out position, the cartridges 50y, 50m, 50c, 50k are mounted on the cartridge tray 13 by the operator substantially vertically (arrow C) as shown in Figure 4. The cartridges 50y, 50m, 50c, 50k are arranged in parallel with each other such that longitudinal directions (axial directions of the photosensitive drum 30 and the developing roller 42) thereof are substantially perpendicular to the moving direction of the cartridge tray 13. The cartridges 50y, 50m, 50c, 50k are entered into the main assembly 100 of the apparatus while being carried on the cartridge tray 13. At this time, the cartridges 50y, 50m, 50c, 50k are moved keeping a distance (gap f2) (Figure 5) between the intermediary transfer belt 19 provided below them and the photosensitive drum 30. When the cartridge tray 13 is positioned at the mounted position , the cartridges 50y, 50m, 50c, 50k are positioned in place by the positioning portion 101a provided in the main assembly of the image forming apparatus 100. The positioning operation will be described in detail hereinafter. Therefore, the user can mount with certainty the cartridges 50y, 50m, 50c, 50k into the main assembly 100 of the apparatus by entering the cartridge tray 13

and closing the door 12. Therefore, the operationality is improved over the structure with which the cartridges 50y, 50m, 50c, 50k are mounted individually into the main assembly 100 of the apparatus by the user.

Referring to Figures 23 to 25 and 36 to 38, the operation of the cartridge tray 13 will be described.

Here, the cartridges are omitted for simplicity of explanation of the operation of the cartridge tray 13.

The cartridge tray 13 is supported drawably relative to a tray holding member 14. The tray holding member 14 is movable in interrelation with movement of the door 12 (opening and closing member). The door 12 is provided on the main assembly 100 of the apparatus and is rotatable about a rotational center 12a.

When the cartridge is taken out of the main assembly 100 of the apparatus, the door 12 is moved from the closed position to the open position. With the movement of the door 12, an engaging portion 15 provided on the door 12 moves clockwisely about the rotational center 12a. Then, as shown in Figure 24, the engaging portion 15 moves from the lower end 14c2 toward the upper end 14c1 in the elongated hole 14c provided in the tray holding member 14. Together with this operation, the engaging portion 15 moves the holding member 14 in the direction z1. At this time,

as shown in Figure 25, the projections 14d1, 14d2 projected from the tray holding member 14 are guided by a guide slot or groove 107 provided in the main assembly 100 of the apparatus. As shown in Figure 26, the guide groove includes a horizontal portion 107a1, an inclined portion 107a2 continuing with the horizontal portion 107a1 and inclining upwardly and a horizontal portion 107a3 continuing with the inclined portion 107a2. Therefore, as shown in Figure 24, when the door 12 is moved to the open position, the projections 14d1, 14d2 are guided along horizontal portion 107a1, the inclined portion 107a2 and the horizontal portion 107a3 in this order. Thus, the tray holding member 14 moves in the direction of z1 and in the direction of an arrow y1 away from the transfer belt 19. In this state, as shown in Figure 25, the cartridge tray 13 can be drawn toward outside of the main assembly 100 of the apparatus in the direction of an arrow D2 through the opening 80. Figure 30 is a partly broken perspective view of this state.

The description will be made as to the case of mounting the cartridge into the main assembly 100 of the apparatus. In the state that door 12 is at the open position as shown in Figure 25 , the cartridge tray 13 is entered into the main assembly 100 of the apparatus in the direction of the arrow D1 through the opening 80. Thereafter, as shown in Figure 23, the

door 12 is moved to the closing position. With the movement of the door 12, the engaging portion 15 provided on the door 12 moves counterclockwisely about the rotational center 12a. Then, as shown in Figure 23, the engaging portion 15 moves along the elongated hole 14c provided in the tray holding member 14 toward the lower end 14c2 of the elongated hole 14c. Together with this operation, the engaging portion 15 moves the holding member 14 in the direction z2. Therefore, as shown in Figure 23, when the door 12 is moved to the closing position, the projections 14d1, 14d2 are guided by the horizontal portion 107a3, the inclined portion 107a2 and the horizontal portion 107a1 in this order. Thus, the tray holding member 14 moves in the direction z2, and moves in the direction of an arrow y2 toward the transfer belt 19.

[Positioning of process cartridge relative to main assembly of electrophotographic image forming apparatus]

Referring to Figures 5, 15 and Figures 19, 27, 29, 30, the description will be made as to the positioning of the cartridges 50y, 50m, 50c, 50k relative to the main assembly 100 of the apparatus.

As shown in Figure 30, there is provided positioning portions 101a for positioning the cartridges 50y, 50m, 50c, 50k in the main assembly 100 of the apparatus. The positioning portions 101a are

provided for the respective cartridges 50y, 50m, 50c, 50k interposing the transfer belt 19 with respect to the longitudinal direction. As shown in Figure 27, (a) and Figure 27, (b) , a first force application member 61 is rotatably supported by the supporting shaft 55 of the main assembly 100 of the apparatus engaged with the supporting hole 61d at a position above the tray holding member 14.

As shown in Figure 27, (a), and Figure 27, (b) , the first force application member 61 moves with the movement of the door 12 from the open position to the closing position. As shown in Figure 20, the projected portion 61f provided on the first force application member 61 urges the projection 31a provided on the upper surface portion of the drum frame 34. By this, the cartridge 50y is urged in the direction of an arrow P (Figure 19) , so that portion to be positioned 31b (Figure 7) provided on the drum unit 31y is abutted to the positioning portion 101a provided in the main assembly 100 of the apparatus by which the cartridge 50y is positioned in place (Figure 6). The same operation is carried out adjacent the opposite longitudinal ends. Also, the same operation is carried out for the other cartridges 50m, 50c, 50k.

The mechanism for movement of the first force application member 61 in interrelation with the movement of the door 12 will be described. The first

force application member 61 is engaged with a connecting member 62 for interrelation with the movement of the door 12. As shown in Figure 15 to Figure 19, the connecting member 62 includes a supporting hole 62c engaged with the supporting shaft 55, a hole 62a engaged with the projected portion 61f, and a supporting pin 62b engaged with the elongated hole 14b (Figure 27, (b)) provided in the tray holding member 14. As shown in Figure 27, by the movement of the door 12 from the open position to the close position, the tray holding member 14 moves in the direction of the arrow y2 (Figure 27) . By this, the supporting pin 62b engaged with the elongated hole 14b also receives the force in the direction of the arrow y2. Therefore, the connecting member 62 rotates in the direction of an arrow Z (Figure 27) about the supporting hole 62c. As shown in Figure 19, between the first force application member 61 and the connecting member 62, there is provided a spring 66. The spring 66 is supported by the supporting shaft 55, and is contacted to the projection 62e provided on the connecting member 62 and to the projected portion 61f provided on the first force application member 61. By the urging force of the spring 66, the projected portion 61f urges the projection 31a provided on the drum frame 34 in the direction of an arrow P so as to position the cartridges 50y, 50m, 50c, 50k to the

positioning portions 101a of the main assembly 100 of the apparatus.

As shown in Figure 21, the projection 31a may be urged directly by the spring 66. Thus, the structure for the connecting member 62 to interrelate with the movement of the door 12 is same as with Figure 15 to Figure 20. When the door 12 is at the open position , one end 66b of the spring 66 is engaged with the hook 62e provided on the connecting member 62 , and the other end 66b of the spring 66 is engaged with the projection 62f provided on the connecting member 62. By the door 12 moving from the open position to the close position, the other end 66b becomes away from the projection 62f and directly urges the projection 31a to position the cartridges 50y, 50m, 50c, 50k to the positioning portion 101a of the main assembly 100 of the apparatus.

[Spacing mechanism of main assembly of electrophotographic image forming apparatus]

Referring to Figure 5 to Figure 8 and Figure 11 to Figure 19 Figure, the description will be made as to the mechanism for operating the force receiving device 90 provided on the cartridge 50y. Figure 5 - Figure 8 are sectional views of the cartridge as seen in the axial direction of the photosensitive drum 30, and Figure 11 - Figure 14 are perspective views as seen from the non-driving side of the cartridge 50y.

The state shown in Figure 5 corresponds to the state shown in Figure 11 and to the state shown in Figure 15. The state shown in Figure 6 corresponds to the state shown in Figure 12 and to the state shown in Figure 16. The state shown in Figure 7 corresponds to the state shown in Figure 13, and the state of Figure 8 corresponds to the state of Figure 14.

As described hereinbefore, with the closing operation of the door 12 from the open position, the first force application member 61 moves about the supporting shaft 55 from the state of Figures 5, 11 and 15 to the state of Figures 6, 12, 16. At this time, the first force application member 61 not only positions the cartridge 50y relative to the main assembly 100 of the apparatus but also acts on the first force receiving member 75 of the cartridge 50y. More particularly, an urging portion 61e of the first force application member 61 abuts the first urged portion of the first force receiving member 75. Thereafter, the first force receiving member 75 urges the cam surface 70c (third urged portion) provided in the second force receiving member 70 by which the second force receiving member 70 is rotated about the shaft 70a. Then, the second force receiving member 70 is moved from the stand-by position as shown in Figures 5, 11, 15 to an outside of the developing unit 41 of the cartridge 50y, that is, away from the

rotation axis 46b of the developing unit 41. With the structure shown in Figure 21, the projected portion 62g projected from the connecting member 62 functions as the first force application member 61.

Referring to Figure 28, the description will be made as to the operation of the second force applying portion 60.

A driving force from a motor 110 (driving source) provided in the main assembly 100 of the apparatus is transmitted to the gear 112 by way of the gear 111. The gear 112 receiving the driving force rotates in the direction of an arrow L to rotate a cam portion 112a provided integrally with the gear 112 in the direction of the arrow L. The cam portion 112a is engaged with a shifting force receiving portion 60b provided on the second force application member 60. Therefore, with rotation of the cam portion 112a, the second force application member 60 moves in the direction of an arrow E or B.

Figure 28 illustrates in (a) the case in which the second force application member 60 moves in the direction of the arrow E and in which the developing roller 42 and the photosensitive drum 30 are still in contact with each other (Figure 7). Figure 28 illustrates in (b) the case in which the second force application member 60 moves in the direction of the arrow B and in which the second force receiving member

70 receives a force from the engaging rib 60y. By doing so, the developing unit 41 is rotated (moved) about the rotation axis 46b, so that developing roller 42 and the photosensitive drum 30 become spaced from each other. The position of the developing unit 41 at this time is a spaced position.

As shown in Figure 15, the second force application member 60 is provided with an elongated hole portion 60c for permitting movement of a supporting shaft 55 on which the first force application member 61 is provided rotatably. Therefore, even when the second force application member 60 moves in the direction of the arrow B (Figure 8) or in the direction of the arrow E (Figure 7), the second force application member 60 can move without being disturbed by the first force application member 61. Similarly to the first force application member 61, the second force application member 60 is provided facing the movement path of the cartridges so as to be above the cartridges 50y, 50m, 50c, 50k entering the main assembly 100 of the apparatus on the cartridge tray 13. In the step of advancement of the cartridges 50y, 50m, 50c, 50k into the main assembly 100 of the apparatus, the second force receiving member 70 is kept at the stand-by position (Figure 15). Therefore, the first force application member 61 and the second force application member 60 can be very close to the

cartridges 50y, 50m, 50c, 50k as long as they do not interfere therewith, so that wastefull space can be removed. Therefore, the main assembly 100 of the apparatus can be downsized with respect to the vertical direction and the longitudinal direction of the cartridge 50y (axial direction of the photosensitive drum 30).

The operation will be described hereinafter in detail.

[Mounting of process cartridge to main assembly of electrophotographic image forming apparatus and operation of force receiving device]

The description will be made as to the series of operations from the mounting of the cartridges 50y, 50m, 50c, 50k to the main assembly 100 of the apparatus to the spacing of the developing roller 42 from the photosensitive drum 30.

As shown in Figure 4, the cartridges 50y, 50m, 50c, 50k are mounted from the top to the cartridge tray 13 drawn out to the drawn-out position in the direction of an arrow C.

By moving the cartridge tray 13 in the direction of the arrow D1, the cartridges 50y, 50m, 50c, 50k are passed through the opening 80 into the main assembly 100 of the apparatus. Thus, in this embodiment, the cartridges 50y, 50m, 50c, 50k are inserted into the main assembly 100 of the apparatus

in the direction substantially perpendicular to the axial direction of the photosensitive drum 30.

As shown in Figures 31, 32, the cartridge 50y is mounted at the most downstream position in the cartridge tray 13 with respect to the inserting or entering direction. The cartridge 50y advances from the upstream side toward the downstream side below the first force application members 61k, 61c, 61m and the engaging ribs 60k, 60c, 60m of the second force application member 60 which are actable on the cartridges 50m, 50c, 50k.

The cartridge 50m is mounted at the second position from the downstream side on the cartridge tray 13 with respect to the entering direction. The cartridge 50m advances from the upstream side toward the downstream side below the first force application members 61k, 61c and the engaging ribs 60k, 60c of the second force application member 60 which are actable on the cartridges 50c, 50k.

The cartridge 50c is mounted at the third position from the downstream side on the cartridge tray 13 with respect to the entering direction. The cartridge 50c passes from the upstream side toward the downstream side below the engaging ribs 60k of the first force application member 61k and the second force application member 60 which are actable on the cartridge 50k.

The most upstream cartridge 50k on the cartridge tray 13 with respect to the entering direction enters from the upstream side toward the downstream side such that second force receiving member 70 thereof passes below the first force application member 61 actable on the cartridge 50k.

The passing of the second force receiving member 70 below the first force application member 61k from the upstream side toward the downstream side is the same with respect to the cartridges 50y, 50m, 50c.

That is, when the process cartridge is inserted with the second force receiving member 70 projected, the first force application member 61 and the second force application member 60 have to be at an upper part so as to avoid interference of the second force receiving member 70 with the first force application member 61 and second force application member 60. However, if the second force receiving member 70 is at the stand-by position , the first force application member 61 and the second force application member 60 can be disposed close to the cartridges 50y, 50m, 50c, 50k without the necessity of taking into account the degree of projection of the second force receiving member 70. Therefore, the main assembly 100 of the apparatus can be downsized with respect to the vertical direction. In addition, as shown in Figures 31, 32, the positions of the force receiving device 90,

the first force application member 61 and the second force application member 60 are such that force receiving device 90 overlaps with the first force application member 61 and the second force application member 60 in the drum axial direction, and therefore, the cartridge can be downsized with respect to the longitudinal direction thereof.

When the cartridge tray 13 is inserted into the main assembly 100 of the apparatus, a gap f1 is maintained between the second force application member 60 and the force receiving device 90 as shown in Figure 5. Also, a gap f2 is maintained between the photosensitive drum 30 and the transfer belt 19. Therefore, the cartridges 50y, 50m, 50c, 50k can enter without interference with the main assembly 100 of the apparatus.

Thereafter, as shown in Figure 23, by moving the door 12 to the close position, the tray holding member 14 moves in the direction of approaching to the transfer belt 19 (arrow y2) . A vertical component of the movement distance in the direction of an arrow y2 is f2. By doing so, as shown in Figure 6, the cartridges 50y, 50m, 50c, 50k also move so that surface of the photosensitive drum 30 is brought into contact to the surface of the transfer belt 19. In this state, the gap f1 between the force receiving device 90 and the second force application member

engaging portion 60 expands to f1+f2.

In addition, by moving the door 12 to the close position, the first force application member 61 is moved so that projection 31a provided on the upper surface portion of the drum frame 34 is urged by the projected portion 61f. By this, as shown in Figure 6, the positioning portions 31b of the cartridges 50y, 50m, 50c, 50k are abutted to the respective positioning portions 101a provided in the main assembly 100 of the apparatus , so that cartridges 50y, 50m, 50c, 50k are positioned to the main assembly 100 of the apparatus.

The cartridges 50y, 50m, 50c, 50k are prevented from moving in the direction of the an arrow a (Figure 1) in the main assembly 100 of the apparatus by engaging the shaft 36d provided on the covering member 36 shown in Figure 10 with a rotation preventing portion 13a provided on the cartridge tray 13.

The urging portion 61e of the first force application member 61 contacts and urges the urged portion 75a (Figure 15) of the first force receiving member 75 positioned at the first position (Figure 15). Thereafter, the first force receiving member 75 is moved in the direction of an arrow r to be positioned at the second position (Figure 16).

At the second position, the urging portion 75b urges the cam surface 70c of the second force

receiving member 70 shown in Figure 15. By doing so, the second force receiving member 70 rotates about the axis of the shaft 70a from the stand-by position to a position outside the developing unit 41 of the cartridges 50y, 50m, 50c, 50k, that is, in the direction away from the rotation axis 46b of the developing unit 41.

However, at this time, the upper surface 70 of the second force receiving member 70 interferes with the lower surface of the engaging rib 60y of the second force application member 60 which is placed at the home position, by which the movement of the second force receiving member 70 is regulated by the engaging rib 60y (Figures 6, 12) . The position of the second force receiving member 70 at this time is called regulating position.

Here, this position is made the home position for the following reason: After the cartridges 50y, 50m, 50c, 50k are mounted to the main assembly 100 of the apparatus, the state is as shown in Figure 8 until the image forming operation is carried out. More particularly, the second force application member 60 has been moved in the direction of the arrow B, so that engaging rib 60y urges the second force receiving member 70. In this state, photosensitive drum 30 photosensitive drum 30 the developing roller 42 are spaced from each other. In the state of Figure 8,

cartridges 50y, 50m, 50c, 50k are dismounted from the main assembly 100 of the apparatus. Thereafter, when cartridges 50y, 50m, 50c, 50k are mounted to the main assembly 100 of the apparatus again, the second force application member 60 is at the position shown in Figure 8, and therefore, when the second force receiving member 70 moves from the stand-by position, it is contacted to the rib 60y.

As shown in Figure 8, the direction (arrow J) of the force received by the first force receiving member 75 from the first force application member 61 is substantially opposite the direction of the force received by the second force receiving member 70 from the second force application member 60. The surface of the second force receiving member 70 which receives the force from the second force application member 60 direction faces the direction of entrance of the cartridges 50y, 50m, 50c, 50k into the main assembly 100 of the apparatus. By selecting the direction of the receiving force, when the second force receiving member 70 receives the force from the second force application member 60, the developing unit 41 can be efficiently moved relative to the drum unit 31 with certainty. Furthermore, the state that photosensitive drum 30 and the developing roller 42 are spaced can be maintained stably.

However, even when the movement of the second

force receiving member 70 is limited by the engaging rib 60y, the force receiving device 90 including the second force application member 60 and the second force receiving member 70 is not damaged. As shown in Figure 22, (a), since the movement of the second force receiving member 70 is regulated, the movement of the urging portion 75b for urging the cam surface 70c is also regulated. Even if the urging portion 61e of the first force application member 61 further urges the urged portion 75a, an elastic portion 75c in the form of arch provided on the first force receiving member 75 flexes (elastic deformation). Therefore, even if the movement of the second force receiving member 70 is regulated, the force receiving device 90 is not damaged.

And, when the second force application member 60 is moved from the position of Figures 6, 12 in the direction of the arrow E as shown in Figures 7, 13, the second force receiving member 70 moves outwardly of the cartridge 50y to enter the movement path of the engaging rib 60y. The position of the second force application member 60 at this time is called projected position. Thus, the second force application member 60 is projected beyond the above-described stand-by position when it is at the projected position. The degree of projection of the second force receiving member 70 at the projected position is larger than the

gap f1+f2 in order to engage with the second force application member 60. The operation of the second force application member 60 is carried out at the prior to the image formation after cartridges 50y, 50m, 50c, 50k are mounted to the main assembly 100 of the apparatus.

Then, as shown in Figures 8, 14, the second force application member 60 moves in the direction of the arrow B, so that side surface 70b which is the second urged portion of the second force receiving member 70 entering the movement path receives the force from the engaging rib 60y. By doing so, the developing unit 41 rotates (moves) about the rotation axis 46b , so that developing roller 42 is spaced from the photosensitive drum 30 by a gap α. The second force receiving member 70 receives the force from the second force receiving member 70 in the projected position. Thus, as compared to a structure in which the second force receiving member moves toward the process cartridge and engages with the developing unit to effect the developing device spacing, the distance from the rotation axis 46b of the developing unit 41 can be made large. Therefore, the driving torque required for spacing the developing roller 42 from the photosensitive drum 30 can be made small.

In addition, by the movement of the second force application member 60 in the direction of the

arrow B, the position where the first force receiving member 75 is pushed by the first force application member 61 and the position where the second force receiving member 70 receives the force from the engaging rib 60y change with respect to the horizontal direction. In other words, the relation between a distance I shown in Figure 7 and a distance II shown in Figure 8 is distance I > distance II. The change of the distance is accommodated by the elastic portion 75c provided on the second force receiving member 70. As shown in Figure 22, (a), the elastic portion 75c is in the form of flexible arch configuration. Inside the elastic portion 75c, there is provided a spring 76 which is an elastic member. The spring 76 prevents the elastic portion 75c from flexing beyond necessity and functions to restore the flexed elastic portion 75c. The arch configuration of the elastic portion 75c is not inevitable, and the elastic member may be a simple elastic member.

In order to effect the image forming operation, the developing roller 42 is contacted to the photosensitive drum 30 by moving the second force application member 60 in the direction of the arrow E. By this, as shown in Figures 7, 13, the second force receiving member 70 is brought into a state of not receiving the force from the engaging rib 60y. Therefore, by the urging force of the spring 95

provided between the developing unit 41 and the drum unit 31, the developing roller 42 and the photosensitive drum 30 are contacted to each other so that cartridges 50y, 50m, 50c, 50k become capable of forming the image. In this occasion, prior to the contact of the developing roller 42 to the photosensitive drum 30, the photosensitive drum 30 rotates, and the developing roller 42 also receives the driving force from the main assembly 100 of the apparatus and rotates. This is accomplished by providing the coupling portion 67a co-axially with the cylindrical portion 46b so that even if the developing unit 41 moves about the cylindrical portion 46b, the position of the coupling portion 67a does not change. Thus, the photosensitive drum 30 and the developing roller 42 are rotated before the developing roller 42 and the photosensitive drum 30 are contacted to each other. Therefore, when the developing roller 42 is brought into contact to the photosensitive drum 30, the speed difference between the peripheral surfaces of the photosensitive drum 30 and the developing roller 42 can be made small, and therefore, wearing of the photosensitive drum 30 and the developing roller 42 can be reduced. When the image formation is completed, the developing roller 42 and the photosensitive drum 30 are spaced from each other by moving the second force application member 60 in the

direction of the arrow B, as described hereinbefore. After the spacing, the rotations of the developing roller 42 and the photosensitive drum 30 are stopped. Thus, the speed difference between the peripheral surfaces of the photosensitive drum 30 and the developing roller 42 is reduced, and therefore, the wearing of the photosensitive drum 30 and the developing roller 42 can be reduced. Therefore, the image quality can be improved.

The elastic portion can be replaced with the structure shown in Figures 33, 34, 35. Here, a force receiving device 190 comprises a first force receiving member 179 and a second force receiving member 178. As shown in Figures 34, 35, the first force application member 165 is provided with a sliding portion 165a (inclined surface), and the first force receiving member 179 is provided with a sliding portion 179a (inclined surface). Figure 33 shows the state before the first force application member 165 moves. Figure 34 shows the state in which the second force receiving member 178 is projected from the cartridge 150y by the first force application member 165 moving to abut the first force receiving member 179. Figure 35 shows the state after the second force application member 164 moves in the direction of the arrow E.

The change from I to II of the distance between the first force receiving member 179 and the second

force receiving member 178 shown in Figures 34, 35 is permitted by the slidability between the sliding portion 179a and the sliding portion 165a and by the movability of the first force receiving member 179 in the direction of an arrow F shown in Figure 35.

In the cartridge 50y used for the description of this embodiment, the developing unit 41 is rotatable relative to the drum unit 31 in order to contact and space the developing roller 42 and the photosensitive drum 30 relative to each other. However, Figure 36 shows an alternative structure wherein the portion to be guided 544 is in the form of a square pole configuration, and the drum unit 531 is provided with an elongated hole 536a engageable with the portion to be guided 544, wherein the developing unit 541 is slidable relative to the drum unit 531.

More particularly, as shown in Figure 37, when the second force application member 560 does not act on the second force receiving member 570 , the developing roller 542 is urged by an urging spring (unshown) (elastic member) so as to contact the developing roller 542 to the photosensitive drum. Then, as shown in Figure 38, the second force application member 560 moves in the direction of the arrow B to act on the second force receiving member 570. By this, the developing unit 541 slides in the direction the relative to the drum unit 531 so that developing

roller 542 and the photosensitive drum 530 are spaced by the gap g. Similarly to the first embodiment, the force receiving device 590 includes the first force receiving member 575 and the second force receiving member 570.

The description will be made as to the operation for taking the cartridges 50y, 50m, 50c, 50k out of the main assembly 100 of the apparatus.

With the movement of the door 12 from the close position to the open position, the first force application member 61 rotates from the position of Figures 6, 12 to the position of Figures 5, 11. By this, the first force receiving member 75 is released from the urging force of the first force application member 61 , so that first force receiving member 75 moves from the state shown in Figures 6, 12 to the state shown in Figures 5, 11. More particularly, the second force receiving member 70 becomes free from the urging portion 75b of the first force receiving member 75. As shown in Figure 5, the second force receiving member 70 also returns to the stand-by position (non-operating position) about the shaft 70a by the force of the spring 73 shown in Figure 19 in the direction of an the arrow A.

With the movement of the door 12 from the close position to the open position, the tray holding member 14 is raised away from the transfer belt 19 as shown

in Figures 3, 4. By this, the cartridges 50y, 50m, 50c, 50k are raised, and therefore, the photosensitive drum 30 is separated from the transfer belt 19.

As described in the foregoing, the second force receiving member 70 for moving the developing unit 41 is constituted such that it projects outwardly from the developing unit 41 when the cartridges 50y, 50m, 50c, 50k are mounted to the main assembly 100 of the apparatus and the door 12 moves to the close position. Therefore, the cartridges 50y, 50m, 50c, 50k can be downsized. In addition, since the mounting is effected when the second force receiving member 70 is at the stand-by position , the space in the main assembly 100 of the apparatus required for the movement of the cartridges 50y, 50m, 50c, 50k may be small. In other words, the size of the opening 80 may be small, and the first force application member 61 and the second force application member 60 can be close to the cartridges 50y, 50m, 50c, 50k. Therefore, the size of the main assembly 100 of the apparatus can be reduced with respect to the vertical direction. In addition, as seen in the vertical direction of the main assembly 100 of the apparatus, as shown in Figures 31, 32, the force receiving device 90 is overlapped with the first force application member 61 and the second force application member 60 with respect to the drum axial direction, and therefore, the cartridge can be

downsized with respect to the longitudinal direction.

When the cartridges 50y, 50m, 50c, 50k are handled by the user or when they are transported, the second force receiving member 70 can be placed at the stand-by position, and therefore, the second force receiving member 70 is not easily damaged.

(Second Embodiment)

In the first embodiment, the cartridges 50y, 50m, 50c, 50k are mounted to the main assembly 100 of the apparatus in the direction substantially perpendicular to the axis of the photosensitive drum 30. In Embodiment 2, the cartridges 450y, 450m, 450c, 450k are mounted to the main assembly 401 of the electrophotographic image apparatus (main assembly of the apparatus) in the direction substantially parallel with the axial direction of the electrophotographic photosensitive drum the photosensitive drum) 430. In the following description, the points different from the first embodiment will be described mainly.

[General arrangement of electrophotographic image forming apparatus]

As shown in Figure 39 Figures 41, the main assembly 401 of the apparatus is loaded with the cartridges 450y, 450m, 450c, 450k in the direction (arrow K) substantially parallel with the axial direction (longitudinal direction) of the

photosensitive drum 430. In this embodiment, the cartridges 450y, 450m, 450c, 450k are mounted to the mounting member 480c provided in the main assembly 401 of the apparatus, in the direction of the arrow K. The cartridges 450y, 450m, 450c, 450k accommodate yellow color, magenta color, cyan color and black color toner particles (developers), respectively.

The cartridges 450y, 450m, 450c, 450k are each provided with a force receiving device 490 having a first force receiving member 475 and a second force receiving member 470. At the rear side of the main assembly 401 of the apparatus with respect to the cartridge entering direction, there are provided a first force application member 461 and a second force application member 460 actable on the first force receiving member 475 and the second force receiving member 470, respectively. As shown in Figure 42, the main assembly 401 of the apparatus is provided with an opening 408 for permitting the cartridges 450y, 450m, 450c, 450k to enter the main assembly 401 of the apparatus and a door 412 movable between a close position closing the opening 408 and an open position opening the opening 408. The door 412 is rotatable about the rotation axis 412a. As shown in Figure 45, the mounting member 480 integrally includes holding portions 480c for holding the cartridges 450y, 450m, 450c, 450k, respectively, an operation member 480b for

moving the first force application member 461, and a connecting portion 480a for connecting the operation member 480b and the door 412 with each other. As shown in Figure 42, the connecting portion 480a and the door 412 are connected with each other by engagement between an elongated hole 480 g provided in the connecting portion 480a and a projection 412b provided on the door 412.

Therefore, with movement of the door 412 from the open position to the close position in the direction of an arrow m, projections 480d, 480e provided on the connecting portion 480a move along guide grooves 401a, 401b provided in the main assembly 401 of the apparatus as shown in Figure 42. Thus, a holding portion 480c integral with the operation member 480b moves in the direction of an arrow n. Thus, the photosensitive drums 430 of the cartridges 450y, 450m, 450c, 450k supported on the holding portion 480c are moved from the positions spaced from the transfer belt 419 shown in Figure 47 to the position contacting to the transfer belt 419 shown in Figure 48. Simultaneously, the portion to be positioned 431b provided on the drum unit 431 is abutted to the positioning portion 401a provided in the main assembly 401 of the apparatus by which the cartridges 450y, 450m, 450c, 450k are positioned correctly.

Each of the cartridges 450y, 450m, 450c, 450k

is prevented from movement in the direction of the arrow a in Figure 39 in the main assembly 401 of the apparatus by engaging the shaft 436d provided on the covering member 436 with a rotation preventing portion 485a provided in the main assembly 401 of the apparatus.

When the cartridges 450y, 450m, 450c, 450k are dismounted from the main assembly 401 of the apparatus, the operations are reverse to the mounting operations.

[Operations first force application member and second force applying portion]

Referring to Figure 40 - Figure 45, the operations of the first force application member 461 will be described. Similarly to the first embodiment, the first force application member 461 is engaged with a connecting member 462 to interrelate with the operation of the operation member 480b. The structure of the connecting member 462 is the same as in the first embodiment. Figures 40 and 42, (a) and Figure 43 show the state in which the door 412 is at the open position and in which the operation member 480b takes an upper position. Figures 41 and 42, (b) and Figure 44 show the state in which the door 412 is at the close position. When the door 412 is closed, the operation member 480b moves down (in the direction of an arrow n). As shown in Figures 43, 44, a projection 462b provided on the connecting member 462 is in

engagement with an elongated hole 480h provided in the mounting member 480. Therefore, with movement of the operation member 480b, the connecting member 462 rotates in the direction of an arrow Q about the rotational center 461d. Similarly to the first embodiment, the first force application member 461 rotates with the rotation of the connecting member 462. When the door 412 is moved from the close position to the open position, the operations are reverse to the above-described operations. The other operations are the same as with the first embodiment.

The operations of the second force applying portion 460 are the same as with the first embodiment.

[General arrangement of process cartridge]

The description will be made as to the structure of the process cartridge of this embodiment. The structures of the cartridges 450y, 450m, 450c, 450k are the same, and therefore, the description will be made as to the cartridge 450y referring to Figure 46.

The cartridge 450y includes a photosensitive drum 430, process means actable on the photosensitive drum 430. The process means includes a charging roller 432 functioning as charging means for charging electrically the photosensitive drum 430, a developing roller 442 functioning as developing means for developing a latent image formed on the photosensitive

drum 430, and/or blade 433 functioning as cleaning means for removing residual toner remaining on the surface of the photosensitive drum 430. The cartridge 450y comprises a drum unit 431 and a developing unit 441.

The structures of the drum unit 431 and the developing unit 441 and the connecting structure between the drum unit 431 and the developing unit 441 are the same as with the first embodiment.

[Force receiving device]

Similarly to the first embodiment, as shown in Figure 47, the cartridge 450y includes a force receiving device 490 for contacting the developing roller 442 and the photosensitive drum 430 to each other and for spacing them from each other. The detail structures thereof are the same as with Figures 9 and 15 - 19. As shown in Figure 47, the force receiving device 490 of this embodiment comprises a first force receiving member 475, a second force receiving member 470 and a spring which is urging means (unshown) .

[Spacing mechanism of main assembly of electrophotographic image forming apparatus and urging mechanism for process cartridge]

Figure 49 shows the state after the second force application member 460 moves in the direction of an arrow E from the home position (Figure 48) in which the developing roller 442 and the photosensitive drum

430 are still in contact with each other. Figure 50 shows the state after the second force application member 460 moves in the direction of an arrow B in which the developing roller 442 and the photosensitive drum 430 are spaced from each other. Similarly to the first embodiment, the second force applying portion 460 is provided with an elongated hole portion 460c for avoiding the rotation axis 461d of the first force application member 461. Even when the second force applying portion 460 moves in the direction of an arrow E or arrow B, the second force applying portion 460 can move without interference with the first force application member 461.

The first force application member 461 and the second force application member 460, as shown in Figures 39, 40, are provided above the cartridges 450y, 450m, 450c, 450k entering the main assembly 401 of the apparatus. When the cartridges 450y, 450m, 450c, 450k are in the process of entering the main assembly 401 of the apparatus, the second force receiving member 470 is kept in the stand-by position.

Also in this embodiment, the second force receiving member 470 is projected outwardly of the developing unit 441 when the cartridges 450y, 450m, 450c, 450k are mounted to the main assembly 401 of the apparatus and the door 412 is moved to the close position. Therefore, the cartridges 50y, 50m, 50c, 50k

can be downsized Since the cartridges 450y, 450m, 450c, 450k are inserted with the second force receiving members 470 are at the stand-by positions, the space required for entering the cartridges 450y, 450m, 450c, 450k may be small. In other words, the size of the opening 480 may be small, and the first force application member 461 and the second force application member 460 can be close to the cartridges 450y, 450m, 450c, 450k. Therefore, the main assembly 401 of the apparatus can be downsized with respect to the vertical direction. Since the arrangement is such that force receiving device 90 are overlapped with the first force application member 61 and the second force application member 60 in the drum axial direction as seen in the vertical direction, the cartridge can be downsized in the longitudinal direction.

When the cartridges 450y, 450m, 450c, 450k are handled by the user or when they are transported, the second force receiving member 470 can be placed at the stand-by position, and therefore, the second force receiving member 470 is not easily damaged.

(Third Embodiment)

This embodiment relates to a modification of the force receiving device.

This embodiment will be described also with a

yellow cartridge 250y accommodating a yellow color developer as an exemplary cartridge.

As shown in Figure 51 - Figure 54, the developing unit 241 is provided with a force receiving member 277 (force receiving device).

The force receiving member 277 includes a shaft portion 277c supported rotatably on the developing device frame 248, a first force receiving portion 277a on which the first force application member 261 is actable, and a second force receiving portion 277b on which the second force application member 263 is actable. The force receiving member 277 is integrally constituted by the first force receiving portion and the second force receiving portion. The spring 298 has one end fixed to the force receiving member 277 and another end fixed to the developing device frame 248. The force receiving member 277 is kept in the state shown in Figure 51 by the spring 298.

As shown in Figure 52, similarly to the first embodiment, by movement of the door (unshown) from the open position to the close position, the first force application member 262 is contacted to the first force receiving portion 277a of the force receiving member 277. By doing so, the force receiving member 277 rotates in the direction of an arrow S shown in Figure 52 about the shaft 277c. The second force receiving portion 277b of the force receiving member 277 moves

outwardly of the developing unit 241.

Thereafter, as shown in Figure 53, the second force application member 263 moves in the direction of an arrow B by the driving force from the main assembly of the apparatus to contact to the second force receiving portion 277b of the force receiving member 277. Further, when the second force application member 263 moves in the direction of an arrow B, the developing unit 241 rotates about the connecting portion 246b with the drum unit 231, by which the developing roller 242 is spaced from the electrophotographic photosensitive drum 230 by a gap γ. At this time, as shown in Figure 53, the portion to be locked 277d of the force receiving member 277 is contacted to the locking portion 248a of the developing device frame 248 to regulate the movement of the force receiving member 277 shown in Figure 52 in the direction of the arrow S. Therefore, by movement of the second force application member 263 in the direction of the arrow E, the developing unit 241 is rotated relative to the drum unit 31. By the movement of the second force application member 263 in the direction of the arrow B, the first force receiving portion 277a of the force receiving member 277 slides on and deform the free end portion 262a of the first force application member 262 from the shape indicated by a solid lines to the shape indicated by

broken lines in Figure 54. To accomplish this, the free end portion 262a of the first force application member 262 is elastically deformable. In addition, the first force receiving portion 277a constitutes a sliding surface slidable relative to the first force application member 262.

The elastic deformability of the free end portion 262a of the first force application member 262 assures the urging of the force receiving member 277 to the locking portion 248a even when the second force application member 263 moves in the direction of the arrow B in the state of Figure 53.

As regards the contact between the developing roller 242 and the photosensitive drum 230, by the movement of the second force application member 263 in the direction of the arrow E in Figure 53 from the state shown in Figure 53, the movement to the second force receiving member 277 by the second force application member 263 is permitted. By the urging force of the spring 295, the developing unit 241 is rotated to contact the developing roller 242 to the photosensitive drum 230.

In this embodiment, the structures other than the force receiving member 277 are the same as those of the cartridge 50y described in the first embodiment. The operations of the first force application member 261 in this embodiment are the same as those of the

first force application member 61 in the first embodiment or the first force application member 461 in the second embodiment.

As described in the foregoing, in the force receiving device of this embodiment, the number of parts is smaller than the number of parts of the force receiving device 90 of the first embodiment.

(Fourth Embodiment)

This embodiment relates to a modification of the force receiving device.

This embodiment will be described also with a yellow cartridge 250y accommodating a yellow color developer as an exemplary cartridge. As shown in Figure 55 - Figure 58, the developing unit 341 is provided with a force receiving device 370. The force receiving device 370 includes a first force receiving member 370a, of second force receiving member 370b, a first spring 370c, and a second spring 370d. The force receiving device 370 is movably supported in a guide 341a provided in the developing device frame 348. The second spring 370d is provided between a locking portion 341c provided at one end of the guide 341a and a locking portion 370e provided on the second force receiving member 370b. The first spring 370c is provided between the first force receiving member 370a and the second force receiving member 370b.

When the door (unshown) is at the open position, the second force receiving member 370b is retracted to the position (stand-by position) where the locking portion 370e is contacted to the second locking portion 341b provided in the guide 341a as shown in Figure 55 by the urging force of the second spring 370d. At this time, a gap f1 is provided between the second force receiving member 370b and the second force application member 360 provided in the main assembly side of the apparatus. In other words, since the second force receiving member 370b does not receive a force from the second force application member 360, the photosensitive drum 330 and the developing roller 342 are contacted to each other.

Similarly to the first embodiment, by movement of the door (unshown) from the open position to the close position, as shown in Figure 56, the first force application member 361 is brought into contact to the first urged portion 370a1 of the first force receiving member 370a. By doing so, the second force receiving member 370b is urged through the spring 370c to move the second force receiving member 370b to an outer of the developing unit 241 (arrow P) . At this time, the second force application member 360 is contacted by the upper surface 370b1 of the second force receiving member 370b to regulate a further movement. However, since the spring 370c elastically deforms, the force

receiving device 370 is not damaged even if the first force application member 361 continues pressing against the first force receiving member 370a with the movement of the second force receiving member 370b regulated.

As shown in Figure 57, when the second force application member 360 moves in the direction of an arrow E, the second force receiving member 370b is further moved by the urging force of the spring 370c into the movement path of the second force application member 360.

Then, as shown in Figure 58, by the movement of the second force application member 360 in the direction of the arrow B, the side surface 370b2 (second urged portion) provided on the second force receiving member 370b receives a force from the second force application member 360. Further, wherein the second force application member 360 moves in the direction of an arrow E, the developing unit 341 rotates about the connecting portion 346b with the drum unit 331, by which the developing roller 342 is spaced from the electrophotographic photosensitive drum 330 by a gap δ. Here, the position where the first force receiving member 370a is urged by the first force application member 361 is fixed, and the second force receiving member 370b is moved by the movement on the second force application member 360 in

the direction of the arrow B shown in Figure 58. Therefore, the distance I between the first force receiving member 370a and the second force receiving member 370b and the distance II between the first force receiving member 370a and the second force receiving member 370b, satisfy distance I > distance I. In the force receiving device 370 of this embodiment, the change of the distance can be accommodated by the sliding of the spring 370c and the first force application member 361 relative to the first force receiving member 370a.

By the movement of the second force application member 360 from the position shown in Figure 58 in the direction indicated by the arrow E in Figure 57, the movement of the second force receiving member 370b by the second force application member 360 is permitted. Similarly to the first embodiment, by the urging spring 395 provided on the cartridge 350y, the developing roller 342 and the photosensitive drum 330 are brought into contact to each other.

Also in this embodiment, the structures other than the force receiving device 370 are the same as those of the cartridge 50y of the first embodiment. The operations of the first force application member 361 in this embodiment are the same as those of the first force application member 61 in the first embodiment or the first force application member 461

in the second embodiment.

(Fifth Embodiment)

This embodiment relates to a modified example of a supporting structure for the force receiving device (Figures 59, 60).

This embodiment will be described also with a yellow cartridge 650y accommodating a yellow color developer as an exemplary cartridge.

The cartridge 650y is provided with a force receiving device 690 for contact and spacing between the developing roller 642 and the photosensitive drum 630. The force receiving device 690 comprises a first force receiving member 675 and a second force receiving member 670 shown in Figures 59, 60, similarly to the first embodiment. The first force receiving member 675 is mounted to the drum frame 634 by engagement between the engaging portion 675d provided on the first force receiving member 675 with the guide portion 638 of the drum frame 634. The first force receiving member 675 mounted to the drum frame 634 is prevented from disengagement from the drum frame 634 by a regulating portion 639 provided on the drum frame 634.

A shaft 670a of the second force receiving member 670 is engaged with a guide portion 645a provided on the bearing unit 645. The bearing unit 645

including a second force receiving member 670 is fixed to one longitudinal end of the developing device frame 648 and rotatably supports the developing roller 642 having a developing roller gear 669 at the end. Similarly to the first embodiment, the bearing unit 645 is provided with a coupling member 667 for receiving the driving force from the driving motor (unshown) , and an idler gear 668 for transmitting the driving force from the coupling member 667 to the developing roller gear 669. The covering member 646 is fixed to the longitudinally outside of the bearing unit 645 so as to cover the coupling member 667 and the idler gear 668. The covering member 646 is provided with a cylindrical portion 646b which is projected beyond the surface of the covering member 646. The coupling member 667 is exposed through an inside opening of the cylindrical portion 646b.

[Assembling of drum unit and developing unit]

As shown in Figures 59, 60, when the developing unit 641 and the drum unit 631 are assembled, an outside circumference of the cylindrical portion 646b are engaged with the supporting hole portion 636a at one end. On the other hand, at the other end, the supporting hole portion 637a is engaged by the projected portion 648b provided projected from the developing device frame 648. The covering member 37 in the first embodiment shown in Figure 11 - Figure 14

corresponds to the covering member 637 of this embodiment, and the supporting hole portion 37a shown in Figure 11 - Figure 14 corresponds to the supporting hole portion 637a of this embodiment. The projected portion 48b provided projected from the developing device frame 48 in the first embodiment correspond to the projected portion 648b provided projected from the developing device frame 648 of this embodiment.

By doing so, the developing unit 641 is rotatably supported on the drum unit 631. Figure 60 shows the cartridge 650y in which the developing unit 641 and the drum unit 631 have been combined with each other. Similarly to the first embodiment, the assembling is such that urging portion 675b of the first force receiving member 675 is capable of acting on a cam surface 671 (third urged portion) provided on the second force receiving member 670 , and similarly to the first embodiment, the contacting and spacing can be accomplished between the electrophotographic photosensitive drum 630 and the developing roller 642. Thus, the similar advantageous effects as with the first embodiment can be provided.

(Sixth Embodiment)

This embodiment relates to a modification of the force receiving device.

This embodiment will be described also with a

yellow cartridge 750y accommodating a yellow color developer as an exemplary cartridge. As shown in Figure 61 - Figure 63, the developing unit 741 is provided with a force receiving device 790. The force receiving device 790 comprises a first force receiving member 775 and a second force receiving member 770. The first force receiving member 775 comprises a supporting portion 775c supported rotatably on the developing device frame 748.

Similarly to the first embodiment shown in Figure 15 - Figure 19, the second force receiving member 770 is urged normally to provide the state shown in Figure 61 by urging means (unshown) . In other words, since the second force receiving member 770 does not receive a force from the second force application member 760, the photosensitive drum 730 and the developing roller 742 are contacted to each other. Similarly to the first embodiment, by movement of the door (unshown) from the open position to the close position, the first force application member 761 is brought into contact to the first urged portion 775a of the first force receiving member 775 from the top side, as shown in Figure 62. By this, the first force receiving member 775 is rotated about the supporting portion 775c , the urging portion 775b of the first force receiving member 775 acts on the third urged portion 770b of the second force receiving

member 770. Then, the second force receiving member 770 moves to an outside (arrow P) of the developing unit 741. At this time, the upper surface portion 770c of the second force receiving member 770b abuts to the second force application member 760 to prevent a further movement. The position of the second force receiving member 770 at this time is called regulating position.

However, even when the second force receiving member 770 is prevented from moving by the engaging rib 760, the force receiving device 790 including the second force application member 760 and the second force receiving member 770 is not damaged. This is because the elastic portion 775d formed by a thin portion provided in the first force receiving member 775 flexes (elastic deformation) as shown in Figure 62. Therefore, even if the movement of the second force receiving member 770 is regulated, the force receiving device 790 is not damaged.

As shown in Figure 63, when the second force application member 760 moves in the direction of an arrow E, the regulation by the second force application member 760 is released. Then, the elastic portion 775d of the first force receiving member 775 restores to the original position from the elastically deformed position to permit the urging portion 775b to move the second force receiving member 770b outwardly.

Then, the second force receiving member 770b moves into the movement path of the second force application member 760.

As shown in Figure 64, by movement of the second force application member 760 in the direction of the arrow B, the side surface 770d (second urged portion) receives a force from the second force application member 760. Further, when the second force application member 760 moves in the direction of an arrow B, the developing unit 741 rotates about the connecting portion 746b with the drum unit 731, by which the developing roller 742 is spaced from the electrophotographic photosensitive drum 730 by a gap λ. Here, the position where the first force receiving member 775 is urged by the first force application member 761 is fixed, and the second force receiving member 760b is moved by the movement on the second force application member 770 in the direction of the arrow B shown in Figure 64. Therefore, the distance I between the first force receiving member 775 and the second force receiving member 770b and the distance II between the first force receiving member 775 and the second force receiving member 770b, satisfy distance I > distance II. In the force receiving device 790 of this embodiment, the distance change can be accommodated by the sliding of the first force application member 761 relative to the first force

receiving member 775a and the deformation of the elastic portion 775d formed by a thin portion provided on the first force receiving member 775.

By the movement of the second force application member 760 from the position shown in Figure 64 in the direction indicated by the arrow E in Figure 63, the movement of the second force receiving member 770b by the second force application member 760 is permitted. Similarly to the first embodiment, the developing roller 742 and the photosensitive drum 730 are contacted to each other by the urging spring 795 provided on the cartridge 750y.

Also in this embodiment, the structures other than the force receiving device 790 are the same as those of the cartridge 50y of the first embodiment. The operations of the first force application member 761 in this embodiment are the same as those of the first force application member 61 in the first embodiment or the first force application member 461 in the second embodiment. The force receiving device 790 of this embodiment provides the similar advantageous effects as with the first embodiment.

(Seventh Embodiment)

Figure 65 to Figure 68 show a modified example of the modified example.

This embodiment will be described also with a

yellow cartridge 850y accommodating a yellow color developer as an exemplary cartridge. Figure 65 is a perspective view of a process cartridge 850y as seen from a coupling member 830a side of the photosensitive drum 830 wherein an urging member 820 of the main assembly of the apparatus has moved in the direction of an arrow V (upward) in Figure 67. Figure 66 is a perspective view of the process cartridge 850y as seen from the side opposite from the coupling member 830a of the photosensitive drum 830 in the same state as of Figure 65. Figure 67 is a perspective view of the process cartridge 850y as seen from the coupling member 830a side of the photosensitive drum 830 wherein the urging member 820 of the main assembly of the apparatus has moved in the direction of an arrow U in Figure 67. Figure 68 is a perspective view of the process cartridge 850y as seen from the side opposite from the coupling member 830a of the photosensitive drum 830 in the same state as of Figure 67.

In this embodiment, as shown in Figures 65, 66, the main assembly of the apparatus comprises an urging member 820 for urging the cartridge 850y to a positioning portion 801a provided in the main assembly of the apparatus. The photosensitive drum 830 is provided with a coupling member 830a for receiving the driving force, and a developing roller is provided with a developing roller gear 869 provided in turn

with a coupling member 867 for receiving the driving force, and the urging member 820 urges the cartridge 850y at the longitudinal end opposite from the other longitudinal end where the coupling member 830a and the coupling member 867 are provided. The urging member 820 has a guide portion 820a, an urging portion 822 and an urging spring 821. The urging portion 822 is supported by the guide portion 820a for movement toward the cartridge 850y.

The urging portion 822 is urged by an urging spring 821 in the direction of an arrow U in Figure 67. The operations of the urging member 820 are similar to the operations of the first force application member 61 of the first embodiment, and with the opening operation of the door of the main assembly of the apparatus, the urging member 820 moves in the direction of an arrow V in Figure 67, and with the closing operation of the door of the main assembly of the apparatus, it moves in the direction of an arrow U in Figure 67. Thus, when the urging member 820 moves in the direction of the arrow U, the urging portion 822 is contacted to the cartridge 850y to urge the cartridge 850y by a force of the urging spring 821. By the urging force, the cartridge 850y is positioned relative to the main assembly of the image forming apparatus 100 by positioning the projection 831a provided on the drum frame 834 to the positioning

portion 801a of the main assembly of the apparatus, similarly to the positioning operation of the cartridge 50y to the main assembly 100 of the apparatus of the first embodiment.

Also in this embodiment, as shown in Figures 65, 66, the developing unit 841 is provided with a force receiving device 890. The force receiving device 890 comprises a first force receiving member 875, a second force receiving member 870 and a rod 872. In this embodiment, the drum frame 834 is provided with a rod 872, and the hole 872a provided in the rod 872 is engaged by the shaft 834a provided on the drum frame 834, and the rod 872 is supported on the drum frame 834 rotatably about the hole 872a. The rod 872 is urging in the direction of an arrow S in Figure 65 by a pressure of the spring 840. In other words, since the second force receiving member 870b does not receive a force from the second force application member 860, the photosensitive drum 830 and the developing roller 842 are contacted to each other.

Similarly to the first embodiment, by movement of the door (unshown) from the open position to the close position, the urging portion 822 contacts to the cartridge 850y and urges the cartridge 850y by the force of the urging spring 821, as shown in Figure 67. At this time, the contact portion 822a of the urging portion 822 relative to the contact portion 822a moves

the contact portion 872a of the rod 872 to rotate the rod 872 about the hole 872a. As shown in Figures 67, 68, an operating portion 872b of the rod 872 moves the first force receiving member 875 in the direction of an arrow W. When the first force receiving member 875 moves in the direction of the arrow W , the second force receiving member 870 moves (projects) outwardly of the developing unit 841 of the cartridge 850y from the stand-by position, similarly to the first embodiment.

The operations are the same as with the first embodiment.

The process cartridge of this embodiment has the same structure as the cartridge 50y of the first embodiment. The operations of the second force application member 860 of this embodiment are the same as the second force application member 60 of the first embodiment. The force receiving device 790 of this embodiment provides the similar advantageous effects as with the first embodiment.

According to the present invention , the process cartridge in which the electrophotographic photosensitive drum and the developing roller are contactable and spaceable relative to each other, and the electrophotographic image forming apparatus to which such a process cartridge is detachably mountable can be downsized. In addition, a force receiving

portion for spacing the developing roller and the electrophotographic photosensitive drum from each other is not easily damaged, when the process cartridge is handled and/or when the process cartridge is transported.

[INDUSTRIAL APPLICABILITY]

As described hereinabove, according to the present invention, it is possible to provide a downsized process cartridge in which the electrophotographic photosensitive drum and the developing roller are contactable to each other and spaceable from each other and a downsized electrophotographic image forming apparatus to which the process cartridge is detachably mountable.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

CLAIMS

1. A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, the main assembly including an opening, a door movable between a close position for closing the opening and an open position for opening the opening, a first force application member movable with movement of the door from the open position to the close position and a second force application member movable by a driving force from a driving source, said process cartridge comprising:

an electrophotographic photosensitive drum;

a developing roller configured and positioned to develop an electrostatic latent image formed on said electrophotographic photosensitive drum;

a drum frame supporting said electrophotographic photosensitive drum;

a developing frame which supports said developing roller and which is movable relative to said drum frame such that said developing roller is movable between a contact position in which said developing roller contacts said electrophotographic photosensitive drum and a spaced position in which said developing roller is spaced from said electrophotographic photosensitive drum; and

a force receiving device including a first force receiving portion configured and positioned to receive a force from the first force application member by movement of said door from the open position to the close position in the state that said process cartridge is mounted to the main assembly of the apparatus through the opening, and a second force receiving portion movable relative to said developing frame to an operative position from a retracted position retracted from the operative position by movement of said first force

receiving portion by a force received from the first force application member, wherein said second force receiving portion takes the operative position for receiving a force from the second force application member to move said developing frame from the contact position to the spaced position, wherein said second force receiving portion takes the retracted position for permitting said process cartridge to enter said main assembly.

2. A process cartridge according to Claim 1, wherein said force receiving device has an elastically deformable elastic portion configured and positioned to permit said second force receiving portion to take a regulating position for contacting the second force application member to be regulated in its movement when said second force receiving portion moves from the retracted position.

3. A process cartridge according to Claim 2, wherein said elastic portion is provided on said first force receiving portion.

4. A process cartridge according to Claim 2, wherein said elastic portion is provided between said first force receiving portion and said second force receiving portion.

5. A process cartridge according to Claim 1, wherein said force receiving device has an elastically deformable elastic portion configured and positioned to permit a change, with movement of the second force application member, of a distance between a position in which said first force receiving portion is pushed by the first force application member and a position in which said second force receiving portion is pushed by the second force application member.

6. A process cartridge according to Claim 1, wherein said force receiving device has a sliding portion configured and positioned to permit a change, with movement of the second force application member, of a distance between a position in which said first force receiving portion is pushed by the first force application member and a position in which said second force receiving portion is pushed by the second force application member, wherein said sliding portion is provided on said first force receiving portion to slide relative to the first force application member when the distance changes.

7. A process cartridge according to Claim 1, further comprising urging means configured and positioned to urge said force receiving device in a direction of moving said second force receiving portion toward said retracted position.

8. A process cartridge according to Claim 1, wherein said process cartridge is detachably mountable to the main assembly of the apparatus through the opening in a direction which is substantially horizontal and which is substantially perpendicular to an axial direction of said electrophotographic photosensitive drum.

9. A process cartridge according to Claim 1, wherein said process cartridge is detachably mountable to the main assembly of the apparatus through the opening in a direction substantially parallel with an axial direction of said electrophotographic photosensitive drum.

10. A process cartridge according to Claim 1, wherein the main assembly of the apparatus includes a drawer member movable between a mounted position inside the main assembly of the apparatus and a drawn out position drawn out of the

mounted position, wherein said process cartridge is mountable to the drawer member at the drawn out position.

11. A process cartridge according to Claim 1, wherein said apparatus includes a transfer belt, and wherein the distance of movement of said second force receiving portion from the retracted position in a vertical direction is larger than the distance of movement, toward the transfer belt in the vertical direction, of said process cartridge having passed through the opening.

12. A process cartridge according to Claim 1, wherein said force receiving device is provided on said developing frame.

13. A process cartridge according to Claim 1, wherein said first force receiving portion is provided on said drum frame, and said second force receiving portion is provided on said developing frame.

14. A process cartridge according to Claim 1, wherein said second force receiving portion moves from an upstream side of the first force application member toward a downstream side with respect to an entering direction of said process cartridge when said process cartridge enters the main assembly of the apparatus through the opening.

15. A process cartridge according to Claim 14, wherein said second force receiving portion is disposed downstream of said first force receiving portion with respect to the entering direction.

16. A process cartridge according to Claim 1, wherein

said second force receiving portion is provided with a force receiving part configured and positioned to be contacted by said first force receiving portion to receive a force for moving from the retracted position, by said first force receiving portion being moved by a force from the first force application member.

17. A process cartridge according to Claim 1, wherein said first force receiving portion and said second force receiving portion are integral with each other.

18. A process cartridge according to Claim 1, wherein a force receiving part of said second force receiving portion configured and positioned to receive a force from the second force application member faces substantially opposite a force receiving part of said first force receiving portion configured and positioned to receive a force from the first force application member.

19. A process cartridge according to Claim 1, wherein said developing frame is movable about a rotation axis relative to said drum unit, and in the operative position, said second force receiving portion is projected at a position more remote from the rotation axis than the retracted position.

20. An electrophotographic image forming apparatus for forming an image on a recording material, to which a process cartridge is detachably mountable, said apparatus comprising:

(i) an opening;

(ii) a door movable between a close position for closing said opening and an open position for opening said opening;

(iii) a first force application member movable with

movement of said door from the open position to the close position;

(iv) a second force application member movably by a driving force from a driving source;

(v) mounting means for detachably mounting a process cartridge, said process cartridge including:

an electrophotographic photosensitive drum;

a developing roller configured and positioned to develop an electrostatic latent image formed on the electrophotographic photosensitive drum,

a drum frame supporting the electrophotographic photosensitive drum,

a developing frame which supports the developing roller and which is movable relative to the drum frame such that the developing roller is movable between a contact position in which the developing roller is contacted to the electrophotographic photosensitive drum and a spaced position in which the developing roller is spaced from the electrophotographic photosensitive drum, and

a force receiving device including a first force receiving portion configured and positioned to receive a force from the first force application member by movement of said door from the open position to the close position in the state that the process cartridge is mounted to a main assembly of said apparatus through said opening, and a second force receiving portion movable relative to said developing frame to an operative position from a retracted position retracted from the operative position by movement of the first force receiving portion by a force received from said first force application member, wherein the second force receiving portion takes the operative position for receiving a force from said second force application member to move the developing frame from the contact position to the spaced position wherein said

second force receiving portion takes the retracted position for permitting said process cartridge to enter said main assembly; and

(vi) feeding means for feeding the recording material.

21. An apparatus according to Claim 20, further comprising a drawer member movable between a mounted position inside the main assembly of said apparatus and a drawn out position drawn out of the mounted position.

22. An apparatus according to Claim 21, wherein a plurality of the process cartridges are mountable to said drawer member.

23. An apparatus according to Claim 20, further comprising a transfer belt to which a developed image formed by the process cartridge is transferred and moving means for moving, toward said transfer belt in interrelation with movement of said door from the open position to the close position, the process cartridge guided between said transfer belt and said second force application member through said opening.

24. A process cartridge according to Claim 1, further comprising an elastic member configured and positioned to urge said developing frame toward the contact position.

25. A process cartridge according to Claim 1, wherein said second force receiving portion is disposed at an upper position of said process cartridge in a state that said process cartridge is mounted to the main assembly, and wherein in said operative position, said second force receiving portion is

projected beyond the retracted position.

26. A process cartridge detachably mountable to a main assembly of an electrophotographic image forming apparatus, the main assembly including an opening, a first movable force application member and a second force application member movable by a driving force from a driving source, said process cartridge comprising:

an electrophotographic photosensitive drum;

a developing roller configured and positioned to develop an electrostatic latent image formed on said electrophotographic photosensitive drum;

a drum frame supporting said electrophotographic photosensitive drum;

a developing frame which supports said developing roller and which is movable relative to said drum frame such that the developing roller is movable between a contact position in which said developing roller contacts said electrophotographic photosensitive drum and a spaced position in which said developing roller is spaced from said electrophotographic photosensitive drum; and

a force receiving device including a first force receiving portion configured and positioned to receive a force from the first force application member by movement of said first force application member in the state that said process cartridge is mounted to the main assembly of the apparatus through the opening, and a second force receiving portion movable relative to said developing frame to an operative position from a retracted position retracted from the operative position by movement of said first force receiving portion by a force receiving from the first force application member, wherein said second force receiving portion takes the operative position for receiving a force from the second force application

member to move said developing frame from the contact position to the spaced position, wherein said second force receiving portion takes the retracted position for permitting said process cartridge to enter said main assembly.

27. An electrophotographic image forming apparatus for forming an image on a recording material, to which a process cartridge is detachably mountable, said apparatus comprising:

(i) an opening;

(ii) a first movable force application member;

(iii) a second force application member movable by a driving force from a driving source;

(iv) mounting means for detachably mounting a process cartridge, said process cartridge including,

an electrophotographic photosensitive drum,

a developing roller configured and positioned to develop an electrostatic latent image formed on the electrophotographic photosensitive drum,

a drum frame supporting the electrophotographic photosensitive drum,

a developing frame which supports the developing roller and which is movable relative to said drum frame such that the developing roller is movable between a contact position in which the developing roller is contacted to the electrophotographic photosensitive drum and a spaced position in which the developing roller is spaced from the electrophotographic photosensitive drum, and

a force receiving device including a first force receiving portion configured and positioned to receive a force from the first force application member by movement of the first force application member in the state that the process cartridge is mounted to a main assembly of said apparatus through said opening, and a second force receiving portion movable

relative to said developing frame to an operative position from a retracted position retracted from the operative position by movement of the first force receiving portion by a force received from said first force application member, wherein the second force receiving portion takes the operative position for receiving a force from said second force application member to move the developing frame from the contact position to the spaced position, wherein said second force receiving portion takes the retracted position for permitting said process cartridge to enter said main assembly.

28. A process cartridge detachably mountable to a main assembly of the electrophotographic image forming apparatus, said process cartridge comprising:

an electrophotographic photosensitive drum;

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

a drum frame supporting said electrophotographic photosensitive drum;

a developing frame supporting said developing roller, said developing frame being rotatable about a rotation axis relative to said drum frame between a contact position in which said developing roller is in contact to said electrophotographic photosensitive drum and a spacing position in which said developing roller is spaced from said electrophotographic photosensitive drum; and

a force receiving device including a first force receiving portion for receiving a first external force and a second force receiving portion for receiving a second external force, wherein said second force receiving portion is moved relative to said developing frame to an operative position from a retracted position retracted from the operative position

by said first force receiving portion receiving the first external force, wherein a distance between the rotation axis and the second force receiving portion is larger in the operative position than in the retracted position, wherein in the operative position, said second force receiving portion moves said developing frame from the contact position to the spacing position by receiving the second external force.

29. A process cartridge according to Claim 28, wherein said force receiving device has an elastically deformable elastic portion configured and positioned to permit said second force receiving portion to take a regulating position for contacting the second force application member to be regulated in its movement when said second force receiving portion moves from the retracted position.

30. A process cartridge according to Claim 29, wherein said elastic portion is provided on said first force receiving portion.

31. A process cartridge according to Claim 29, wherein said elastic portion is provided between said first force receiving portion and said second force receiving portion.

32. A process cartridge according to Claim 28, further comprising urging means configured and positioned to urge said force receiving device in a direction of moving said second force receiving portion toward said retracted position.

33. A process cartridge according to Claim 28, wherein said force receiving device is provided on said developing frame.

34. A process cartridge according to Claim 28, wherein said first force receiving portion is provided on said drum frame, and said second force receiving portion is provided on said developing frame.

35. A process cartridge according to Claim 28, wherein said first force receiving portion and said second force receiving portion are integral with each other.

36. A process cartridge according to Claim 28, further comprising an elastic member configured and positioned to urge said developing frame toward the contact position.

37. An electrophotographic image forming apparatus for forming an image on a recording material, to which a process cartridge is detachably mountable, said apparatus comprising:

(i) mounting means;

(ii) a process cartridge detachably mounted to said mounting means, said process cartridge including,

an electrophotographic photosensitive drum,

a developing roller configured and positioned to develop an electrostatic latent image formed on said electrophotographic photosensitive drum,

a drum frame supporting said electrophotographic photosensitive drum,

a developing frame which supports said developing roller and which is movable relative to said drum frame such that the developing roller is movable between a contact position in which said developing roller contacts said electrophotographic photosensitive drum and a spaced position in which said developing roller is spaced from said electrophotographic photosensitive drum, and

a force receiving device including a first force

receiving portion for receiving a first external force and a second force receiving portion for receiving a second external force, wherein said second force receiving portion is moved relative to said developing frame to an operative position from a retracted position retracted from the operative position by said first force receiving portion receiving the first external force, wherein a distance between the rotation axis and the second force receiving portion is larger in the operative position than in the retracted position, wherein in the operative position, said second force receiving portion moves said developing frame from the contact position to the spacing position by receiving the second external force; and

(iii) feeding means for feeding the recording material.

38. An apparatus according to Claim 37, further comprising a drawer member movable between a mounted to position inside the main assembly of said apparatus and a drawn out position drawn out of the mounted to position.

39. An apparatus according to Claim 37, wherein a plurality of the process cartridges are mountable to said drawer member.

40. A process cartridge according to Claim 1, wherein said drum frame rotatably supports said photosensitive drum by way of a cover member.

41. A process cartridge according to Claim 1, wherein said developing frame rotatably supports said developing roller by the way of a bearing member.

42. A process cartridge according to Claim 28, wherein

said drum frame rotatably supports said photosensitive drum by way of a cover member.

43. A process cartridge according to Claim 28, wherein said developing frame rotatably supports said developing roller by the way of a bearing member.