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(54) **DEVELOPING DEVICE PROVIDED WITH THICKNESS-REGULATING MEMBER**

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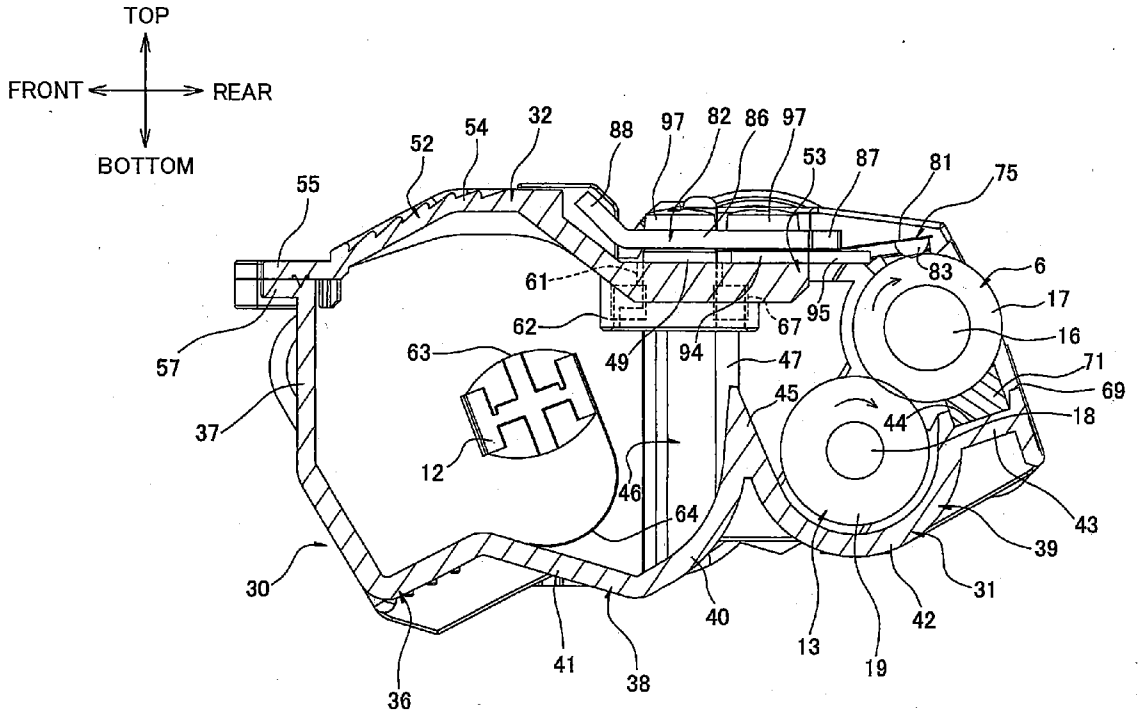
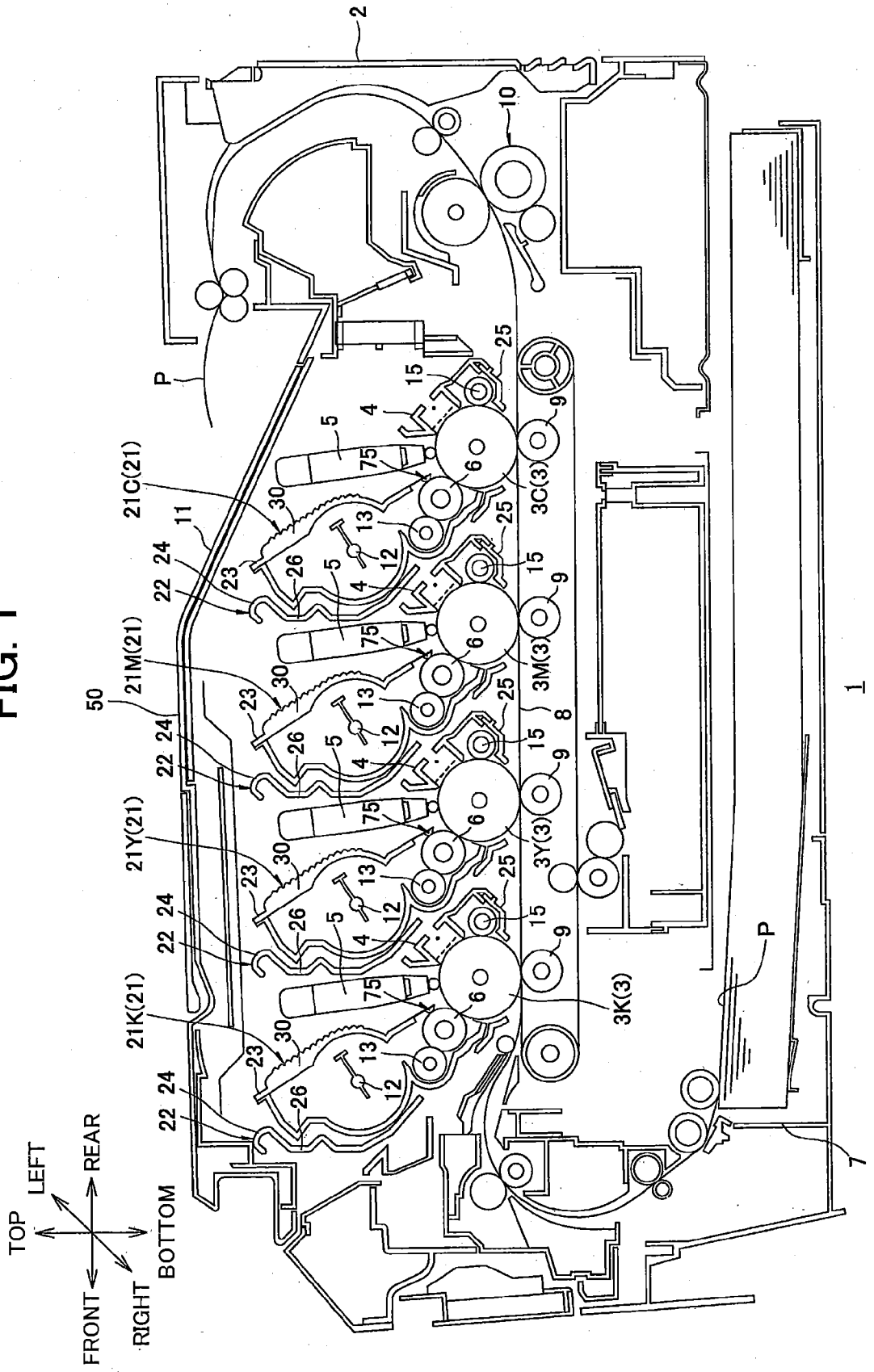
(57) **ABSTRACT**

A developing device includes: a first frame; a second frame; a developer-carrying member; and a thickness-regulating member. The first frame includes: a pair of first walls opposed with each other; and a second wall connecting the pair of first walls and having a first fixing part. The second frame includes a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame. The developer-carrying member has an axis extending in a first direction, is configured to rotate about the axis, and is disposed between the pair of first walls. The thickness-regulating member is fixed to the first fixing part and is configured to regulate a thickness of developer carried on the developer-carrying member. The third wall is disposed between the second wall and the thickness-regulating member.



23

FIG. 1


2
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15
4
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75
6
9
3C(3)
21C(21)
30
11
13
12
23
26
22
24
3M(3)
21M(21)
50
8
3Y(3)
21Y(21)
3K(3)
21K(21)
1
7
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RIGHT
BOTTOM

FIG. 2

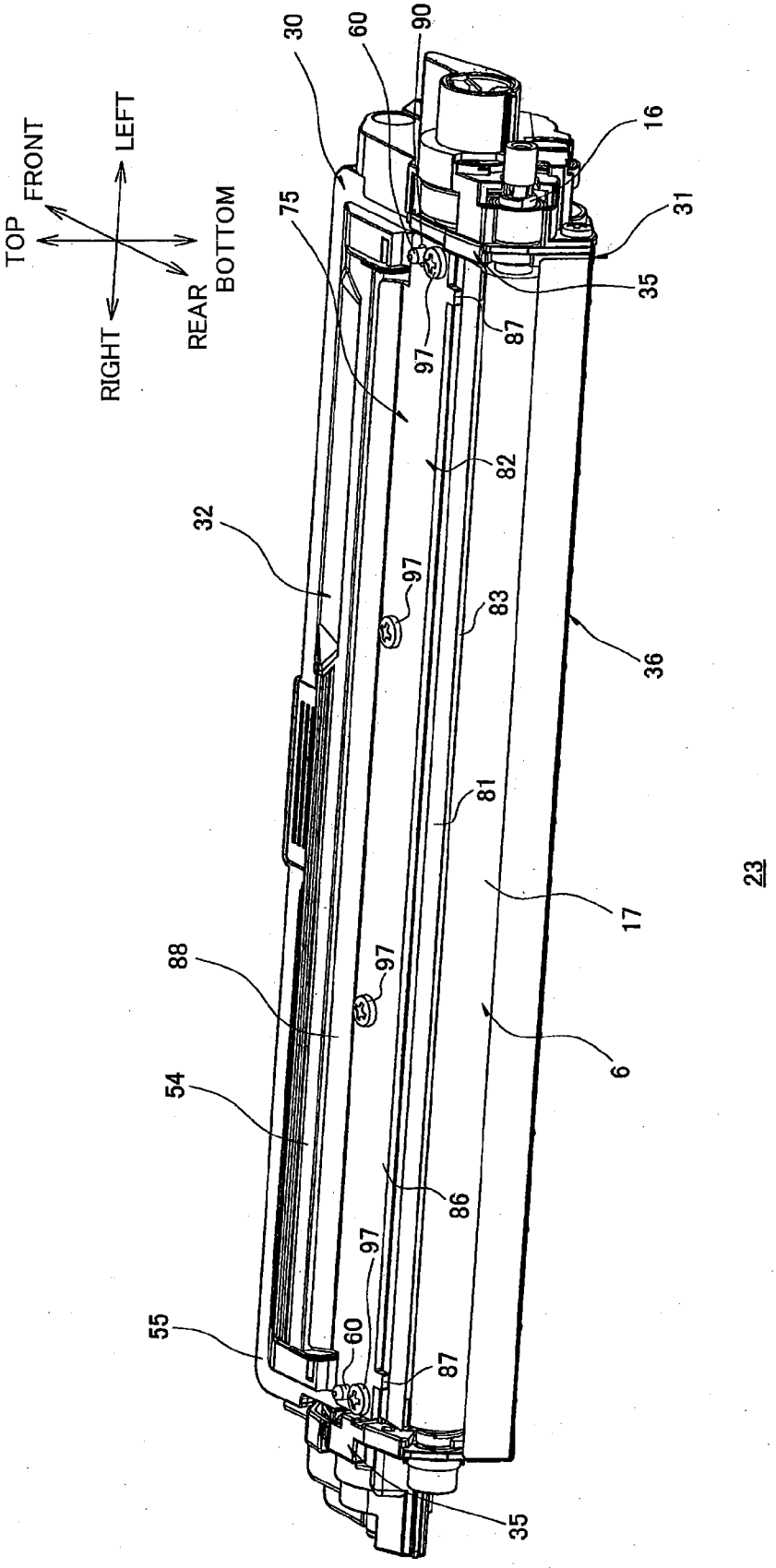
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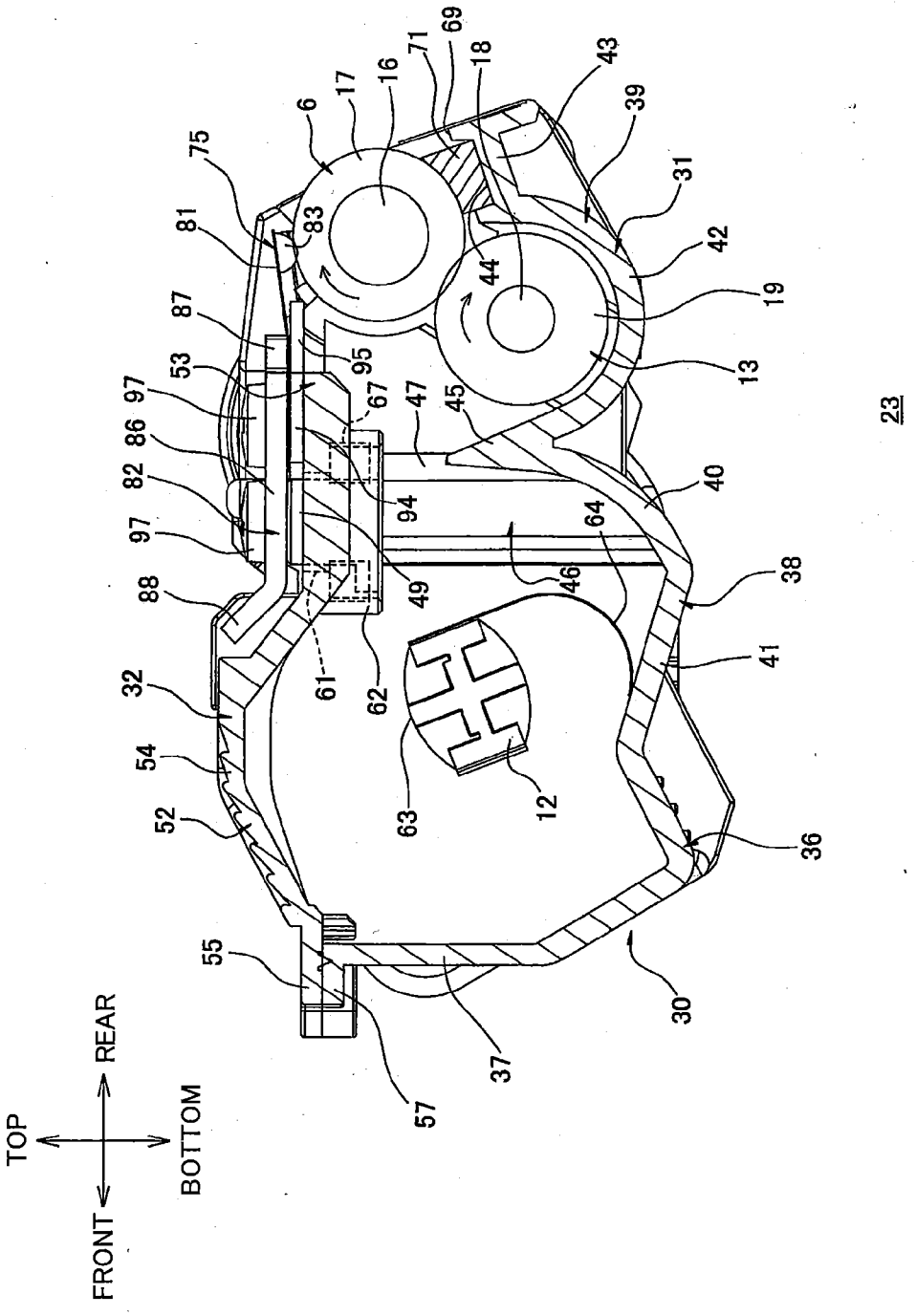
FIG. 3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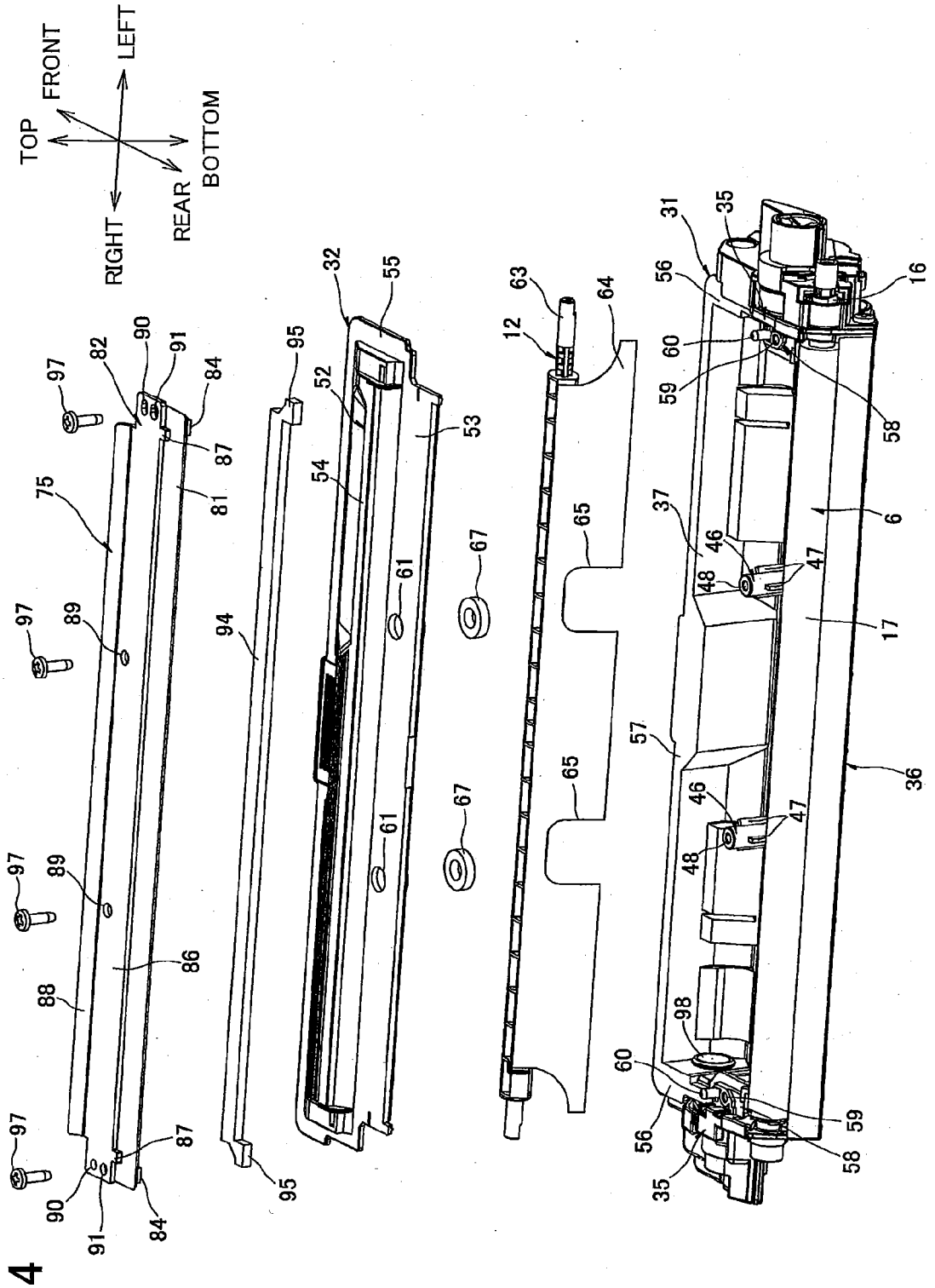
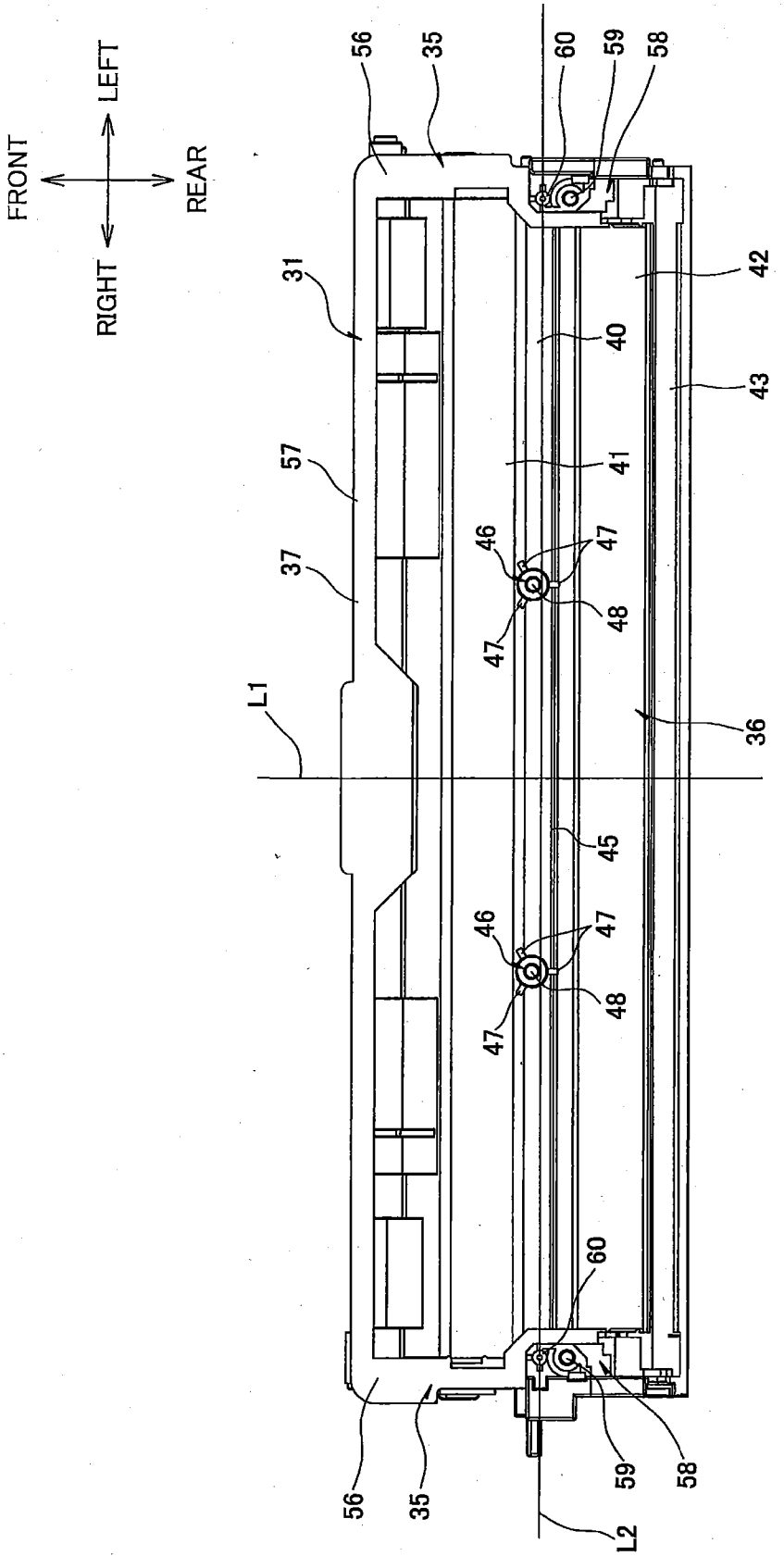


FIG. 4

FIG. 5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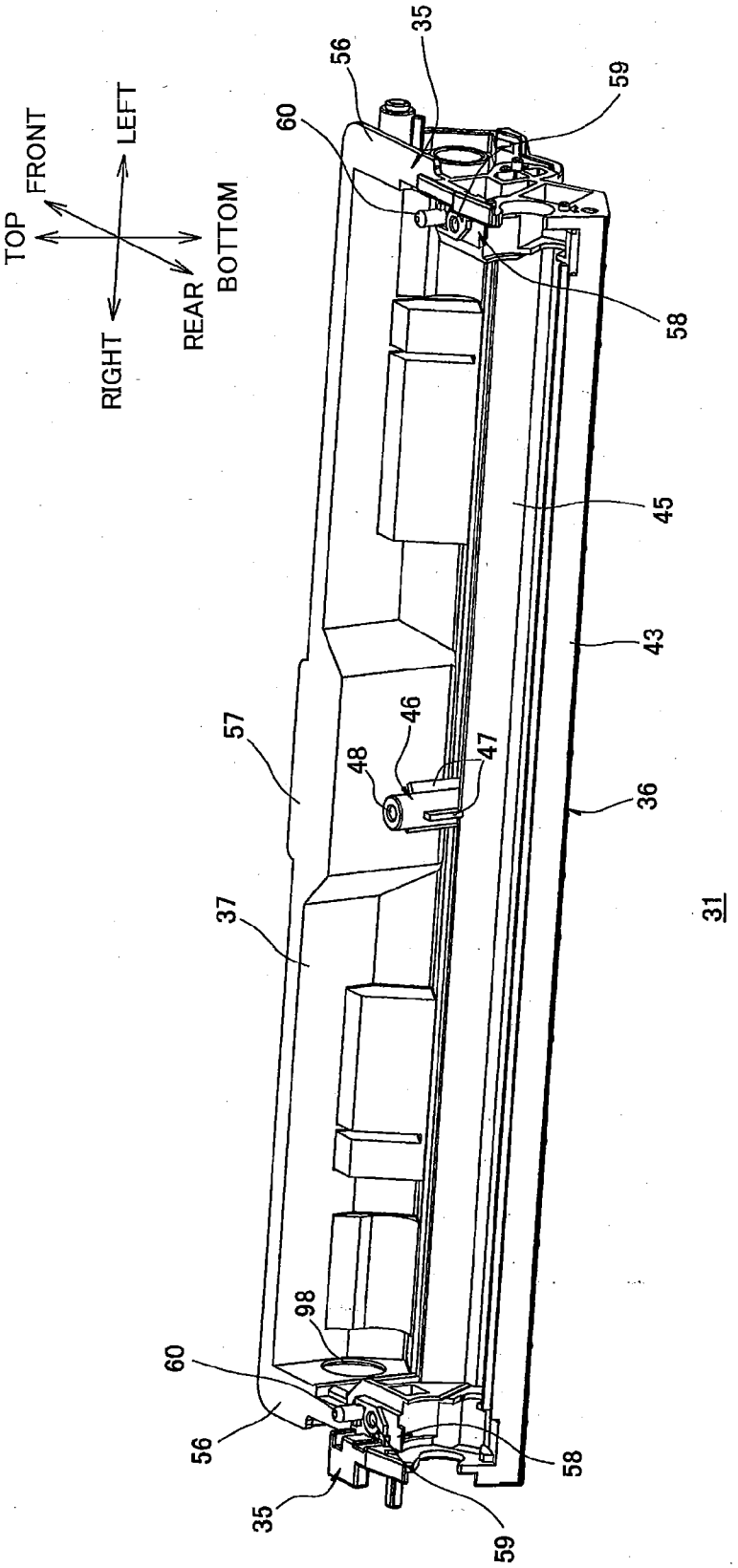
L1
36
45
46
47
48
47
60
56
35
59
58
L2

FIG. 6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DEVELOPING DEVICE PROVIDED WITH THICKNESS-REGULATING MEMBER

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Japanese Patent Application No. 2011-190044 filed Aug. 31, 2011. The entire content of this application is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to an image-forming device employing an electrophotographic system, and a developing device that is detachably mountable in the image-forming device.

BACKGROUND

[0003] An electrophotographic printer known in the art has developing devices detachably mounted therein. Each developing device includes a developing frame, a developing roller supported in the developing frame for carrying toner, and a blade assembly for restricting the thickness of the toner layer carried on the developing roller.

[0004] One such developing device that has been proposed is a developer cartridge in which the developing frame is configured of a lower frame for rotatably supporting the developing roller, and an upper frame welded to the lower frame.

[0005] In this developer cartridge, an opening exposing the developing roller is defined by the front end of a beam-like part constituting the upper frame, and the front ends of the two side walls and the bottom wall of the lower frame. The blade assembly is fixed to both the upper frame and the lower frame. Specifically, the blade assembly is fixed to screw-mounting holes adjacent to the front end of the beam-like part constituting the upper frame and to the upper front end of both side walls constituting the lower frame.

SUMMARY

[0006] However, while the developing roller is supported in the lower frame of the developer cartridge described above, the blade assembly is fixed to both the upper and lower frames. Consequently, offset between the upper and lower frames occurring during the welding process or variation in the frames themselves may inhibit sufficient relative positioning precision between the blade assembly and the developing roller.

[0007] Further, since the blade assembly is fixed to the screw-mounting holes adjacent to the front end of the beam-like part constituting the upper frame and the upper front end of both side walls constituting the lower frame, in some cases the opening defined by the beam-like part and side walls is too wide to ensure sufficient strength in the developing frame. Insufficient strength in the developing frame may make it impossible to maintain the relative positional relationship of the blade assembly and developing roller.

[0008] Therefore, it is an object of the present invention to provide a developing device, and an image-forming device provided with the developing device, that can improve the strength of the assembled first and second frames through a simple structure and that can improve precision in positioning the developer-carrying member and thickness-regulating member relative to each another.

[0009] In order to attain the above and other objects, the invention provides a developing device including: a first frame; a second frame; a developer-carrying member; and a thickness-regulating member. The first frame includes: a pair of first walls opposed with each other; and a second wall connecting the pair of first walls and having a first fixing part. The second frame includes a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame. The developer-carrying member has an axis extending in a first direction, is configured to rotate about the axis, and is disposed between the pair of first walls. The thickness-regulating member is fixed to the first fixing part and is configured to regulate a thickness of developer carried on the developer-carrying member. The third wall is disposed between the second wall and the thickness-regulating member.

[0010] Another aspect of the present invention provides an image-forming device including: a main body; and a developing device mountable of the main body. The developing device includes: a first frame; a second frame; a developer-carrying member; and a thickness-regulating member. The first frame includes: a pair of first walls opposed with each other; and a second wall connecting the pair of first walls and having a first fixing part. The second frame includes a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame. The developer-carrying member has an axis extending in a first direction, is configured to rotate about the axis, and is disposed between the pair of first walls. The thickness-regulating member is fixed to the first fixing part and is configured to regulate a thickness of developer carried on the developer-carrying member. The third wall is disposed between the second wall and the thickness-regulating member.

[0011] Another aspect to the present invention provides a developing device includes: a first frame; a second frame; a developer-carrying member; and a thickness-regulating member. The first frame includes: a pair of first walls opposed with each other; and a second wall connecting the pair of first walls and having a first fixing part. The second frame includes a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame. The developer-carrying member has an axis extending in a first direction, is configured to rotate about the axis, and is disposed between the pair of first walls. The thickness-regulating member is fixed to the first fixing part and is configured to regulate a thickness of developer carried on the developer-carrying member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The particular features and advantages of the invention as well as other objects will become apparent from the following description taken in connection with the accompanying drawings, in which:

[0013] FIG. **1** is a lateral cross-sectional view of a printer according to an embodiment of the present invention.

[0014] FIG. **2** is a perspective view of a developer cartridge according to the embodiment of the present invention when viewed from a left-top side.

[0015] FIG. **3** is a lateral cross-sectional view of the developer cartridge shown in FIG. **2**.

[0016] FIG. **4** is a perspective view of the disassembled developer cartridge shown in FIG. **2**.

[0017] FIG. **5** is a plane view of a lower frame shown in FIG. **4**.

[0018] FIG. **6** is a perspective view of a developer cartridge having a single first fixing part according to a variation of the present invention when viewed from a left-top side.

DETAILED DESCRIPTION

[0019] 1. Printer

[0020] As shown in FIG. **1**, a printer **1** (one example of the image-forming device of the present invention) is a direct tandem-type color printer.

[0021] In the following description, directions related to the printer **1** and developer cartridges **23** (described later) will correspond to the directions of the arrows indicated in the drawings and will assume that the printer **1** is in a level orientation and that the developer cartridges **23** are vertically erect. In addition, the left-right direction will be equivalent to the width direction.

[0022] Specifically, the vertical and front-rear directions of the printer **1** and drum cartridges **22** (described later) differ from the vertical and front-rear directions of the developer cartridges **23**. The developer cartridges **23** are mounted in the printer **1** and drum cartridges **22** so that their front side faces the upper front side of the printer **1** and their rear side faces the bottom rear side of the printer **1**.

[0023] The printer **1** includes a main casing **2** (one example of the main body of the present invention). Four photosensitive drums **3** are arranged inside the main casing **2** parallel to each other and juxtaposed in the front-rear direction. In the following description, the four photosensitive drums **3** are differentiated according to the colors (black, yellow, magenta, and cyan) of toner images they carry and, thus will be referred to as a black photosensitive drum **3**K, a yellow photosensitive drum **3**Y, a magenta photosensitive drum **3**M, and a cyan photosensitive drum **3**C.

[0024] Disposed in opposition to each photosensitive drum **3** are a Scorotron charger **4**, an LED unit **5**, and a developing roller **6** (one example of the developer-carrying member of the present invention).

[0025] The surfaces of the photosensitive drums **3** are uniformly charged by the corresponding Scorotron chargers **4** and are subsequently exposed to light emitted by the corresponding LED units **5** based on image data, forming electrostatic latent images on the surfaces of the respective photosensitive drums **3**. Toner carried on the developing rollers **6** is supplied to the corresponding latent images, producing visible toner images on the surfaces of the photosensitive drums **3**.

[0026] Sheets P of a paper are accommodated in a paper cassette **7** inside the main casing **2**. Various rollers are provided for supplying the sheets P from the paper cassette **7** to a conveying belt **8**. A portion of the conveying belt **8** is disposed between the photosensitive drums **3**, and transfer rollers **9** disposed at positions confronting the respective photosensitive drums **3**. A transfer bias is applied to the transfer roller **9** for sequentially transferring the toner images carried on the photosensitive drums **3** onto the sheet P so that the images are superimposed.

[0027] After toner images in the four colors have been transferred onto the sheet P, the sheet P is conveyed to a fixing unit **10**. The fixing unit **10** fixes the toner images to the sheet P with heat. Various rollers are provided for subsequently discharging the sheet P into a discharge tray **11**.

[0028] 2. Process Cartridges

[0029] The printer **1** is provided with four process cartridges **21** corresponding to the four printing colors. The four process cartridges **21** are distinguished in the following description according to their corresponding color, i.e., a black process cartridge **21**K, a yellow process cartridge **21**Y, a magenta process cartridge **21**M, and a cyan process cartridge **21**C.

[0030] The process cartridges **21** are detachably mounted in the main casing **2** and are arranged parallel to one another and juxtaposed in the front-rear direction.

[0031] A top cover **50** is provided in the top wall of the main casing **2** and can be opened and closed. The process cartridges **21** can be mounted in or removed from the main casing **2** by opening the top cover **50**.

[0032] Each process cartridge **21** includes a drum cartridge **22** detachably mounted in the main casing **2**, and a developer cartridge **23** (one example of the developing device of the present invention) detachably mounted in the drum cartridge **22**.

[0033] (1) Drum Cartridges

[0034] The drum cartridge **22** is configured of a drum frame **24**. The drum frame **24** further includes a drum support part **25**, and a developer-cartridge-accommodating part **26**.

[0035] The drum support part **25** constitutes the lower side of the drum frame **24** and functions to support the corresponding photosensitive drum **3**, Scorotron charger **4**, and a drum cleaning roller **15**.

[0036] The photosensitive drums **3** are substantially cylindrical in shape and elongated in the left-right direction. The photosensitive drums **3** are rotatably supported in bottom ends of the respective drum support parts **25** and exposed through openings formed in the bottoms of the same. The Scorotron chargers **4** are disposed so as to confront the corresponding photosensitive drums **3** from a position diagonally above and rearward therefrom, but are separated from the same. The drum cleaning rollers **15** are disposed on the rear side of their corresponding photosensitive drums **3**, confronting and contacting the same.

[0037] The developer-cartridge-accommodating part **26** of each drum frame **24** is provided above and forward from the drum support part **25** and is formed with an opening on the top and rear sides to allow mounting and removal of the corresponding developer cartridge **23**.

[0038] (2) Developer Cartridges

[0039] As shown in FIGS. **2** and **3**, each of the developer cartridges **23** is configured of a developer frame **30**. The developer frame **30** is generally box-shaped and elongated in the left-right direction. The developer frame **30** includes a lower frame **31** (one example of the first frame of the present invention), and an upper frame **32** (one example of the second frame of the present invention).

[0040] (2-1) Lower Frame

[0041] As shown in FIG. **4**, the lower frame **31** is integrally configured of a pair of side walls **35** (one example of the pair of first walls of the present invention) arranged parallel to each other and separated in the width direction, a bottom wall **36** (one example of the second wall of the present invention) connecting the lower edges of the side walls **35**, and a front wall **37** connecting the front edges of the side walls **35** and bottom wall **36**.

[0042] The side walls **35** have a generally flat plate shape. First contact parts **56** are formed on the top edge of the side walls **35**, and second fixing parts **58** are formed on the rear portion of the side walls **35**.

[0043] Each of the first contact parts **56** has a generally flat plate shape. The first contact parts **56** extend continuously outward from the top edges of the side walls **35** in left and right directions, respectively.

[0044] The second fixing parts **58** have a generally flat plate shape and extend continuously inward from the top edges of the side walls **35** in left and right directions, respectively.

[0045] A second screw hole **59** is formed in each second fixing part **58**. A positioning protrusion **60** is formed on each second fixing part **58**. The second screw holes **59** penetrate the centers of the corresponding second fixing parts **58** vertically. The positioning protrusions **60** are provided on the second fixing parts **58** in front of the corresponding second screw holes **59**. The positioning protrusions **60** protrude upward from the respective second fixing parts **58**. The distal end of each positioning protrusion **60** is generally arc-shaped in cross section, with the convex side of the arc facing upward.

[0046] A toner fill hole **98** is formed in the right side wall **35**. The toner fill hole **98** is generally circular in shape in a side view and is formed in a front side portion of the right side wall **35** corresponding to a toner-accommodating chamber **38** (described later).

[0047] As shown in FIG. **3**, the front portion of the bottom wall **36** is formed continuously of a curved wall **40**, and a bent wall **41**, while the rear portion of the bottom wall **36** is formed continuously of an arc-shaped wall **42**, and a rib part **43**.

[0048] The curved wall **40** has a general arc shape that follows the rotational path of an agitator **12** (described later).

[0049] The bent wall **41** has an upward bend formed at a midpoint in the front-rear direction. More specifically, beginning from its rear edge, the bent wall **41** slopes upward toward the front from the front edge of the curved wall **40** and subsequently bends so as to slope downward toward the front.

[0050] The arc-shaped wall **42** has a general arc shape that follows the rotational path of a supply roller **13** (described later).

[0051] The rib part **43** has a general T-shape in a side view, with the bottom of the "T" formed continuously with the rear edge of the arc-shaped wall **42** and the head of the "T" protruding rearward. A lower-sponge-holding part **44** is formed on the top surface of the rib part **43**. The lower-sponge-holding part **44** has a generally squared U-shape in a side view that opens upward.

[0052] The front portion and rear portion of the bottom wall **36** are formed continuously by coupling the rear edge of the curved wall **40** with the front edge of the arc-shaped wall **42**.

[0053] A partitioning wall **45** is formed between the front portion and rear portion of the bottom wall **36**. The partitioning wall **45** is formed as a continuous extension from the curved wall **40** and arc-shaped wall **42**, protruding upward. That is, the partitioning wall **45** protrudes toward the upper frame **32** while extending in the left-right direction.

[0054] The distal end of the partitioning wall **45** vertically confronts but is separated from the bottom surface of a rear-side top wall **53** (described later) of the upper frame **32**.

[0055] As shown in FIG. **4**, a plurality (two in the preferred embodiment) of first fixing parts **46** is formed in the bottom wall **36** adjacent to the front side of the partitioning wall **45**. Hence, the first fixing parts **46** are disposed inside the toner-accommodating chamber **38** (described later). Each first fixing part **46** is generally cylindrical in shape and is erected upward from the curved wall **40** (see FIG. **3**). The distal ends of the first fixing parts **46** penetrate corresponding cylindrical parts **62** and through-holes **61** (described later) so as to protrude upward from the rear-side top wall **53** (described later). The portions of the first fixing parts **46** protruding above the rear-side top wall **53** will be referred to as protruding portions **49** (see FIG. **3**). First screw holes **48** are formed in the top ends of the protruding portions **49**.

[0056] The vertical dimension of the protruding portions **49** is substantially equivalent to the sum of thicknesses of a sealing member **94** and a blade member **81** (described later; see FIG. **3**).

[0057] Ridge parts **47** are provided on the outer peripheral surface of each first fixing part **46**. The ridge parts **47** are generally rectangular in a plan view and protrude radially from the peripheral surface of the first fixing part **46** in directions orthogonal to the vertical. The ridge parts **47** extend vertically from the base end of the first fixing part **46** to a vertical midpoint, with the upper endfaces confronting the bottom surface of the rear-side top wall **53** (described later).

[0058] A plurality (three in the preferred embodiment) of the ridge parts **47** is provided on each first fixing part **46**. The ridge parts **47** are formed on the outer peripheral surface of the first fixing part **46** at regular intervals in the circumferential direction so as to be separated from each other by about 120 degrees.

[0059] As shown in FIG. **5**, the first fixing parts **46** are symmetrical about a line L**1** extending in the front-rear direction (a plane orthogonal to the left-right direction) and passing through the left-to-right center of the lower frame **31**. Further, the first fixing parts **46** and the positioning protrusions **60** are all arranged along a line L**2** extending in the left-right direction.

[0060] As shown in FIG. **3**, the bottom portion of the front wall **37** is formed continuously from the front edge of the bent wall **41**, sloping upward toward the front, while the upper portion of the front wall **37** extends straight upward continuously from the top edge of the lower portion.

[0061] A second contact part **57** is formed on the top edge of the front wall **37**. As shown in FIG. **4**, the second contact part **57** has a generally flat plate shape that extends continuously forward from the top edge of the front wall **37**.

[0062] (2-2) Upper Frame

[0063] The upper frame **32** is integrally provided with a front-side top wall **52**, and a rear-side top wall **53** (one example of the third wall of the present invention).

[0064] The front-side top wall **52** is configured of an expanded part **54** and a contact part **55**.

[0065] The expanded part **54** constitutes the central portion of the front-side top wall **52** and expands upward.

[0066] The contact part **55** has a substantially flat plate shape and is provided along both left and right sides and the front side of the expanded part **54** so as to surround the same. When the upper frame **32** is assembled to the lower frame **31**, the contact part **55** conforms to the shape of the first contact parts **56** and the second contact part **57**.

[0067] The rear-side top wall **53** has a generally flat plate shape and extends continuously rearward from the rear edge of the front-side top wall **52**. The rear-side top wall **53** is positioned between the upper edges of the side walls **35** and opposes the bottom wall **36** vertically while remaining separated from the same (see FIG. **3**).

[0068] A notch is formed in each of the left and right ends of the rear-side top wall **53**. The notches are generally rectangular in a plan view and shaped to expose the second fixing parts **58** when the upper frame **32** is assembled to the lower frame **31**.

[0069] A plurality (two in the preferred embodiment) of through-holes **61** is formed in the rear-side top wall **53**. As shown in FIG. **3**, the through-holes **61** are formed to allow insertion of the protruding portions **49** provided on the first fixing parts **46** when the upper frame **32** is assembled to the lower frame **31**. The through-holes **61** have an inner diameter that is larger than the outer diameter of the first fixing parts **46**.

[0070] As shown in FIG. **3**, cylindrical parts **62** are provided on the bottom surface of the rear-side top wall **53**. The cylindrical parts **62** have a general cylindrical shape and are positioned with their axes aligned with the centers of the corresponding through-holes **61**. The through-holes **61** are inserted into the interior space of the cylindrical parts **62**. The inner diameter of the cylindrical parts **62** is larger than the diameter of the through-holes **61**.

[0071] An elastic member **67** is provided between the bottom surface of the rear-side top wall **53** inside each of the cylindrical parts **62** (around the outer edge of each through-hole **61**) and the top edge of the corresponding ridge parts **47**. The ridge parts **47** support the upper frame **32** via the elastic members **67**. The elastic members **67** have a general annular shape. The inner diameter of each elastic member **67** is substantially equivalent to the outer diameter of the first fixing part **46**, while the outer diameter of the elastic member **67** is substantially equivalent to the inner diameter of the cylindrical part **62**.

[0072] (2-3) Developer Frame

[0073] As shown in FIG. **3**, when the lower frame **31** and upper frame **32** are assembled together, as will be described later, a space formed in the developer frame **30** is divided by the partitioning wall **45** into the toner-accommodating chamber **38** (one example of the developer-accommodating chamber) constituting the space forward of the partitioning wall **45**, and a developing chamber **39** constituting the space rearward of the partitioning wall **45**. In other words, the partitioning wall **45** partitions the developer frame **30** into the toner-accommodating chamber **38** and developing chamber **39**.

[0074] (2-4) Toner-Accommodating Chamber

[0075] The toner-accommodating chamber **38** is specifically defined by the side walls **35**, partitioning wall **45**, curved wall **40**, bent wall **41**, front wall **37**, front-side top wall **52**, and front portion of the rear-side top wall **53**. The toner-accommodating chamber **38** is filled with toner (one example of the developer). An agitator **12** is also provided in the toner-accommodating chamber **38** and positioned in the vertical and front-to-rear center thereof.

[0076] As shown in FIG. **4**, the agitator **12** includes a rotational shaft **63** that is rotatably supported in the side walls **35**, and an agitating blade **64** provided on the rotational shaft **63**.

[0077] The agitating blade **64** is fixed to the outer peripheral surface of the rotational shaft **63** and extends radially outward therefrom. A plurality (two in the preferred embodiment) of notched parts **65** is formed in the agitating blade **64** in areas corresponding to the first fixing parts **46** to avoid a contact with the first fixing parts **46**. The notched parts **65** are generally U-shaped and open radially outward away from the rotational shaft **63**.

[0078] By supporting the rotational shaft **63** in the side walls **35**, the agitator **12** is rotatably supported in the developer frame **30**.

[0079] (2-5) Developing Chamber

[0080] As shown in FIG. **3**, the developing chamber **39** is specifically defined by the side walls **35**, partitioning wall **45**, arc-shaped wall **42**, rib part **43**, and rear portion of the rear-side top wall **53**. An opening **69** is formed in the rear side of the developing chamber **39**. The opening **69** is specifically defined by the rear edges of the side walls **35**, the rear edge of the rib part **43**, and the rear edge of the rear-side top wall **53**.

[0081] The developing roller **6** and a supply roller **13** are provided inside the developing chamber **39**.

[0082] The developing roller **6** is disposed in the rear end of the developing chamber **39** between the side walls **35** so that the rear and top portions of the developing roller **6** are exposed through the opening **69**. The developing roller **6** is configured of a developing roller shaft **16**, and a rubber roller **17** provided around the developing roller shaft **16**. By rotatably supporting the developing roller shaft **16** in the side walls **35**, the developing roller **6** is rotatably disposed in the developer frame **30**.

[0083] During a developing operation, a drive force is transmitted to the developing roller **6** from a drive source (not shown), such as a motor, provided in the main casing **2**. A power supply (not shown) also applies a developing bias to the developing roller **6** during the developing operation. When the drive force is transmitted from the drive source, the developing roller **6** is driven to rotate in a direction indicated by the arrow in FIG. **3** (clockwise in a right side view) so that a portion of the developing roller **6** confronting and contacting the supply roller **13** (described later in greater detail) moves in a direction opposite from the supply roller **13**.

[0084] A lower sponge **71** is provided beneath the developing roller **6** so as to confront and contact the bottom surface of the same. The lower sponge **71** is generally rectangular in a side view and is retained in the lower-sponge-holding part **44**.

[0085] The supply roller **13** is disposed inside the arc-shaped wall **42** so as to confront and contact the developing roller **6** on the lower front side. The supply roller **13** includes a supply roller shaft **18**, and a sponge roller **19** provided around the supply roller shaft **18**. By rotatably supporting the supply roller shaft **18** in the side walls **35**, the supply roller **13** is rotatably provided in the developer frame **30**.

[0086] During a developing operation, a drive force is transmitted to the supply roller **13** from a drive source (not shown), such as a motor, provided in the main casing **2**. A power supply (not shown) also applies a supply bias to the supply roller **13** during a developing operation. When the drive force is transmitted from the drive source, the supply roller **13** is driven to rotate in a direction indicated by the arrow in FIG. **3** (clockwise in a right side view) so that the portion of the supply roller **13** confronting and contacting the developing roller **6** moves in a direction opposite from the developing roller **6**.

[0087] (2-6) Thickness-Regulating Member

[0088] A thickness-regulating member **75** is provided on the developer frame **30** for regulating the layer thickness of toner carried on the surface of the developing roller **6**. The thickness-regulating member **75** is disposed so as to confront the bottom wall **36** with the rear-side top wall **53** interposed therebetween. As shown in FIG. **4**, the thickness-regulating member **75** includes a blade member **81** (one example of the first plate-like member of the present invention), and a reinforcing member **82** (one example of the second plate-like member of the present invention).

[0089] The blade member **81** is formed of a thin metal plate or the like having a degree of flexibility and has a generally flat plate shape that is elongated in the left-right direction. The front end of the blade member **81** is disposed on the rear-side top wall **53**, and the rear end extends to a position above the

developing roller **6** and opposes the outer peripheral surface of the same while remaining slightly separated therefrom. Provided on the rear end of the blade member **81** are a contact part **83** that contacts the surface of the **86**, and side edge seals **84** that contact both ends of the developing roller **6**.

[0090] The contact part **83** is formed of an elastic resin material, such as silicone resin. As shown in FIG. **3**, the contact part **83** is disposed in a left-right orientation along the bottom surface of the blade member **81**. The contact part **83** has a general arc shape in a side view, with the convex side facing downward.

[0091] As shown in FIG. **4**, the side edge seals **84** are provided on the left and right edges of the blade member **81** so as to sandwich the contact part **83** in the left-right direction.

[0092] The reinforcing member **82** is integrally provided with a main body **86**, protrusions **87** protruding from the rear edge of the main body **86**, and an extension **88** extending obliquely upward and forward from the front edge of the main body **86**.

[0093] The main body **86** has a generally flat plate shape and is elongated in the left-right direction. The front-rear dimension of the main body **86** is shorter than that of the blade member **81**. First fixing holes **89** are formed in portions of the main body **86** corresponding to the through-holes **61**. In addition, positioning holes **90** are formed one in each of the left and right ends of the main body **86** at positions corresponding to the positioning protrusions **60**, while second fixing holes **91** are formed one on each of the left and right ends of the main body **86** at positions corresponding to the second screw holes **59**. Hence, the second fixing hole **91** and the positioning hole **90** on each of the left and right ends of the main body **86** are aligned in the front-rear direction.

[0094] Two of the protrusions **87** are provided on the rear edge of the main body **86** at positions spaced apart in the left-right direction. The protrusions **87** are generally rectangular in a side view.

[0095] The extension **88** has a generally flat plate shape that is elongated in the left-right direction. The extension **88** is formed continuously with the front edge of the main body **86** at an angle bent obliquely upward and forward.

[0096] The blade member **81** and reinforcing member **82** are fixed together by bonding the upper surface on the front portion of the blade member **81** to the lower surface on the rear portion of the main body **86**. Accordingly, the rear portion of the blade member **81** is exposed, i.e., not covered by the reinforcing member **82**.

[0097] The blade member **81** is disposed so that its front portion is positioned between the positioning holes **90** and second fixing holes **91** formed in the main body **86**. Note that through-holes (not shown) are formed in the front portion of the blade member **81** at positions corresponding to the second fixing holes **91**.

[0098] A sealing member **94** is disposed between the thickness-regulating member **75** and the rear-side top wall **53** for sealing the gap between the same. The sealing member **94** is generally rectangular in a plan view and is elongated in the left-right direction. The sealing member **94** is disposed between the top surface of the rear-side top wall **53** and the bottom surface on the front portion of the blade member **81**. In other words, the front portion of the blade member **81** and the sealing member **94** are sandwiched between the rear portion of the main body **86** and the rear-side top wall **53**.

[0099] Side parts **95** are provided one on each left and right end of the sealing member **94**. The side parts **95** are generally triangular in a plan view and protrude rearward and outward in respective left and right directions from the corresponding left and right ends of the sealing member **94**.

[0100] (2-7) Assembling the Developer Cartridge

[0101] To assemble the developer cartridge **23**, first the agitator **12** is assembled in the lower frame **31**. The agitator **12** is arranged in the lower frame **31** so that the notched parts **65** are aligned with the first fixing parts **46**. The agitator **12** is assembled to the lower frame **31** so that the rotational shaft **63** is rotatably supported in the side walls **35** at position corresponding to the toner-accommodating chamber **38** (see FIG. **3**).

[0102] Next, the upper frame **32** is assembled to the lower frame **31**. To assemble the upper frame **32** to the lower frame **31**, first the elastic members **67** are fitted over the distal ends of the corresponding first fixing parts **46**. Next, the distal ends of the first fixing parts **46** are inserted into the corresponding through-holes **61** formed in the upper frame **32**, and the upper frame **32** is placed on top of the lower frame **31** so that the contact part **55**, first contact parts **56**, and second contact part **57** are aligned. At this time, the first fixing parts **46** fit loosely into the through-holes **61** since the outer diameter of the first fixing parts **46** is smaller than the diameter of the through-holes **61**. Further, the elastic members **67** are positioned in the cylindrical parts **62** between the top ends of the corresponding ridge parts **47** and the bottom surface of the rear-side top wall **53**.

[0103] Next, the assembled lower frame **31** and upper frame **32** are welded together. More specifically, the contact part **55**, first contact parts **56**, and second contact part **57** are welded to each other.

[0104] The developer frame **30** is formed by assembling the lower frame **31** and upper frame **32** as described above. Next, the supply roller **13** is assembled in the lower frame **31**. Here, the supply roller **13** is assembled so that the left and right ends of the supply roller shaft **18** are rotatably supported in the side walls **35** at positions corresponding to the developing chamber **39**, and the outer peripheral surface of the sponge roller **19** confronts the inner peripheral surface of the arc-shaped wall **42**, with a slight gap formed therebetween (see FIG. **3**).

[0105] Next, the developing roller **6** is assembled in the lower frame **31**. The developing roller **6** is positioned so that the lower front side of the rubber roller **17** opposes and contacts the upper rear side of the sponge roller **19** and is assembled in the lower frame **31** so that the developing roller shaft **16** is rotatably supported in the side walls **35** at positions corresponding to the developing chamber **39** (see FIG. **3**).

[0106] Next, the thickness-regulating member **75** is arranged on the upper frame **32**. To arrange the thickness-regulating member **75** on the upper frame **32**, first the thickness-regulating member **75** and sealing member **94** described above are prepared. Next, the sealing member **94** is arranged on the top surface of the rear-side top wall **53** constituting the upper frame **32**.

[0107] Here, the sealing member **94** is placed over the rear edge of the rear-side top wall **53** and, excluding the side parts **95**, is fixed to the rear-side top wall **53** with adhesive tape (not shown). The sealing member **94** is oriented so that the side parts **95** protrude rearward and outward in left and right directions from respective left and right ends of the rear-side top wall **53** and are positioned above the rear portion of the second fixing parts **58**.

[0108] Next, the positioning protrusions **60** of the second fixing parts **58** are inserted through the corresponding posi-

tioning holes **90** formed in the reinforcing member **82**, and the thickness-regulating member **75** is placed over the top of the rear-side top wall **53** so that the second screw holes **59** formed in the second fixing parts **58** are aligned with the corresponding second fixing holes **91**. At this time, the first screw holes **48** of the first fixing parts **46** are visible in the corresponding first fixing holes **89** via the through-holes **61**. The above operations complete the process of arranging the thickness-regulating member **75** on the upper frame **32**.

[0109] Next, the thickness-regulating member **75** is fixed to the lower frame **31**. To fix the thickness-regulating member **75** to the lower frame **31**, four screw members **97** are inserted through each of the first fixing holes **89** and corresponding second fixing holes **91** and are screwed into the respective first screw holes **48** and second screw holes **59**. This operation fixes the thickness-regulating member **75** to the lower frame **31**, thereby completing assembly of the developer cartridge **23**.

[0110] Thereafter, the toner-accommodating chamber **38** is filled with toner via the toner fill hole **98**. Once the toner-accommodating chamber **38** is filled, a cap (not shown) is press-fitted into the toner fill hole **98** to seal the toner in the toner-accommodating chamber **38**.

[0111] 3. Operational Advantages

[0112] (1) With the developer cartridge **23** of the preferred embodiment, the thickness-regulating member **75** is fixed to the first fixing parts **46** erected from the curved wall **40**, as shown in FIG. **3**. Hence, both the thickness-regulating member **75** and the developing roller **6** are positioned relative to the lower frame **31**. Accordingly, this construction improves the precision for positioning the developing roller **6** and thickness-regulating member **75** relative to each other and, specifically, for positioning the developing roller **6** and contact part **83** relative to each other.

[0113] Further, since the distal ends of the first fixing parts **46** are inserted into the rear-side top wall **53**, which forms the opening **69** together with the rear ends of the side walls **35** and bottom wall **36**, the rear end of the rear-side top wall **53** defining the opening **69** is positioned farther rearward than the first fixing parts **46**. This configuration can enhance the strength of the assembled lower frame **31** and upper frame **32** (the developer frame **30**).

[0114] Hence, the developer cartridge **23** of the embodiment can enhance the strength of the developer frame **30** through a simple construction, while improving accuracy in positioning the developing roller **6** and thickness-regulating member **75** relative to each other.

[0115] (2) Further, the through-holes **61** are formed in the rear-side top wall **53** to allow the first fixing parts **46** to be inserted through and exposed above the rear-side top wall **53**. Accordingly, when assembling the lower frame **31** and upper frame **32** together, i.e., when assembling the developer frame **30**, the lower frame **31** and upper frame **32** need only be assembled together so that the distal ends of the first fixing parts **46** are exposed from the through-holes **61**, making the assembly operation smooth and easy.

[0116] Further, since the first screw holes **48** formed in the distal ends of the first fixing parts **46** are exposed through the through-holes **61**, the thickness-regulating member **75** can easily be fixed to the first fixing parts **46**.

[0117] (3) The protruding portions **49** of the first fixing parts **46** are fitted in the through-holes **61** with play. Accordingly, in the event that a load is applied to the upper frame **32**, this configuration can prevent the load from being applied to the first fixing parts **46**, thereby preventing the load from being applied to the thickness-regulating member **75** fixed to the first fixing parts **46**.

[0118] By preventing the contact part **83** of the thickness-regulating member **75** from pressing against the outer peripheral surface of the developing roller **6**, this construction prevents a load applied to the upper frame **32** from deforming the developing roller **6**.

[0119] (4) In the embodiment described above, the sealing member **94** is provided between the blade member **81** and the rear-side top wall **53** of the upper frame **32** to seal the gap between the blade member **81** and rear-side top wall **53**. In addition, the vertical dimension of the protruding portions **49** is set substantially equivalent to the sum of thicknesses of the sealing member **94** and blade member **81**. This configuration can prevent toner from leaking out through the blade member **81** and rear-side top wall **53**.

[0120] (5) The second fixing parts **58** are formed in the top edge of the rear portion of the side walls **35**. The thickness-regulating member **75** is fixed by screwing screw members **97** into the second screw holes **59** of the second fixing parts **58**. By reliably fixing the thickness-regulating member **75** to the lower frame **31** in this way, it is possible to improve the precision for positioning the developing roller **6** and contact part **83** relative to each other.

[0121] (6) The positioning protrusions **60** are also formed on the corresponding second fixing parts **58**. The positioning protrusions **60** are inserted through respective positioning holes **90** formed in the reinforcing member **82**.

[0122] In addition, the positioning protrusions **60** are positioned along the same line L**2**, oriented in the left-right direction, as the first fixing parts **46**. Accordingly, this arrangement can improve the precision for positioning the developing roller **6** and contact part **83** relative to each other.

[0123] (7) Each of the first fixing parts **46** has three ridge parts **47**. The ridge parts **47** confront the bottom surface of the rear-side top wall **53** and support the upper frame **32** via the elastic members **67**. Hence, if a load were applied to the upper frame **32**, the elastic members **67** can mitigate the effects of this load, suppressing the degree of load applied to the lower frame **31**. Accordingly, this configuration prevents the contact part **83** of the thickness-regulating member **75** from pressing against the developing roller **6**, suppressing deformation of the developing roller **6**.

[0124] (8) The thickness-regulating member **75** also includes the blade member **81** and reinforcing member **82**. The front portion of the blade member **81** is disposed above the sealing member **94**, while the reinforcing member **82** is arranged so that the front portion of the blade member **81** and the sealing member **94** are sandwiched between the reinforcing member **82** and the top surface of the rear-side top wall **53**. The reinforcing member **82** is fixed to the first fixing parts **46** by screwing the screw members **97** into the first screw holes **48** via the first fixing holes **89**, thereby fixing the blade member **81** relative to the lower frame **31**.

[0125] In this way, the force for fixing the reinforcing member **82** to the first fixing parts **46** is not applied to the blade member **81**, and the contact part **83** can suitably contact the outer peripheral surface of the developing roller **6** without deforming the same.

[0126] (9) In the preferred embodiment, the bottom wall **36** is provided with the partitioning wall **45**. The partitioning wall **45** is adjacent to the first fixing parts **46** with respect to

the front-rear direction. Accordingly, this configuration can enhance the strength of the lower frame **31**.

[0127] (10) Further, since the first fixing parts **46** are arranged in the toner-accommodating chamber **38**, additional space need not be provided for the first fixing parts **46**, enabling the developer frame **30** and, hence, the developer cartridge **23** to be made compact.

[0128] (11) The agitator **12** is also provided in the toner-accommodating chamber **38**. The agitating blade **64** of the agitator **12** has notched parts **65** formed therein at positions corresponding to the first fixing parts **46**. Accordingly, the agitator **12** can be provided in the toner-accommodating chamber **38** while keeping the developer cartridge, **23** as compact as possible. Further, the notched parts **65** formed in the agitating blade **64** can ensure the smooth rotation of the agitating blade **64**.

[0129] (12) Further, a plurality (two in the embodiment) of the first fixing parts **46** is provided and arranged symmetrically about the line L1 passing through the front-rear direction through the left-to-right center of the lower frame **31**. Thus, the thickness-regulating member **75** can be fixed to the first fixing parts **46** with an even balance, helping to improve the precision for positioning the developing roller **6** and contact part **83** relative to each other.

[0130] (13) The printer **1** is also provided with the developer cartridges **23** described above. Hence, the configuration of the printer **1** can improve the precision for positioning the developing roller **6** and thickness-regulating member **75** (contact part **83**) relative to each other.

[0131] 4. Variations of the Embodiment

[0132] While the invention has been described in detail with reference to the embodiment thereof, it would be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention.

[0133] For example, while the lower frame **31** described above is provided with a plurality (two in the embodiment) of first fixing parts **46**, the lower frame **31** may be configured with a single first fixing part **46** disposed in the left-to-right center region of the lower frame **31**, as illustrated in FIG. **6**.

[0134] In this variation, only one of the through-hole **61**, first fixing hole **89**, elastic member **67**, and notched part **65** of the agitating blade **64** need be provided for the first fixing part **46**. This construction can help reduce manufacturing costs while achieving the operational advantages described above.

What is claimed is:

1. A developing device comprising:

a first frame comprising:

a pair of first walls opposed with each other; and

a second wall connecting the pair of first walls and having a first fixing part;

a second frame comprising a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame;

a developer-carrying member having an axis extending in a first direction, configured to rotate about the axis, and disposed between the pair of first walls; and

a thickness-regulating member fixed to the first fixing part and configured to regulate a thickness of developer carried on the developer-carrying member, the third wall being disposed between the second wall and the thickness-regulating member.

2. The developing device according to claim **1**, wherein the third wall has a through-hole through which the first fixing part extends from the second wall to the thickness-regulating member.

3. The developing device according to claim **2**, wherein the first fixing part is fitted in the through-hole with play.

4. The developing device according to claim **1**, further comprising a sealing member disposed between the third wall and the thickness-regulating member to seal a gap between the third wall and the thickness-regulating member.

5. The developing device according to claim **4**, wherein the first fixing part protrudes beyond the third wall a distance equal to or more than a thickness of the sealing member.

6. The developing device according to claim **1**, wherein each of the pair of first walls has a second fixing part to which the thickness-regulating member is fixed.

7. The developing device according to claim **6**, wherein each of the pair of first walls has a pair of positioning protrusion protruding toward the thickness-regulating member,

wherein the thickness-regulating member has a pair of positioning holes into which the pair of positioning protrusions is inserted, respectively, to position the thickness-regulating member, and

wherein the pair of positioning protrusions and the first fixing part are arranged in the first direction.

8. The developing device according to claim **1**, further comprising an elastic member,

wherein the first fixing part has a ridge part, the elastic member being provided between the ridge part and the third wall.

9. The developing device according to claim **4**, wherein the thickness-regulating member comprises:

a first plate-like member extending in a second direction directing toward the developer carrying member and having a first end and a second end in the second direction, and having a contact part provided on the first end to regulate a thickness of developer carried on the developer-carrying member; and

a second plate-like member provided to sandwich the second end of the first plate-like member and the sealing member in cooperation with the third wall.

10. The developing device according to claim **9**, wherein the second plate-like member is fixed to the first fixing part.

11. The developing device according to claim **1**, wherein the first frame further comprises:

a partitioning wall partitioning the space into a developer-accommodating chamber for accommodating the developer; and

a developing chamber in which the developer-carrying member is provided, and

wherein the first fixing part and the partitioning wall are arranged in a direction perpendicular to the first direction adjacent to each other.

12. The developing device according to claim **11**, wherein the first fixing part extends in the developer-accommodating chamber.

13. The developing device according to claim **11**, further comprising an agitator provided in the developer-accommodating chamber,

the agitator comprising:

a rotational shaft rotatably supported by the pair of first walls; and

an agitating blade supported by the rotational shaft and having a notched part to avoid a contact with the first fixing part when the rotational shaft is rotated.

14. The developing device according to claim **2**, further comprising a plurality of first fixing part symmetrically-formed on the second wall about a virtual plane passing at a center between the pair of first walls and orthogonal to the first direction.

15. An image-forming device comprising:

a main body; and

a developing device mountable of the main body, the developing device comprising:

a first frame comprising:

a pair of first walls opposed with each other; and

a second wall connecting the pair of first walls and having a first fixing part,

a second frame comprising a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame;

a developer-carrying member having an axis extending in a first direction, configured to rotate about the axis, and disposed between the pair of first walls; and

a thickness-regulating member fixed to the first fixing part and configured to regulate a thickness of developer carried on the developer-carrying member, the third wall being disposed between the second wall and the thickness-regulating member.

16. A developing device comprising:

a first frame comprising:

a pair of first walls opposed with each other; and

a second wall connecting the pair of first walls and having a first fixing part,

a second frame comprising a third wall opposed to the second wall and attached to the pair of first walls when assembled to the first frame;

a developer-carrying member having an axis extending in a first direction, configured to rotate about the axis, and disposed between the pair of first walls; and

a thickness-regulating member fixed to the first fixing part and configured to regulate a thickness of developer carried on the developer-carrying member.

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