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ITO et al.

(54) **DEVELOPING DEVICE PROVIDED WITH DEVELOPING ROLLER AND THICKNESS REGULATING BLADE**

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(57) **ABSTRACT**

The developing device includes a casing, a developing roller, a thickness regulating blade, and a seal member. The developing roller has an outer peripheral surface carrying developer. The thickness regulating blade is configured to regulate a thickness of the developer carried on the outer peripheral surface and has an opposed surface confronting the casing. The thickness regulating blade further has one end part supported on the casing and another end part provided with a press member in sliding contact with the outer peripheral surface. The press member is located on the opposed surface and protrudes toward the developing roller. The press member is formed with a receiving portion depressed inward at its widthwise ends in an axial direction of the developing roller. The seal member is disposed between the thickness regulating blade and the casing and contacting at least a part of the receiving portion.

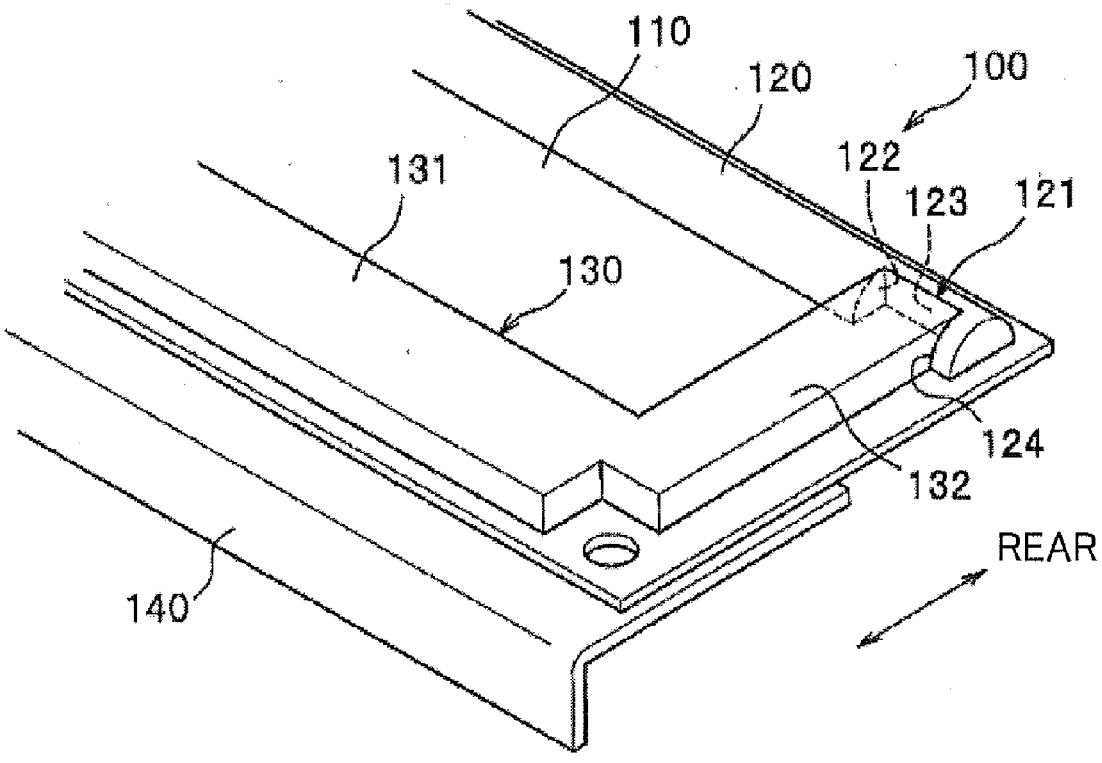


FIG. 1

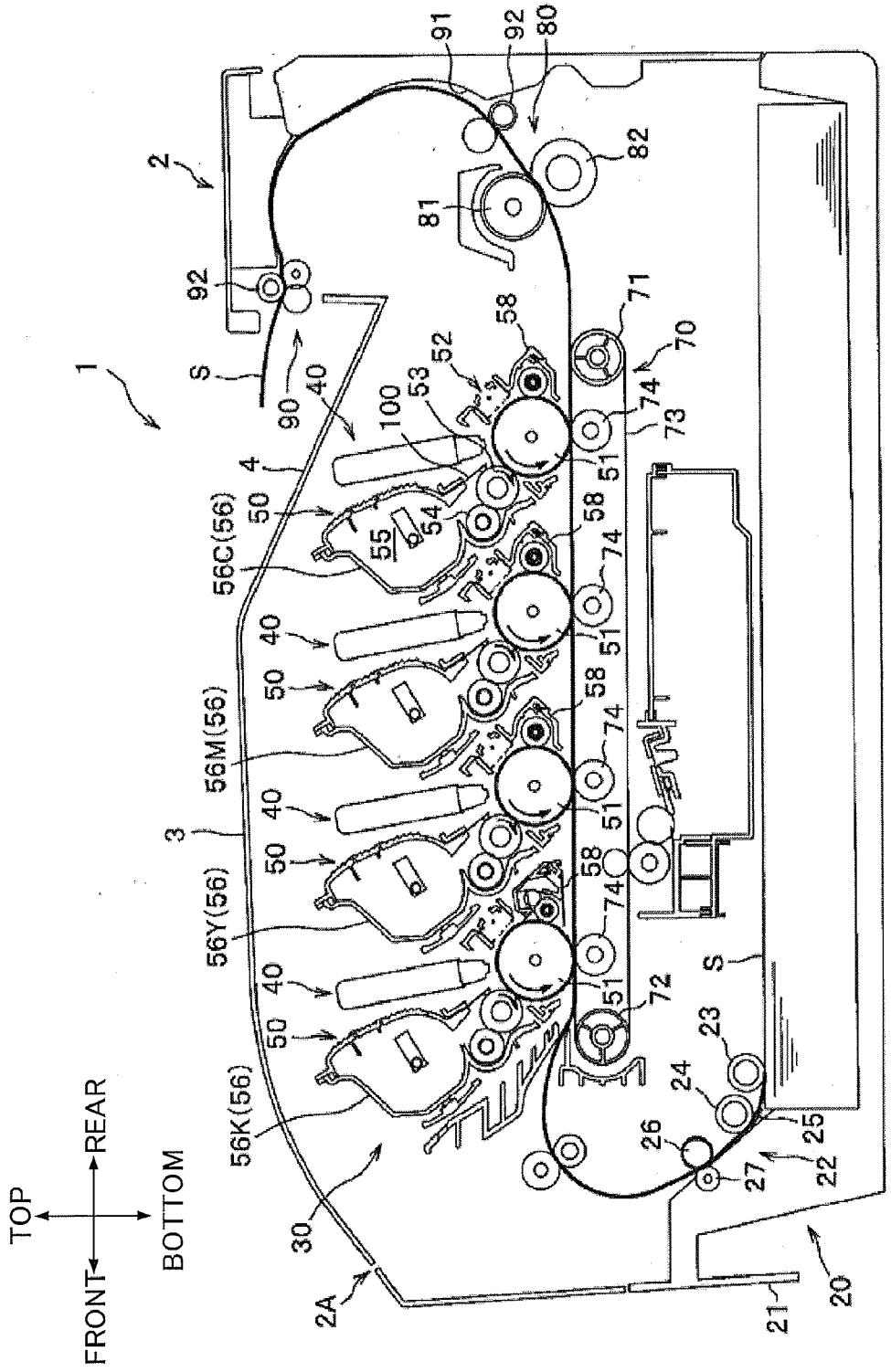

TOP
REAR
FRONT
BOTTOM
1
2
2A
3
4
20
21
22
23
24
25
26
27
30
40
50
51
52
53
54
55
56C(56)
56M(56)
56Y(56)
56K(56)
58
70
71
72
73
74
80
81
82
90
91
92
100
S

FIG. 2

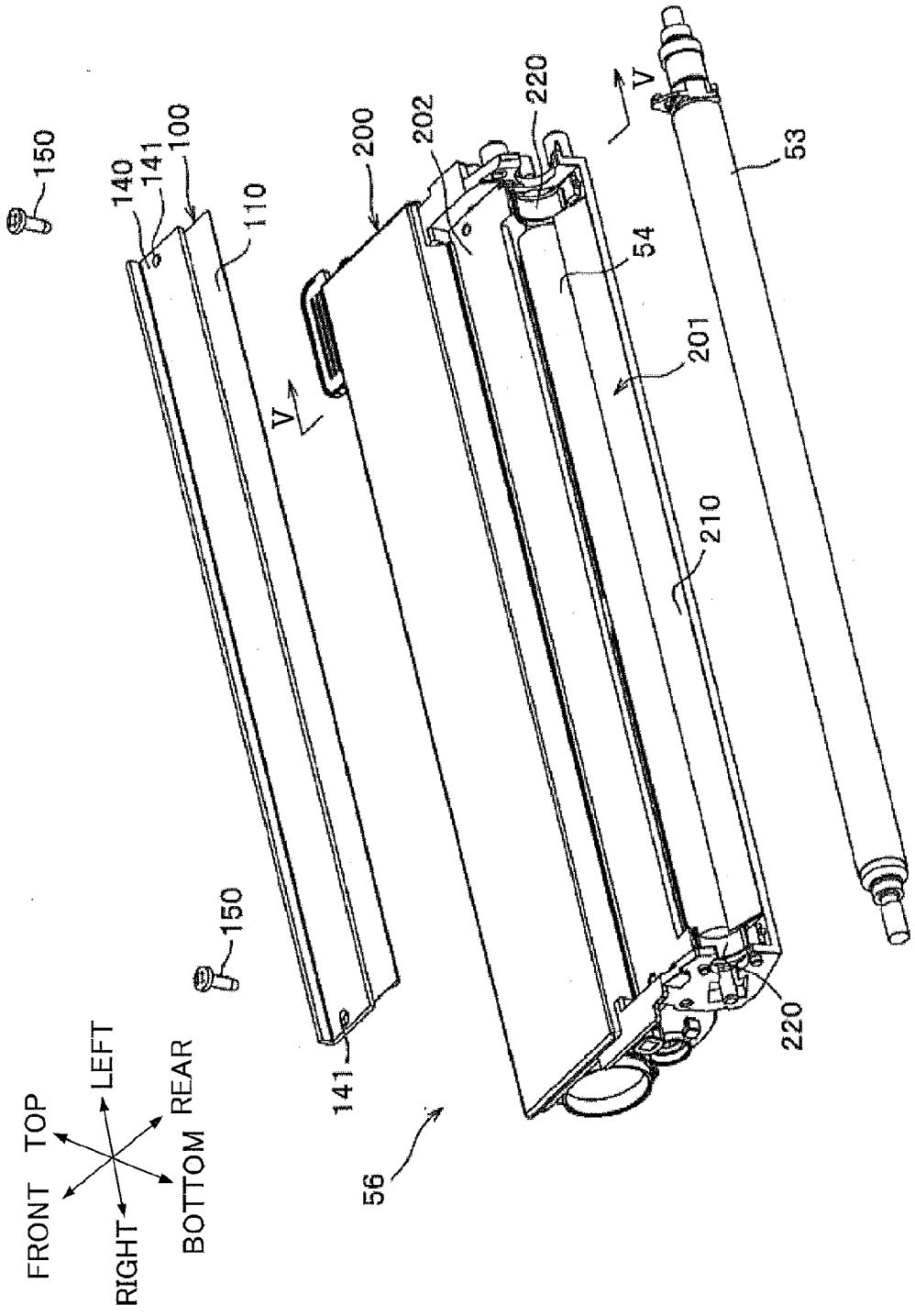

150
140
141
100
110
200
202
220
V
53
54
201
210
150
141
56
220
FRONT
TOP
LEFT
RIGHT
BOTTOM
REAR

FIG. 3

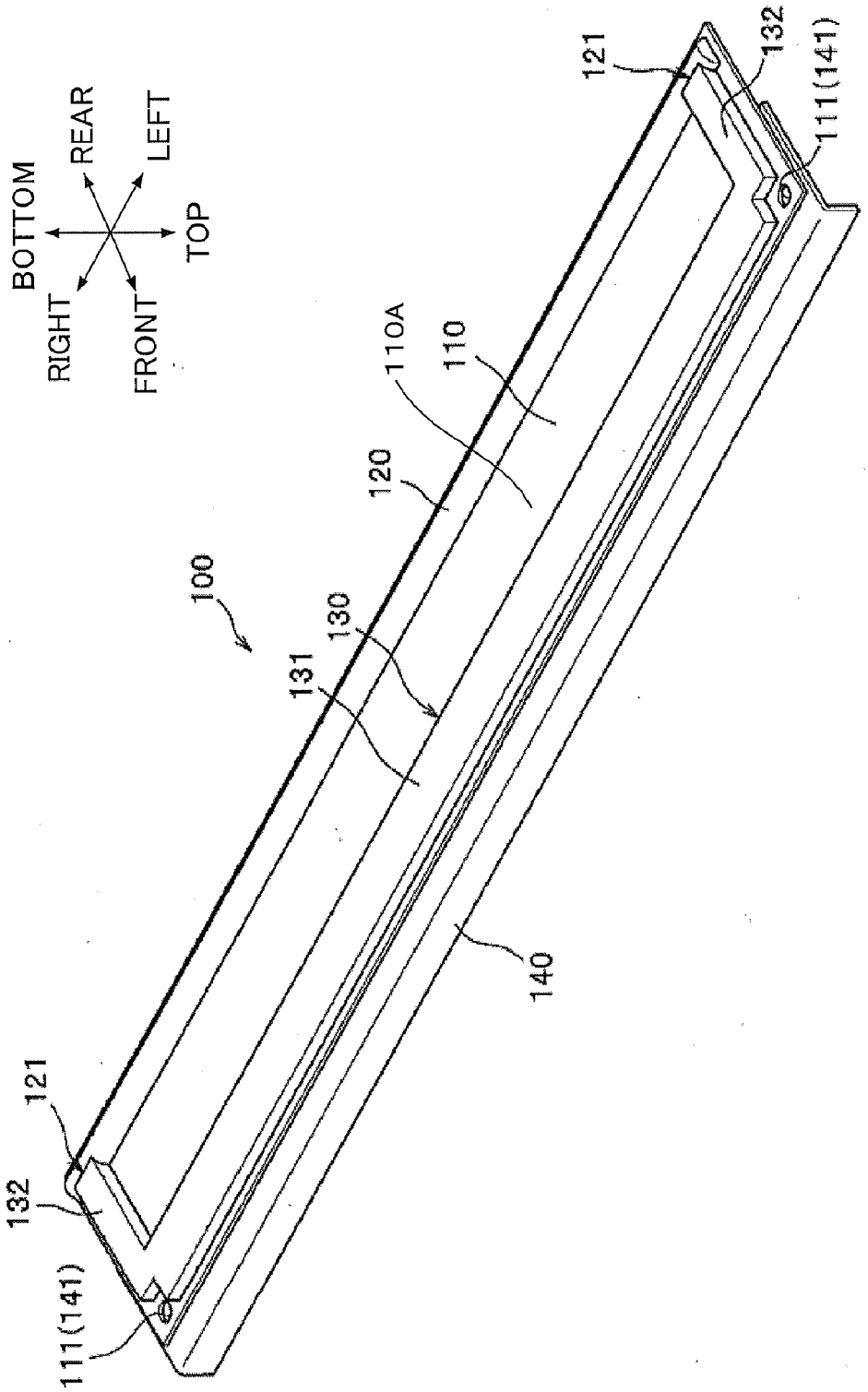

BOTTOM
REAR
LEFT
RIGHT
FRONT
TOP
100
110
110A
120
130
131
132
121
140
111(141)

FIG. 4(a)

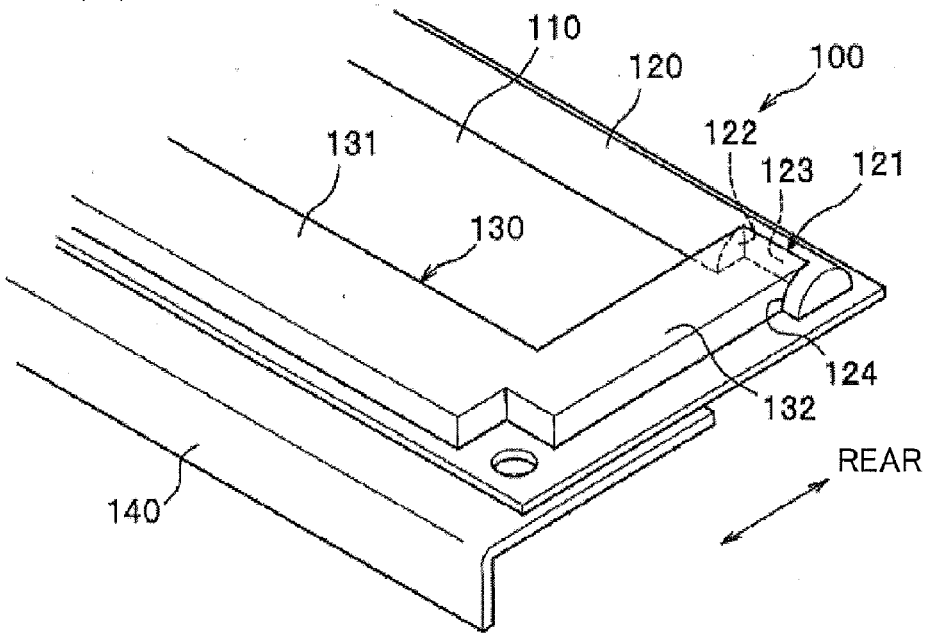

110
120
100
122
131
123
121
130
124
132
REAR
140

FIG. 4(b)

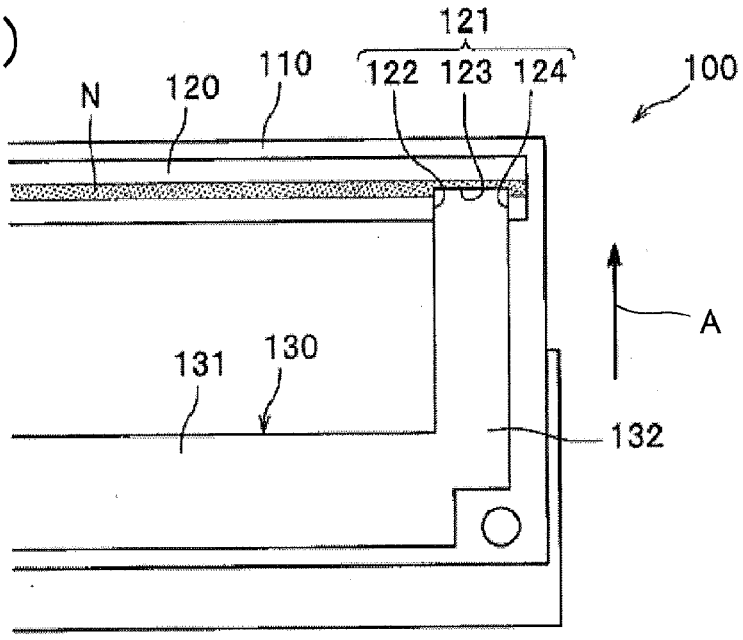

121
N
120
110
122
123
124
100
A
131
130
132

FIG. 5(a)

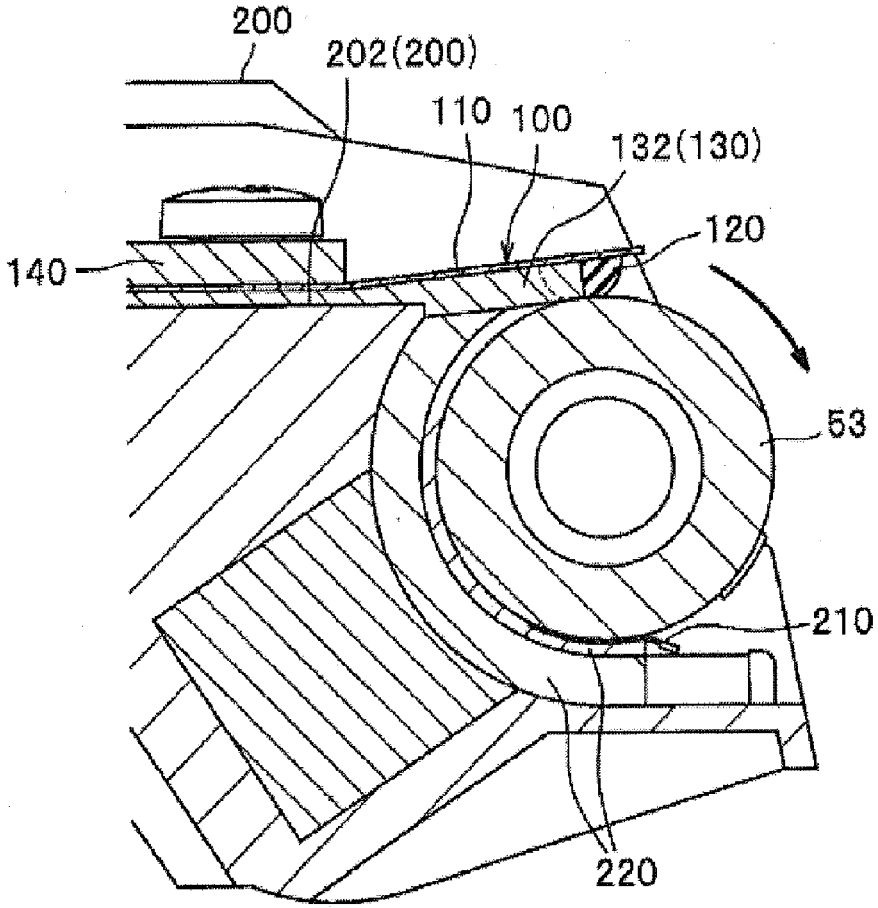

200
202(200)
110
100
132(130)
120
140
53
210
220

FIG. 5(b)

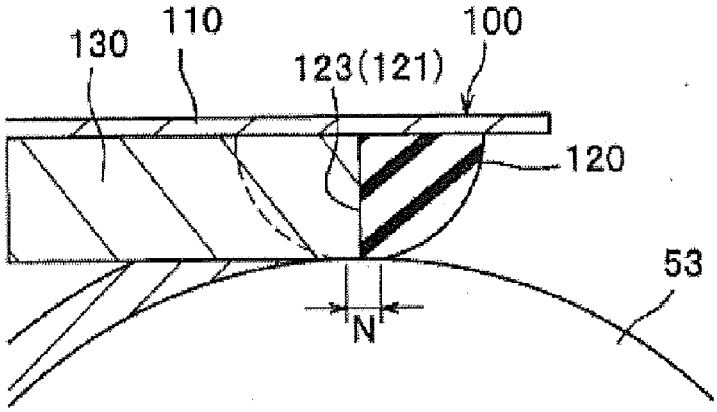

130
110
123(121)
100
120
53
N

FIG. 6(a)

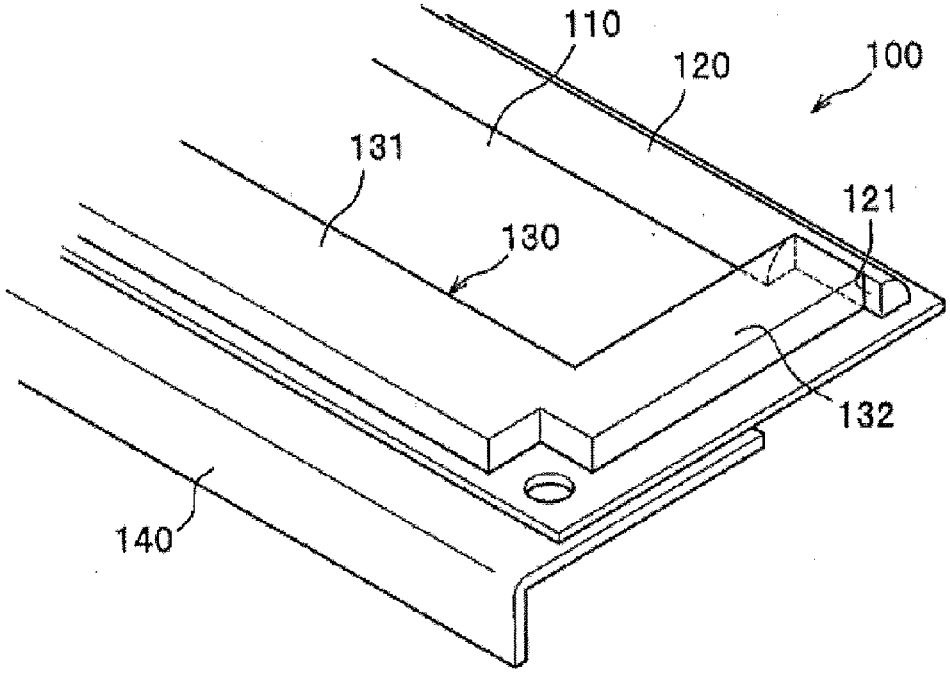
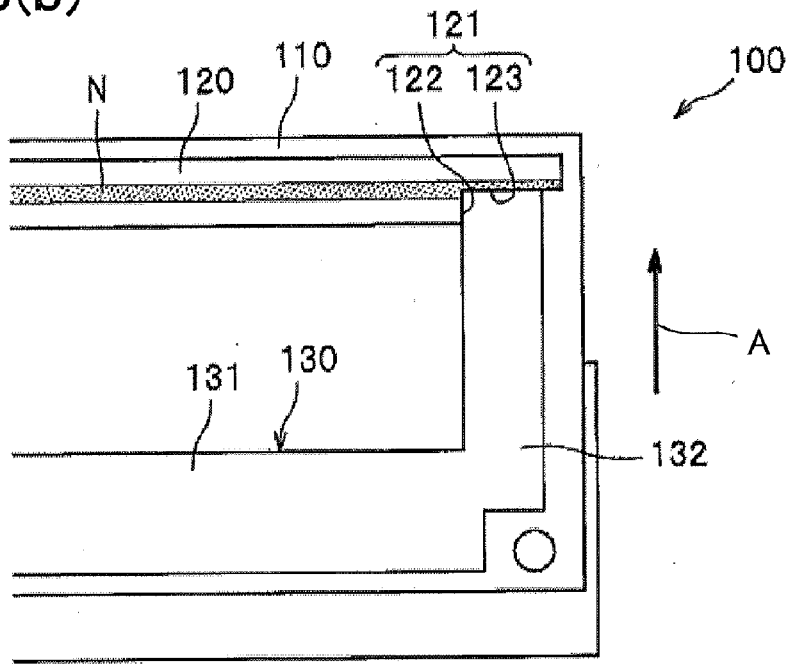

110
120
100
131
121
130
132
140

FIG. 6(b)


121
N
120
110
122
123
100
A
131
130
132

DEVELOPING DEVICE PROVIDED WITH DEVELOPING ROLLER AND THICKNESS REGULATING BLADE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Japanese Patent Application No. 2011-077200 filed Mar. 31, 2011. The entire content of this priority application is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present invention relates to a developing device provided with a developing roller and a thickness regulating blade for regulating a thickness of developing agent deposited on the developing roller.

BACKGROUND

[0003] A conventional developing device includes a casing, a developing roller carrying developing agent thereon, a thickness regulating blade slidingly contacting the developing roller and regulating a thickness of the developing agent carried on the developing roller, and a plurality of seal members preventing the developing agent from leaking from a gap between the thickness regulating blade and the developing roller. The thickness regulating blade is provided with a press member in sliding contact with the developing roller.

[0004] The seal member includes an upper side seal located between the thickness regulating blade and the casing, and a blade side seal located at each width end of the press member. The upper side seal is configured to prevent a developing agent from leaking from a base portion of the thickness regulating blade. The blade side seal is configured to prevent the developing agent from leaking from a gap among the thickness regulating blade, the casing, and the developing roller.

SUMMARY

[0005] The conventional developing device includes a plurality of seal members, increasing manufacturing cost.

[0006] The seal member is disposed on a surface in confrontation with the casing of the thickness regulating blade, and provided at a position outside of both ends of the press member in a longitudinal direction of the press member. If a gap is accidentally generated among the press member, the seal member, and the developing roller, the developing agent leaks from the gap.

[0007] In view of the foregoing, it is an object of the invention to provide a developing device capable of reducing the number of a seal member for preventing a toner leakage and capable of providing the seal member without a gap when a press member is provided on a surface in confrontation with a casing of the developing device.

[0008] In order to attain the above and other objects, the invention provides a developing device. The developing device includes a casing, a developing roller, a thickness regulating blade, and a seal member. The casing accommodates developer therein. The developing roller is rotatably provided in the casing and has an outer peripheral surface carrying the developer. The thickness regulating blade is configured to regulate a thickness of the developer carried on the outer peripheral surface and has an opposed surface confronting the casing. The thickness regulating blade further has one end part supported on the casing and another end part provided with a press member in sliding contact with the outer peripheral surface. The press member is located on the opposed surface and protrudes toward the developing roller. The press member is formed with a receiving portion depressed inward at its widthwise ends in an axial direction of the developing roller. The seal member is disposed between the thickness regulating blade and the casing and contacting at least a part of the receiving portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] 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:

[0010] FIG. **1** is a schematic cross-sectional view showing an overall structure of a color laser printer according to an embodiment of the invention;

[0011] FIG. **2** is an exploded perspective view of a developer cartridge from which a thickness regulating blade and a developing roller are removed;

[0012] FIG. **3** is a perspective view of the thickness regulating blade as viewed from reverse side;

[0013] FIG. **4**(*a*) is an enlarged perspective view of a left end portion of the thickness regulating blade;

[0014] FIG. **4**(*b*) is an enlarged bottom view of the left end portion of the thickness regulating blade;

[0015] FIG. **5**(*a*) is a partial cross-sectional view taken along a line V-V in FIG. **2**;

[0016] FIG. **5**(*b*) is an enlarged cross-sectional view of a press member;

[0017] FIG. **6**(*a*) is an enlarged perspective view of the left end portion of a thickness regulating blade according to a modification of the embodiment; and

[0018] FIG. **6**(*b*) is an enlarged bottom view of the left end portion of the thickness regulating blade according to the modification of the embodiment;

DETAILED DESCRIPTION

[0019] An embodiment of the invention will be described while referring to the accompanying drawings. An overall structure of a color laser printer **1** in which a developing device according to the present invention is mounted will be briefly described, and after that technical features of the present embodiment will be described in detail.

[0020] Throughout the specification, the expressions "front", "rear", "above", "below", and "laterally" are used herein to define the various parts when the color laser printer **1** is disposed in an orientation in which it is intended to be used. For example, a left side in FIG. **1** is a front side with respect to a user, a right side in FIG. **1** is a rear side, a front side of FIG. **1** is a right side, and a back side of FIG. **1** is a left side.

[0021] [Overall Structure of Color Laser Printer]

[0022] The color laser printer **1** has a main body **2** in which provided are a sheet supply section **20** for supplying a sheet S, an image forming section **30** for forming an image on the sheet S, and a sheet discharging section **90** for discharging the sheet S carrying a color image thereon.

[0023] The main body **2** has an upper portion formed with an opening **2**A and an upper cover **3** pivotally supported thereon for exposing and closing the opening **2**A. The upper cover **3** has a top surface serving as a discharge tray **4** on which the discharged sheet S from the main body **2** is stacked.

[0024] The sheet supply section **20** disposed at a bottom portion of the main body **2** includes a sheet supply tray **21** detachably mounted to the main body **2**, a sheet supplying mechanism **22** for conveying the sheet S from the sheet supply tray **21** to the image forming section **30**. The sheet supplying mechanism **22** is disposed at a front portion of the sheet supply tray **21** and includes a sheet supply roller **23**, a separation roller **24**, a separation pad **25**, a paper dust roller **26**, and a pinch roller **27**.

[0025] In the sheet supply section **20**, the sheet S stacked on the sheet supply tray **21** is fed upward one by one, passes between the paper dust roller **26** and the pinch roller **27** so that the paper dust is removed therefrom, follows a U-shaped path through a conveying path (not shown), and supplied to the image forming section **30**.

[0026] The image forming section **30** mainly includes four LED (light emitting diode) units **40**, four process cartridges **50**, a transfer unit **70**, and a fixing unit **80**.

[0027] The LED unit **40** is pivotably connected to an LED supporting member (not shown) disposed below the upper cover **3** and is arbitrarily fixed to a fixing member (not shown) provided on the main body **2**.

[0028] The four process cartridges **50** are juxtaposed in a front/rear direction at a position between the upper cover **3** and the sheet supply section **20**, and includes a drum cartridge **58** and a developer cartridge **56** detachably mounted to the drum cartridge **58**.

[0029] The drum cartridge **58** includes a photosensitive drum **51** and a charger **52**. The drum cartridge **58** may be either detachably mounted to the main body **2** or fixedly provided in the main body **2**.

[0030] The developer cartridge **56** includes a casing **200** (FIG. **2**) defining a toner accommodating chamber **55** for accommodating toner, a developing roller **53**, a supply roller **54**, and a thickness regulating blade **100**.

[0031] The four developer cartridges **56**K, **56**Y, **56**M, and **56**C respectively accommodate black (K), yellow (Y), magenta (M), and cyan (C) toner. These cartridges are arranged in the stated order from an upstream side in a sheet feeding direction.

[0032] The transfer unit **70** is disposed between the sheet supply section **20** and the process cartridge **50** and includes a drive roller **71**, a follower roller **72**, an endless transfer belt **73**, and a transfer roller **74**.

[0033] The drive roller **71** and the follower roller **72** are arranged in parallel with and away from each other in the front/rear direction. The transfer belt **73** is stretched between the drive roller **71** and the follower roller **72** and has an outer surface in contact with each photosensitive drum **51**. Four transfer rollers **74** are disposed inside the transfer belt **73** and confronts corresponding photosensitive drum **51**, with the transfer belt **73** interposed therebetween. A transfer bias (transfer voltage) opposite in polarity to the toner is applied to the transfer roller **74** under a constant current control during a transfer operation.

[0034] The fixing unit **80** is disposed on the rear side of the process cartridge **50** and the transfer unit **70**. The fixing unit **80** includes a heating roller **81** and a pressure roller **82** facing the heating roller **81** and applying a pressure to the same.

[0035] The sheet discharging section **90** includes a sheet discharge path **91** running upward from the fixing unit **80** and turning forward, and a plurality of conveying rollers **92** conveying the sheet S.

[0036] In a color print mode, an outer surface of each of the photosensitive drums **51** is charged by the charger **52** and exposed by the LED unit **40**, so that the potential level of the exposed portion becomes lower than the remaining portion on the outer surface, thereby forming an electrostatic latent image on the photosensitive drum **51** based on image data. The toner accommodated in the toner accommodating chamber **55** is supplied to the developing roller **53** by the supply roller **54**, regulated to a prescribed uniform thickness by the thickness regulating blade **100**, and then deposited on the developing roller **53**.

[0037] The toner carried on the developing roller **53** is supplied to the electrostatic latent image formed on the photosensitive drum **51**. As a result, the electrostatic latent image is developed into a visible toner image.

[0038] The sheet S supplied on the transfer belt **73** passes between each photosensitive drum **51** and each transfer roller **74** located within the transfer belt **73**, transferring the toner image formed on the photosensitive drum **51** onto the sheet S. The sheet S passes between the heating roller **81** and the pressure roller **82**, so that the toner image transferred onto the sheet S is thermally fixed.

[0039] The sheet S with thermally fixed toner image is conveyed through the sheet discharge path **91** by the conveying rollers **92**, discharged outside of the main body **2**, and stacked on the discharge tray **4**.

[0040] [Developer Cartridge]

[0041] Next, the detailed construction of the developer cartridge **56** will be described. A direction will be used throughout the following description assuming that the developer cartridge **56** is transversely disposed. That is, as shown in FIG. **2**, a side to which the thickness regulating blade **100** is mounted as viewed from the casing **200** defines "upward", and the opposite side "downward". A side at which the developing roller **53** is disposed with respect to the casing **200** defines "rear", and the opposite side defines "front". Based on the upward/downward direction and the front/rear direction, "right" and "left" are defined.

[0042] As shown in FIG. **2**, the casing **200** has a rear side wall formed with an elongated opening **201**. The developing roller **53** is rotatably supported on the casing **200** so as to cover the opening **201**. The opening **201** has a lower portion provided with a film **210** and widthwise end portions provided with a side seal **220**. A mounting surface **202** to which the thickness regulating blade **100** is to be mounted is disposed above the opening **201**.

[0043] The side seal **220** is curved to follow a circumferential surface of the developing roller **53** and is in sliding contact with the developing roller **53**. The film **210** is in sliding contact with a lower portion of the developing roller **53**, and the thickness regulating blade **100** is in sliding contact with the upper portion of the developing roller **53**. The developing roller **53** is surrounded by the thickness regulating blade **100**, the film **210**, and the side seal **220** in the upward/downward and rightward/leftward directions, thereby preventing the toner in the casing **200** from leaking from the shielded portion of the developing roller **53**.

[0044] The thickness regulating blade **100** slidingly contacts the developing roller **53** to regulate a thickness of the toner thereon. The thickness regulating blade **100** has a base part fixed to the mounting surface **202** and a free end part in sliding contact with the developing roller **53**. As shown in FIG. **3**, the thickness regulating blade **100** is configured of a metallic plate **110** and a reinforcing member **140**.

[0045] The metallic plate **110** is in contact with the developing roller **53** and made of substantially thin rectangular metallic plate. The metallic plate **110** has an opposed surface **110**A facing the casing **200** provided with a press member **120** and a seal member **130**.

[0046] The press member **120** is formed of a rubber or the like and in sliding contact with the circumferential surface of the developing roller **53**. The press member **120** protrudes from the free end part of the thickness regulating blade **100** toward the developing roller **53**. Specifically, as shown in FIG. **4**(*a*), the press member **120** has a semicircular cross-section and extends from one widthwise end of the developing roller **53** to the other in an axial direction of the developing roller **53**. The press member **120** has a contact part N in direct sliding contact with the developing roller **53**. The contact part N is disposed furthest from the metallic plate **110** on the press member **120** in top-to-bottom direction and extends in the axial direction.

[0047] The press member **120** has widthwise ends portion formed with a concave part **121** positioned at a front side (upstream side in a rotational direction of the developing roller **53**, shown in arrow A of FIG. **4**(*b*)) and depressed rearward (downstream side in the rotational direction of the developing roller **53**). The concave part **121** is of substantially squared U-shape and includes a first side surface **122**, a depth-side surface **123**, and a second side surface **124**.

[0048] The first side surface **122** extends in front/rear direction (rotational direction of the developing roller **53**). The depth-side surface **123** extends in the axial direction from a rear end portion (the most downstream side in the rotational direction of the developing roller **53**) of the first side surface **122**. As shown in FIG. **5**(*b*), the depth-side surface **123** extends orthogonal to the opposed surface **110**A of the metallic plate **110**. The depth-side surface **123** is aligned with the contact part N as shown in a hatching area of FIG. **4**(*b*). The second side surface **124** extends from an outside end portion of the depth-side surface **123** toward the upstream side in the rotational direction of the developing roller **53** so as to be in confrontation with the first side surface **122**.

[0049] The seal member **130** is made of a sponge or the like. The seal member **130** has a thickness greater than that of the press member **120** before the thickness regulating blade **100** is assembled in the casing **200**, whereas the seal member **130** has a thickness equivalent to the press member **120** due to the elastic deformation after the thickness regulating blade **100** is assembled in the casing **200**.

[0050] The seal member **130** includes, as shown in FIG. **3**, a main part **131** positioned at the base part of the metallic plate **110** and extending in the axial direction, and a side part **132** connected to widthwise end of the main part **131** and extending toward the concave part **121** of the press member **120**. The side part **132** has a rear end portion fitted into the concave part **121** so as to be sandwiched between the first side surface **122** and the second side surface **124** and in contact with the first side surface **122**, the depth-side surface **123**, and the second side surface **124**. As shown in FIG. **5**(*a*), the rear end portion of the side part **132** is closely in contact with an end surface of the side seal **220** at the downstream side in the rotational direction of the developing roller **53** in order to avoid toner leakage from a gap which may be formed by the side seal **220**, the side part **132**, and the developing roller **53**.

[0051] The seal member **130** provides hermetically seals between the thickness regulating blade **100** and the mounting surface **202**, and between the thickness regulating blade **100** and the developing roller **53**, which prevents the toner leakage from these gaps.

[0052] If the seal member **130** were provided at downstream side in the rotational direction of the developing roller **53** from the contact part N, the toner may leak from a gap accidentally formed by the press member **120**, the seal member **130**, and the developing roller **53**. On the other hand, in the embodiment, the depth-side surface **123** of the concave part **121** positioned most downstream side in the rotational direction of the developing roller **53** is aligned with the contact part N in the rotational direction of the developing roller **53**. The contact part N extends over the entire width of the thickness regulating blade **100** in the axial direction. Thus, even if the gap is accidentally formed by the press member **120**, the seal member **130**, and the developing roller **53**, the contact part N blocks the toner which may leak to the downstream side in the rotational direction of the developing roller **53** through the formed gap.

[0053] The reinforcing member **140** extends in the rightward/leftward direction and located at an opposite side of the opposed surface **110**A of the metallic plate **110** where the press member **120** is provided, as shown in FIG. **2**. The reinforcing member **140** sandwiches the metallic plate **110** in cooperation with the casing **200** in order to reinforce the metallic plate **110**. Providing the reinforcing member **140** on the opposed surface **110**A in this way prevents the deformation of the metallic plate **110**, provides the base part of the metallic plate **110**, and uniforms a contact pressure between the developing roller **53** and the metallic plate **110**.

[0054] As shown in FIG. **3**, the metallic plate **110** is formed with a through hole **111** located at a position outside of an area surrounded by the press member **120** and the seal member **130**. The reinforcing member **140** is also formed with a through hole **141** located at a position corresponding to the through hole **111**. The through holes **111** and **141** respectively penetrate the metallic plate **110** and the reinforcing member **140** in a thickness direction thereof. As shown in FIG. **2**, a screw **150** passes through the through holes **111** and **141** to fix the thickness regulating blade **100** to the mounting surface **202** of the casing **200**.

[0055] With the metallic plate **110** having this construction, as shown in FIGS. **2** and **5**(*a*), the metallic plate **110** is fixed to the mounting surface **202** of the casing **200**, and sandwiched by the mounting surface **202** and the reinforcing member **140**. The press member **120** located at the rear end portion of the metallic plate **110** is in sliding contact with the circumferential surface of the developing roller **53** while being urged by the metallic plate **110**.

[0056] Advantageous effects of the embodiment will be described. Because the single seal member **130** seals between the thickness regulating blade **100** and the casing **200**, and between the thickness regulating blade **100** and the developing roller **53**, the manufacturing cost can be reduced in comparison with a case where a plurality of seal members is provided.

[0057] Further, because the seal member **130** is in contact with the concave part **121** of the press member **120** provided on the opposed surface **110**A in confrontation with the casing **200**, the seal member **130** can be provided without a gap.

[0058] Further, because the seal member **130** is in facial contact with the concave part **121**, the contact part N providing a direct contact between the developing roller **53** and the press member **120** can be defined continuously from one

widthwise end of the thickness regulating blade **100** to the other in the axial direction of developing roller **53**. In the embodiment, even if a gap is accidentally formed by the press member **120**, the side part **132**, and the developing roller **53**, the contact part N blocks the toner which may leak from the gap, compared with a case where the side part **132** is located at the outside of the press member **120** in the axial direction without the concave part **121**.

[0059] The rear end part of the side part **132** is in facial contact with the depth-side surface **123** of the concave part **121**, which prevents the toner from leaking via a gap between the seal member **130** and the depth-side surface **123**.

[0060] Because the depth-side surface **123** of the concave part **121** vertically extends relative to the opposed surface **110**A on which the press member **120** is provided, the rear end part of the side part **132** can easily contact the depth-side surface **123** without gap.

[0061] The side part **132** of the seal member **130** is in also facial contact with the first side surface **122**, which reliably prevents the toner from leaking from the gap between the seal member **130** and the concave part **121**.

[0062] Because the side part **132** of the seal member **130** is sandwiched between the first side surface **122** and the second side surface **124**, the toner leakage from the gap between the seal member **130** and the concave part **121** can be reliably obviated, and the seal member **130** can be easily positioned relative to the press member **120**.

[0063] 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.

[0064] In the above-described embodiment, the side part **132** of the seal member **130** is in contact with the first side surface **122**, the depth-side surface **123**, and the second side surface **124**. However, the present invention is not limited to this configuration. The side part **132** may be in contact with at least a part of the concave part **121**. For example, the side part **132** may be in contact with only the depth-side surface **123** of the concave part **121**. This prevents toner leakage from the gap between the concave part **121** and the seal member **130**.

[0065] Although, the concave part **121** is of substantially squared U-shape in the above-described embodiment, the present invention is not limited to this configuration. For example, as shown in FIGS. **6**(*a*) and **6**(*b*), the press member **120** may be cut out so as to be formed with the concave part **121** having substantially L-shape without the second side surface **124**. In this modification, a rear end part of the side part **132** is in contact with the first side surface **122** and the depth-side surface **123**. Since the concave part **121** is formed in L-shape, the seal member **130** can be easily attached to the metallic plate **110** compared with the above-described embodiment.

[0066] Although the color laser printer **1** is employed as an image forming device, the present invention is applicable to a multifunction device or a copying device can be available.

What is claimed is:

1. A developing device comprising:
- a casing accommodating developer therein;
- a developing roller rotatably provided in the casing and having an outer peripheral surface carrying the developer;
- a thickness regulating blade configured to regulate a thickness of the developer carried on the outer peripheral surface and having an opposed surface confronting the casing, the thickness regulating blade further having one end part supported on the casing and another end part provided with a press member in sliding contact with the outer peripheral surface, the press member being located on the opposed surface and protruding toward the developing roller, the press member being formed with a receiving portion depressed inward at its widthwise ends in an axial direction of the developing roller; and
- a seal member disposed between the thickness regulating blade and the casing and contacting at least a part of the receiving portion.

2. The developing device according to claim **1**, wherein the seal member comprises:
- a main part extending in the axial direction and having widthwise end portions in the axial direction; and
- a side part integrally formed with the main part and extending from the widthwise end portions of the main part so as to contact at least the part of the receiving portion.

3. The developing device according to claim **1**, wherein the receiving portion is formed such that an upstream side of the press member in a rotational direction of the developing roller is partially cut out.

4. The developing device according to claim **1**, wherein:
- the receiving portion has a depth-side surface at a position most downstream side in a rotational direction of the developing roller;
- the press member includes a contact part configured to be in direct sliding contact with the outer peripheral surface of the developing roller; and
- the depth-side surface is in alignment with the contact part.

5. The developing device according to claim **4**, wherein the seal member is in contact with the depth-side surface of the receiving portion.

6. The developing deice according to claim **4**, wherein the receiving portion includes a first side surface extending in a rotational direction of the developing roller, and the depth-side surface is connected to a downstream end portion of the first side surface in the rotational direction and extends outward in the axial direction.

7. The developing device according to claim **6**, wherein the seal member is in contact with the first side surface.

8. The developing device according to claim **7**, wherein the receiving portion further includes a second side surface in confrontation with the first side surface, wherein the seal member is sandwiched between the first side surface and the second side surface.

9. The developing device according to claim **4**, wherein the depth-side surface extends orthogonal to the opposed surface of the thickness regulating blade.

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