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(54) DEVELOPING DEVICE AND IMAGE FORMING APPARATUS

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(57) **ABSTRACT**

A developing device includes a developer container and a developer carrying member. The developer carrying member includes a shaft, a sleeve that rotates while carrying toner on its outer circumferential face, and a magnet that extends along the axis of the developer carrying member. The developer container includes a duct, an intake port which opens above the developer carrying member and through which the inside of the developer container and the inside of the duct communicate with each other, and a first filter that covers the intake port. The edges of the first filter at one side and at the other side in the axial direction of the developer carrying member are both located within a range opposite the magnet as seen from the direction perpendicular to the axial direction.

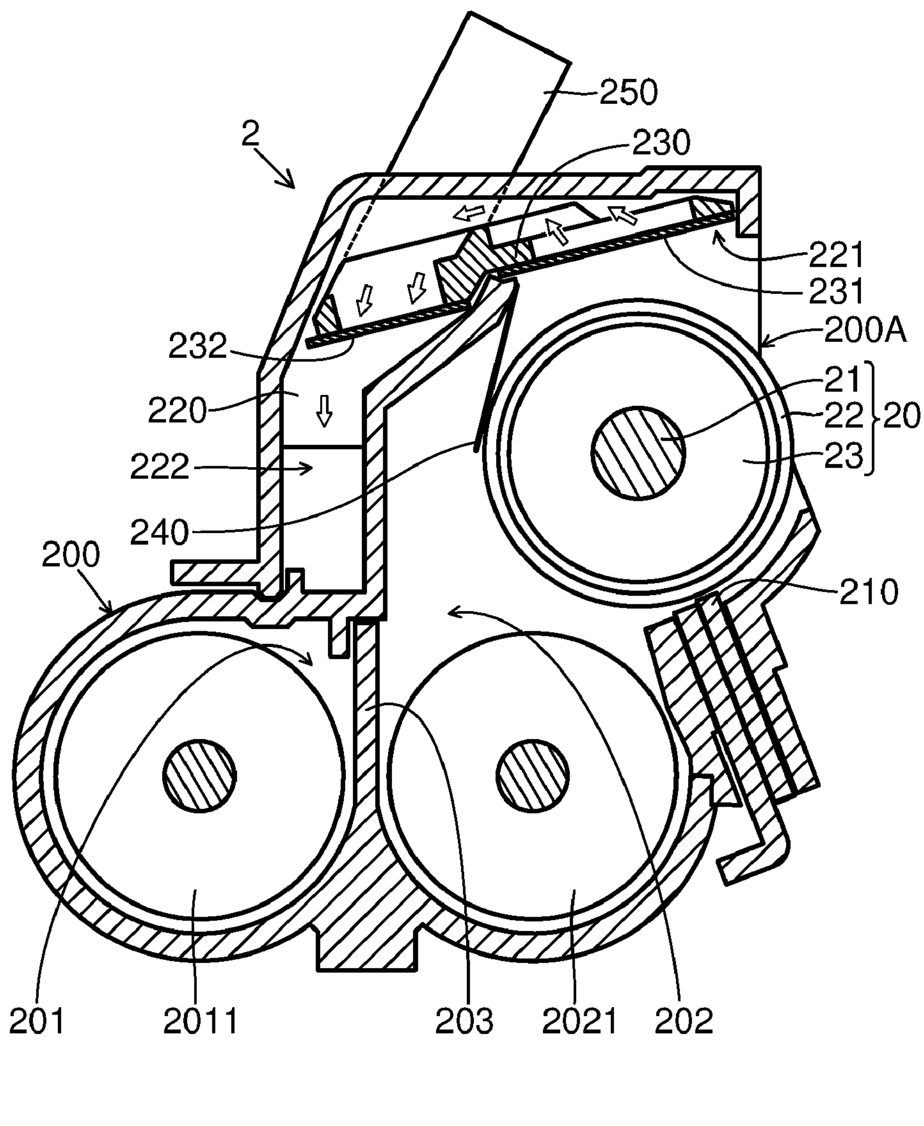


FIG.1

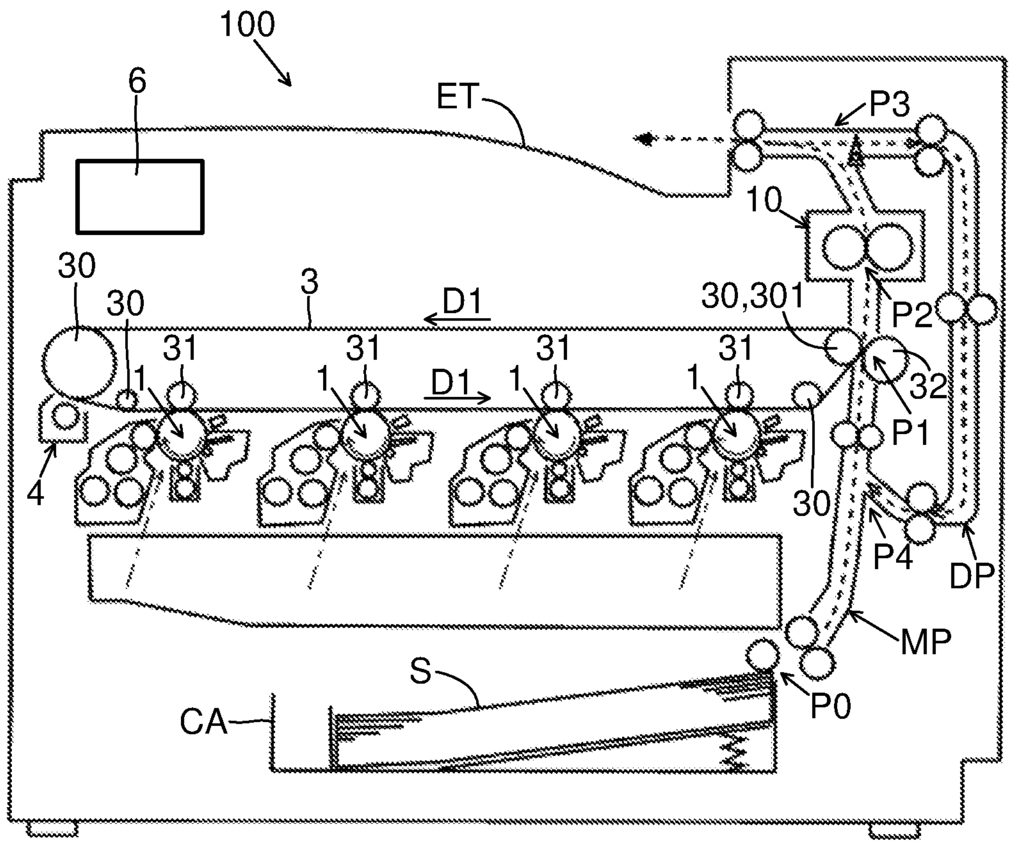

100
6
ET
P3
10
30
30
3
D1
30,301
P2
31
31
31
31
1
1
1
1
D1
32
P1
4
30
P4
DP
MP
S
P0
CA

FIG.2

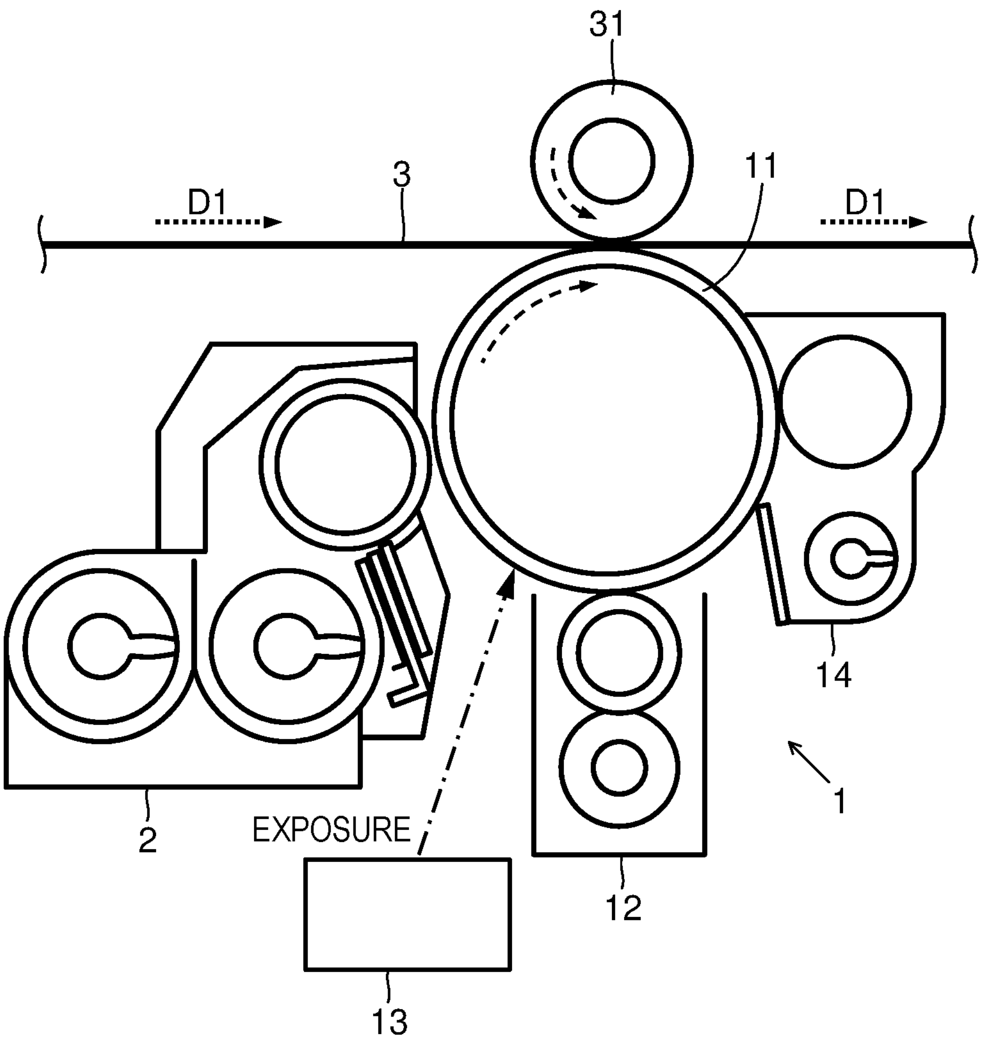


FIG.3

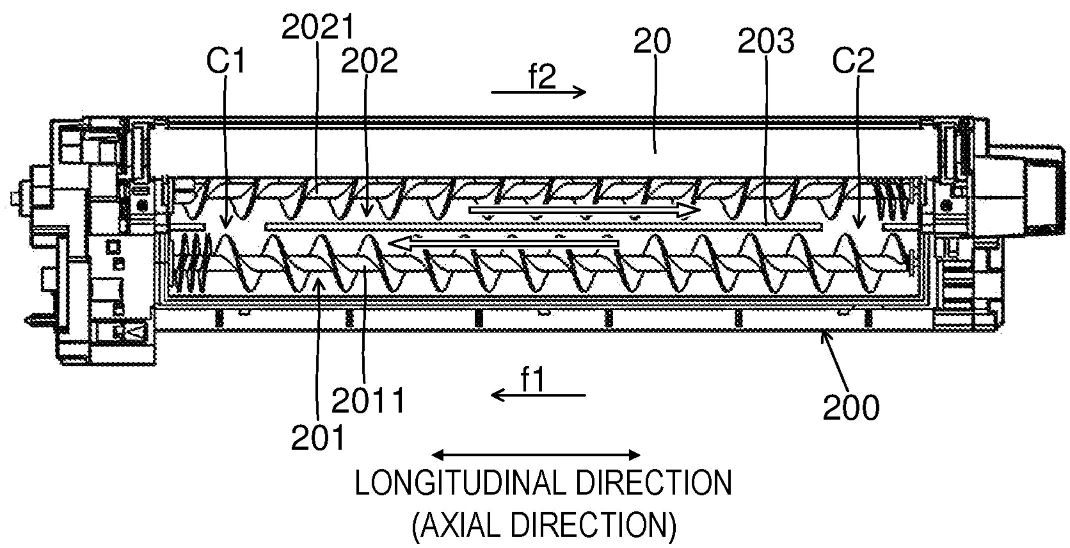
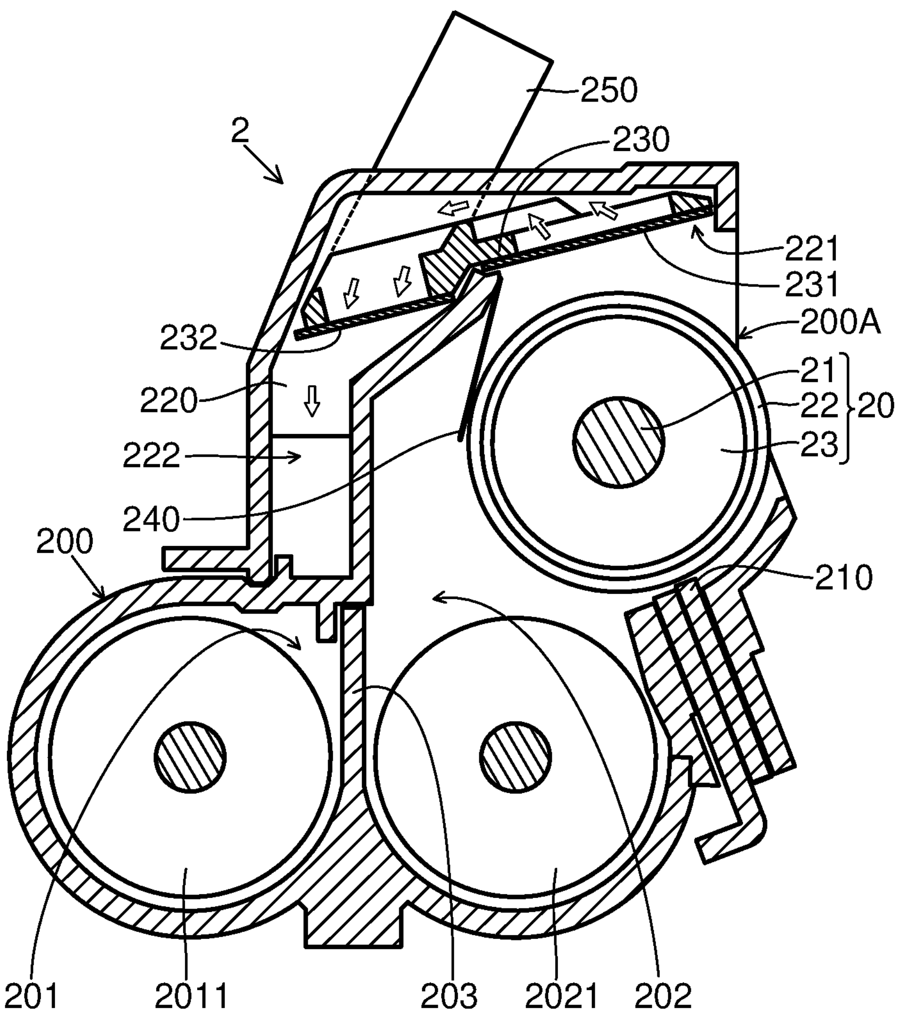

2021
C1
202
f2
20
203
C2
201
2011
f1
200
LONGITUDINAL DIRECTION
(AXIAL DIRECTION)

FIG.4



250
2
230
221
231
200A
232
21
22
20
23
220
222
240
200
210
201
2011
203
2021
202

FIG.5

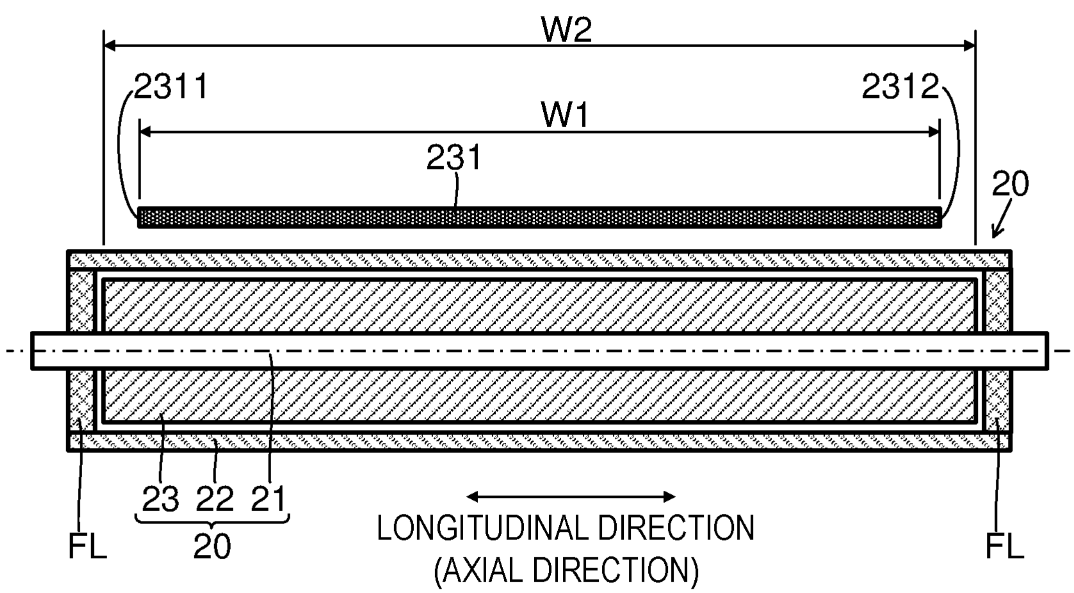

W2
2311
2312
W1
231
20
23 22 21
20
FL
LONGITUDINAL DIRECTION
(AXIAL DIRECTION)
FL

FIG.6

No.	W2(mm)	W1(mm)	W3(mm)	VIBRATION FREQUENCY	UPPER PART	END PART
1	332	312	20	NEVER	YES	-
2	332	332	20	NEVER	YES	-
3	332	352	20	NEVER	YES	-
4	332	372	20	NEVER	YES	-
5	332	312	20	EVERY 4000 SHEETS	NO	NO
6	332	332	20	EVERY 4000 SHEETS	NO	NO
7	332	352	20	EVERY 4000 SHEETS	NO	YES
8	332	372	20	EVERY 4000 SHEETS	NO	YES
9	332	156	20	EVERY 4000 SHEETS	SLIGHT	NO
10	332	312	10	EVERY 4000 SHEETS	SLIGHT	NO
11	332	332	10	EVERY 4000 SHEETS	SLIGHT	NO
12	332	352	10	EVERY 4000 SHEETS	SLIGHT	YES
13	332	372	10	EVERY 4000 SHEETS	SLIGHT	YES
14	332	312	5	EVERY 4000 SHEETS	YES	NO
15	332	332	5	EVERY 4000 SHEETS	YES	NO
16	332	352	5	EVERY 4000 SHEETS	YES	YES
17	332	372	5	EVERY 4000 SHEETS	YES	YES
18	332	312	5	EVERY 1000 SHEETS	NO	NO
19	332	332	5	EVERY 1000 SHEETS	NO	NO
20	332	352	5	EVERY 1000 SHEETS	NO	YES
21	332	372	5	EVERY 1000 SHEETS	NO	YES

DEVELOPING DEVICE AND IMAGE FORMING APPARATUS

INCORPORATION BY REFERENCE

[0001] This application is based upon and claims the benefit of priority from the corresponding Japanese Patent Application No. 2022-191111 filed on Nov. 30, 2022, the entire contents of which are hereby incorporated by reference.

BACKGROUND

[0002] The present disclosure relates to a developing device and an image forming apparatus.

[0003] Known developing devices include a developer container that stores developer containing toner. Known developing devices also include a developer carrying member that feeds toner to an image carrying member.

SUMMARY

[0004] According to one aspect of the present disclosure, a developing device includes a developer container and a developer carrier. The developer container stores developer containing toner and has an opening at a position facing an image carrying member. The developer carrying member is arranged inside the developer container and is exposed out of the developer container through the opening. The developer carrying member carries toner to feed it to the image carrying member. The developer carrying member includes a shaft, a sleeve, and a magnet. The sleeve is supported so as to be rotatable about the shaft and rotates while carrying the toner on its outer circumferential face. The magnet is arranged inside the sleeve and extends along the axis of the developer carrying member. The developer container includes a duct, an intake port, and a first filter. The duct lets the air in the developer container flow out of it. The intake port opens above the developing roller. Through the intake port, the inside of the developer container and the inside of the duct communicate with each other. The first filter covers the intake port. The edges of the first filter at one side and at the other side in the axial direction of the developer carrying member are both located within a range opposite the magnet as seen from the direction perpendicular to the axial direction of the developing roller.

[0005] According to a second aspect of the present disclosure, an image forming apparatus includes the developing device described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a schematic diagram of an image forming apparatus including a developing device according to an embodiment.

[0007] FIG. **2** is a schematic diagram of and around an image forming portion including the developing device according to the embodiment.

[0008] FIG. **3** is a diagram showing the inside of the developing device according to the embodiment as seen from above.

[0009] FIG. **4** is a cross-sectional view of the developing device (a cross-sectional view cut along a plane perpendicular to the axis of a developing roller) according to the embodiment.

[0010] FIG. **5** is a schematic diagram showing the position where a first filter of the developing device is arranged according to the embodiment.

[0011] FIG. **6** is a diagram showing the results of tests performed to confirm the effect of the embodiment.

DETAILED DESCRIPTION

[0012] Now, an image forming apparatus according to one embodiment of the present disclosure will be described taking a tandem-type color laser printer as an example. However, image forming apparatuses to which the present disclosure is applicable are not limited to color laser printers. The present disclosure can be applied to various image forming apparatuses such as monochrome printers and multifunction peripherals. In the following description, the direction perpendicular to a flat floor on which an image forming apparatus is installed is defined as the up-down direction.

[0013] <Overall Structure of an Image Forming Apparatus>

[0014] As shown in FIG. **1**, an image forming apparatus **100** according to the embodiment includes a main conveying passage MP. The image forming apparatus **100** includes a sheet cassette CA. The sheet cassette CA is removably mounted in the main body of the image forming apparatus **100**. In the sheet cassette CA, sheets S used in a print job are stored. The main conveying passage MP leads from a feeding position P**0** of the sheets P from the sheet cassette CA via a transfer position P**1** and a fixing position P**2** to a discharge tray ET.

[0015] In a print job, a sheet S in the sheet cassette CA is fed from the feeding position P**0** to the main conveying passage MP. The image forming apparatus **100** conveys the sheet S along the main conveying passage MP. Then, the image forming apparatus **100** prints an image on the sheet S being conveyed. In other words, the image forming apparatus **100** transfers a toner image to the sheet S being conveyed. At the transfer position P**1**, a toner image is transferred to the sheet S being conveyed.

[0016] The image forming apparatus **100** includes image forming portions **1** for four colors, namely cyan, magenta, yellow and black. Each image forming portion **1** forms a toner image of the corresponding color. Hereinafter, their structure will be described with focus on one image forming portion **1**. The image forming portions **1** have basically similar structures; thus, for the structure of the other developing devices **2**, reference is to be made to the following description and no overlapping description will be repeated.

[0017] As shown in FIG. **2**, the image forming portion **1** includes a developing device **2**. The image forming portion **1** includes, in addition to the developing device **2**, a photosensitive drum **11**, a charging device **12**, an exposure device **13**, and a cleaning device **14**. The photosensitive drum **11** corresponds to an "image carrying member".

[0018] During image formation by the image forming portion **1**, the photosensitive drum **11** rotates. In FIG. **2**, the photosensitive drum **11** rotates clockwise. The charging device **12** electrostatically charges the outer circumferential face of the photosensitive drum **11**. The exposure device **13** exposes to light the outer circumferential face of the photosensitive drum **11** to form on it an electrostatic latent image. Then, the developing device **2** feeds toner to the outer circumferential face of the photosensitive drum **11** to develop the electrostatic latent image into a toner image. The toner image on the outer circumferential face of the photosensitive drum **11** is primarily transferred to an intermediate transfer belt **3**, which will be described later. The cleaning device **14** removes toner that remains on the outer circumferential face of the photosensitive drum **11** without being transferred to the intermediate transfer belt **3**.

[0019] As shown in FIG. **1**, the image forming apparatus **100** includes an intermediate transfer belt **3**. The intermediate transfer belt **3** is an endless belt. The intermediate transfer belt **3** is stretched around and rotatably supported by a plurality of rollers **30**. The intermediate transfer belt **3** makes contact with the outer circumferential face of the photosensitive drum **11** and, in that state, rotates (turns around) in the direction indicated by arrow D**1** in the diagram.

[0020] The plurality of rollers **30** include a driving roller **301**. One of the plurality of rollers **30** is the driving roller **301**. The driving roller **301** is coupled to a belt motor (not shown) and rotates by receiving a driving force from the belt motor. The intermediate transfer belt **3**, as the driving roller **301** rotates, rotates by following it. The other rollers **30** rotate by following the intermediate transfer belt **3**.

[0021] The image forming apparatus **100** includes a primary transfer roller **31**. The primary transfer roller **31** is provided one for each of the colors of cyan, magenta, yellow, and black. That is, a plurality of (four) primary transfer rollers **31** are provided. Each primary transfer roller **31** is arranged in a region inside the inner circumference of the intermediate transfer belt **3**. Each primary transfer roller **31** is arranged, across the intermediate transfer belt **3**, opposite the photosensitive drum **11** of the corresponding color.

[0022] The image forming apparatus **100** includes a secondary transfer roller **32**. The secondary transfer roller **32** is in pressed contact with the outer circumferential face of the intermediate transfer belt **3** at the transfer position P**1**. The secondary transfer roller **32** holds the intermediate transfer belt **3** against the driving roller **301** to form a transfer nip with the intermediate transfer belt **3**. At the transfer position P**1**, the transfer nip is formed. The main conveying passage MP passes across the transfer nip.

[0023] In a print job, a sheet S is conveyed toward the transfer position P**1** (that is, the transfer nip). The sheet S being conveyed passes through the transfer nip. That is, the intermediate transfer belt **3** makes contact with the sheet S being conveyed at a position downstream of the contact positions with the photosensitive drums **11** in the rotation direction of the intermediate transfer belt **3**.

[0024] Each of the image forming portions **1** forms a toner image of the corresponding color. Each of the primary transfer rollers **31** primarily transfers the toner image to the outer circumferential face of the intermediate transfer belt **3**. That is, the intermediate transfer belt **3** has toner images primarily transferred from the photosensitive drums **11**.

[0025] The intermediate transfer belt **3** rotates while carrying on its outer circumferential face the toner images primarily transferred from the photosensitive drums **11**. When the sheet S passes through the transfer nip, the sheet S makes contact with the outer circumferential face of the intermediate transfer belt **3**. The secondary transfer roller **32** is fed with a transfer voltage from a transfer voltage power supply (not shown). The secondary transfer roller **32** forms a transferring electric field between it and the intermediate transfer belt **3** and thereby secondarily transfers the toner images to a sheet S passing through the transfer nip.

[0026] The image forming apparatus **100** includes a cleaning portion **4**. The cleaning portion **4** is arranged so as to face the outer circumferential face of the intermediate transfer belt **3**. The cleaning portion **4** is arranged downstream of the transfer position P**1** in the rotation direction of the intermediate transfer belt **3**. The cleaning portion **4** cleans the outer circumferential face of the intermediate transfer belt **3**. Specifically, the cleaning portion **4** has a blade (not shown) that makes contact with the outer circumferential face of the intermediate transfer belt **3**. The blade of the cleaning portion **4** removes toner that remains, without being transferred to the intermediate transfer belt **3**, on the outer circumferential face of the intermediate transfer belt **3**.

[0027] The image forming apparatus **100** also includes a fixing portion **10**. The fixing portion **10** includes a heating roller and a pressing roller. The fixing portion **10** is arranged at the fixing position P**2**. The heating roller incorporates a heater. The pressing roller is kept in pressed contact with the heating roller. The heating roller and the pressing roller are kept in pressed contact with each other to form a fixing nip at the fixing position P**2**.

[0028] In a print job, a sheet S having a toner image transferred to it passes across the fixing position P**2**. That is, the sheet S is held at the fixing nip between the heating roller and the pressing roller. The fixing portion **10** heats the sheet S passing across the fixing position P**2**. At the fixing position P**2**, the sheet S is pressed. The fixing portion **10** heats and presses the sheet S having the toner image transferred to it to fix the toner image to the sheet S. After fixing, the sheet S is discharged onto the discharge tray ET.

[0029] The image forming apparatus **100** includes, although not identified by any reference sign, a conveying portion. The conveying portion includes a pair of conveying rollers. The pair of conveying rollers includes a pair of rollers. The pair of rollers has a conveying nip between them. The pair of conveying rollers rotates to convey a sheet S that has entered the conveying nip. The conveying portion conveys the sheet S along the main conveying passage MP. The conveying portion conveys the sheet S along a duplex printing conveying passage DP, which will be described later.

[0030] As a print job, the image forming apparatus **100** can perform, in addition to a simplex print job in which a toner image is printed only on one side of the sheet S, a duplex print job in which a toner image is printed on each side of the sheet S. For a duplex print job, the image forming apparatus **100** includes the duplex printing conveying passage DP.

[0031] The duplex printing conveying passage DP branches from the main conveying passage MP at a branch position P**3** on it downstream of the fixing position P**2** in the sheet conveying direction. Then, the duplex printing conveying passage DP joins the main conveying passage MP at a merge position P**4** on it upstream of the transfer position P**1** in the sheet conveying direction.

[0032] When a job to be executed is a simplex print job, a sheet S passes through the transfer nip only once, and transfer is performed once on the sheet S that is passing through the transfer nip. After first-time fixing, the sheet S is directly discharged onto the discharge tray ET.

[0033] When a job to be executed is a duplex print job, transfer is performed once on each of the obverse and reverse sides of a sheet S; thus, the sheet S passes through the transfer nip twice. Specifically, when the sheet S passes through the transfer nip for the first time, transfer is performed to one side of the sheet S. Subsequently to first-time transfer, after the rear end of the sheet S passes across the branch position P3, before the sheet S is completely discharged onto the discharge tray ET, the sheet S is switched back to be drawn, from its rear end, into the duplex printing conveying passage DP.

[0034] Then, the sheet S is conveyed along the duplex printing conveying passage DP. The sheet S in the duplex printing conveying passage DP is conveyed, at the merge position P4, back to the main conveying passage MP. The sheet S having been conveyed back to the main conveying passage MP is conveyed along the main conveying passage MP and passes through the transfer nip again. Here, the sheet S has its obverse and reverse sides reversed compared to when it passed through the transfer nip last time. Thus, when the sheet S passes through the transfer nip for the second time, transfer is performed on the other side, that is, the reverse side, of the sheet S.

[0035] The image forming apparatus **100** includes a control portion **6**. The control portion **6** includes processing circuits such as a CPU and an ASIC. The control portion **6** includes storage devices such as a ROM and a RAM. The control portion **6** controls print jobs performed on the image forming apparatus **100**.

[0036] <Structure of a Developing Device>

[0037] Now, with reference to FIGS. **2** to **5**, the structure of the developing devices **2** will be described with focus on one of them. The developing devices **2** have basically similar structures; thus, for the structure of the other developing devices **2**, reference is to be made to the following description and no overlapping description will be repeated.

[0038] As shown in FIG. **2**, the developing device **2** is arranged so as to face the outer circumferential face of the photosensitive drum **11**. Specifically, the developing device **2** is arranged such that the outer circumferential face of a developing roller **20**, which will be described later, faces the outer circumferential face of the photosensitive drum **11**. In other words, the developing roller **20**, described later, is arranged adjacent to the photosensitive drum **11**. The developing device **2** may be removably mounted in the main body of the image forming apparatus **100**.

[0039] The developing device **2** is structured as shown in FIGS. **3** and **4**. The developing device **2** includes a developing roller **20**. The developing device **2** also includes a developer container **200**. The developer container **200** stores developer containing toner. In other words, the developer container **200** stores toner to be fed to the photosensitive drum **11**. The developer stored in the developer container **200** is, for example, magnetic one-component developer containing magnetic toner.

[0040] The developing roller **20** is arranged inside the developer container **200**. The developer container **200** has an opening **200**A at a position facing the photosensitive drum **11**. The developing roller **20** has part of its outer circumferential face exposed out of the developer container **200** through the opening **200**A. The developing roller **20** carries toner on its outer circumferential face to feed it to the outer circumferential face of the photosensitive drum **11**. The developing roller **20** corresponds to a "developer carrying member".

[0041] The developer container **200** extends in the direction parallel to the axis of the photosensitive drum **11** (that is, the rotary shaft of the photosensitive drum **11**). That is, the developer container **200** is a container of which the longitudinal direction coincides with the direction parallel to the axis of the photosensitive drum **11**. The developer container **200** is arranged such that its longitudinal direction coincides with the horizontal direction.

[0042] The developer container **200** has a first stirring chamber **201** and a second stirring chamber **202**. The first and second stirring chambers **201** and **202** are separated by a partition portion **203**. The developer container **200** includes a first communication portion C**1** and a second communication portion C**2**.

[0043] The first and second conveying chambers **201** and **202** are provided inside the developer container **200**. The partition portion **203** is disposed inside the developer container **200** generally upright from a bottom part of it and extends in the direction parallel to the axis of the photosensitive drum **11**. That is, the partition portion **203** partitions the inside of the developer container **200** in the direction perpendicular to the axial direction of the photosensitive drum **11**. Of the inside of the developer container **200**, the part on one side of the partition portion **203** in the direction perpendicular to the axial direction of the photosensitive drum **11** constitutes the first stirring chamber **201**, and the part on the other side of the partition portion **203** in the direction perpendicular to the axial direction of the photosensitive drum **11** constitutes the second stirring chamber **202**.

[0044] The first stirring chamber **201** is connected to a developer supply pipe (not shown). The first stirring chamber **201** is supplied with developer via the developer supply pipe.

[0045] In the first stirring chamber **201**, a first stirring screw **2011** is arranged. In the second stirring chamber **202**, a second stirring screw **2021** is arranged. The first and second stirring screws **2011** and **2021** are each structured such that a blade is wound in a helical shape around its rotary shaft that extends parallel to the axis of the photosensitive drum **11**. The first stirring screw **2011** rotates to convey developer while stirring it in a first direction f**1** (see FIG. **3**). The second stirring screw **2021** rotates and thereby conveys developer while stirring it in a second direction f**2** (see FIG. **3**). In FIG. **3**, the developer conveying directions in the first and second conveying chambers **201** and **202** are indicated by hollow arrows.

[0046] The first communication portion C**1** is provided at the downstream end in the first direction f**1** (that is, the upstream end in the second direction f**2**), and the second communication portion C**2** is provided at the downstream end in the second direction f**2** (that is, the upstream end in the first direction f**1**). Through the first communication portion C**1**, the downstream end of the first stirring chamber **201** in the first direction f**1** and the upstream end of the second stirring chamber **202** in the second direction f**2** communicate with each other. Through the second communication portion C**2**, the downstream end of the second stirring chamber **202** in the second direction f**2** and the upstream end of the first stirring chamber **201** in the first direction f**1** communicate with each other. Through the first communication portion C**1**, developer is conveyed from the first stirring chamber **201** toward the second stirring chamber **202**. Through the second communication portion C**2**, developer is conveyed from the second stirring chamber **202** toward the first stirring chamber **201**.

[0047] The developing roller **20** is arranged inside the developer container **200**, at a position opposite the photosensitive drum **11**. The developer container **200** has an opening **200**A at a position where the developing roller **20** faces the photosensitive drum **11**. Thus, no part of the side wall forming the developer container **200** lies between the developing roller **20** and the photosensitive drum **11**.

[0048] The developing roller **20** is arranged inside the developer container **200**, above the second stirring screw **2021**. Although the developing roller **20** is arranged inside the developer container **200**, part of it is exposed out of the developer container **200** through the opening **200**A. The part of the outer circumferential face of the developing roller **20** that is exposed out of the developer container **200** faces the outer circumferential face of the photosensitive drum **11**.

[0049] The developing roller **20**, in its area facing the photosensitive drum **11**, holds toner on its outer circumferential face to feed it to the photosensitive drum **11**. The toner in the second stirring chamber **202** in the developer container **200** is fed from the developing roller **20** to the photosensitive drum **11**. The toner fed to the photosensitive drum **11** attaches to an electrostatic latent image on the outer circumferential face of the photosensitive drum **11**, and the electrostatic latent image is developed into a toner image.

[0050] The developing roller **20** is rotatably supported. Specifically, the developing roller **20** is supported such that its outer circumferential face rotates about an axis that extends parallel to the axis of the photosensitive drum **11**. In FIGS. **2** and **4**, the developing roller **20** rotates counterclockwise.

[0051] The developing roller **20** is arranged inside the developer container **200** such that its axis is parallel to the axis of the photosensitive drum **11**. The developing roller **20** includes a shaft **21**, a sleeve **22**, and a magnet **23**. FIG. **5** is a sectional view of the developing roller **20** cut along a plane including its axis. FIG. **5** is a diagram schematically showing the sectional structure of the developing roller **20**, and its shape, dimension, etc. as shown there do not reflect the actual structure.

[0052] The shaft **21** extends parallel to the axis of the photosensitive drum **11**. That is, the developer container **200** is formed such that its longitudinal direction coincides with the direction parallel to the axis of the shaft **21**.

[0053] The sleeve **22** is formed in a cylindrical shape that extends along the axis of the shaft **21**. The shaft **21** is inserted in the sleeve **22**. The sleeve **22** is supported so as to be rotatable about the shaft **21**, about its axis. For example, at each of the opposite ends of the shaft **21** in the axial direction, a flange FL that is rotatable on the shaft **21** is arranged. The flange FL rotates by receiving a driving force from an unillustrated motor. The sleeve **22** is fixed to the flange FL and rotates together with it.

[0054] The sleeve **22** has an outer circumferential face that faces the photosensitive drum **11**. That is, the outer circumferential face of the sleeve **22** constitutes the outer circumferential face of the developing roller **20**. The sleeve **22** rotates while carrying toner on its outer circumferential face and feeds the toner to the photosensitive drum **11**.

[0055] The magnet **23** is arranged inside the sleeve **22**. The magnet **23** is fixed to the circumferential face of the shaft **21** and extends along the axis of the shaft **21**. The magnet **23** has a plurality of magnetic poles in the circumferential direction of the shaft **21**. With the magnetic force of the magnet **23**, toner is held on the outer circumferential face of the developing roller **20** (that is, the outer circumferential face of the sleeve **22**), and a magnetic brush is formed on the outer circumferential face of the developing roller **20**.

[0056] The developing device **2** includes a regulating blade **210**. The regulating blade **210** is arranged upstream of a region where the developing roller **20** and the photosensitive drum **11** face each other in the rotation direction of the developing roller **20**. The regulating blade **210** extends over the entire region of the developing roller **20** in the axial direction of the developing roller **20** (that is, in the axial direction of the shaft **21**).

[0057] The regulating blade **210** is arranged such that a tip end part of it lies close to the outer circumferential face of the developing roller **20** (that is, the outer circumferential face of the sleeve **22**). The tip end part of the regulating blade **210** faces the outer circumferential face of the developing roller **20** across a predetermined distance.

[0058] As the first and second stirring screws **2011** and **2021** rotate, the developer stored in the developer container **200** circulates between the first and second stirring chambers **201** and **202** through the first and second communication portions **C1** and **C2**. Meanwhile, the developer in the developer container **200** is, by being stirred, electrostatically charged and held on the outer circumferential face of the developing roller **20** to form a magnetic brush. As the magnetic brush passes between the outer circumferential face of the developing roller **20** and the regulating blade **210**, it is regulated to have a predetermined layer thickness.

[0059] Then, as the developing roller **20** rotates, the magnetic brush is conveyed to a region where the developing roller **20** and the photosensitive drum **11** face each other. Here, the developing roller **20** is fed with a predetermined developing voltage. This produces a potential difference between the developing roller **20** and the photosensitive drum **11**, and the toner in the magnetic brush is supplied to the photosensitive drum **11**.

[0060] <Toner Collection Mechanism Around the Developing Roller>

[0061] Now, with reference to FIGS. **4** and **5**, a toner collection mechanism for collecting scattered toner around the developing roller **20** will be described. The toner collection mechanisms in the developing devices **2** have basically similar structures. Thus, hereinafter, their structures will be described with focus on the toner collection mechanism in one developing device **2**. For the toner collection mechanisms in the other developing devices **2**, reference is to be made to the following description and no overlapping description will be repeated.

[0062] The developer container **200** includes a duct **220**, an intake port **221**, and an exhaust port **222**. The developer container **200** also includes a first filter **231** and a second filter **232**.

[0063] The duct **220** lets the air in the developer container **200** flow out of it. In FIG. **4**, the air circulation direction in the duct **220** is indicated by hollow arrows.

[0064] The duct **220** is arranged adjacent to the second stirring chamber **202**. The duct **220** faces the photosensitive drum **11** across the region in the developer container **200** where the developing roller **20** is arranged, in a direction intersecting the longitudinal direction of the developer container **200** (that is, the axial direction of the developing roller

20). The duct **220** is connected to inside the developer container **200**. Specifically, the duct **220** is connected to the second stirring chamber **202**. The duct **220** lets the air in the second stirring chamber **202** flow out of it.

[0065] The intake port **221** is an opening through which the inside of the developer container **200** (that is, the inside of the second stirring chamber **202**) and the inside of the duct **220** communicate with each other and that is located at the upstream end of the duct **220** in the air circulation direction. The intake port **221** is formed in an upper part of the second stirring chamber **202** so as to be open above the developing roller **20**. That is, the intake port **221** faces the developing roller **20**. Through the intake port **221**, the air in the developer container **200** flows into the duct **220**.

[0066] The intake port **221** is formed in a rectangular shape of which the longitudinal direction coincides with the direction parallel to the axis of the developing roller **20** (that is, the direction parallel to the axis of the shaft **21**). Here, the width of the intake port **221** in the longitudinal direction is smaller than that of the magnet **23** in the longitudinal direction (that is, in the axial direction of the shaft **21**). That is, the inner edge of the intake port **221** at one side in the longitudinal direction is located inward of the edge of the magnet **23** at the same side (closer to the middle of the magnet **23** in the longitudinal direction), and the inner edge of the intake port **221** at the other side in the longitudinal direction is located inward of the edge of the magnet **23** at the same side.

[0067] The exhaust port **222** is arranged, for example, in a rear part of the developer container **200**. The exhaust port **222** allows the inside and the outside of the duct **220** to communicate with each other. The air in the duct **220** flows out of it through the exhaust port **222**.

[0068] Although not illustrated, the exhaust port **222** may be connected to any other exhaust path provided in the main body of the image forming apparatus **100**. Furthermore, such another exhaust path may be connected to an exhaust fan. Then, driving the exhaust fan permits the air sucked into the developer container **200** to be forcibly discharged outside through the duct **220**.

[0069] The first filter **231** is arranged in the intake port **221**. The first filter **231** collects developer contained in the air that flows out of the developer container **200** into the duct **220**.

[0070] The first filter **231** covers the entire region of the intake port **221** with no gap as seen from a direction in which the intake port **221** is open. The first filter **231** has an outline that substantially coincides with the shape of the opening of the intake port **221** so as to cover the entire region of the intake port **221**. That is, the first filter **231** is formed in a rectangular shape of which the longitudinal direction coincides with the direction parallel to the axis of the developing roller **20** (that is, the direction parallel to the axis of the shaft **21**).

[0071] For example, the first filter **231** is made of a non-woven fabric and is formed by needle punching. The non-woven fabric that forms the first filter **231** is made of fibers having a round section with a fiber diameter of 10 μm to 20 μm. The non-woven fabric that forms the first filter **231** has a thickness of about 1 mm.

[0072] The second filter **232** is arranged in the duct **220**. That is, the second filter **232** is arranged downstream of the first filter **231** in the air circulation direction in the duct **220**. The second filter **232** collects developer contained in the air that has passed through the first filter **231**.

[0073] The second filter **232** has an outline that substantially coincides with the shape of the opening in a direction intersecting the air circulation direction in the duct **220**. Thus, the air circulation path in the duct **220** is blocked by the second filter **232**.

[0074] For example, the second filter **232** is made of a non-woven fabric and is formed by spun-bonding. The non-woven fabric that forms the second filter **232** is made of fibers having a round section with a fiber diameter of 20 μm to 40 μm. The non-woven fabric that forms the second filter **232** has a thickness of about 0.2 mm.

[0075] The second filter **232** has a finer mesh than the first filter **231**. In other words, the second filter **232** has developer collecting efficiency than the first filter **231**. In yet other words, a filter with lower developer collecting efficiency than the second filter **232** is used as the first filter **231**. In this way, it is possible to prevent the first filter **231** from collecting a large amount of developer, and this helps suppress clogging in the first filter **231**. Even if the first filter **231** has low developer collecting efficiency, arranging the second filter **232** downstream of the first filter **231** in the air circulation direction helps prevent the developer from leaking out of the developer container **200**.

[0076] The developer container **200** includes a blocking member **240**. The blocking member **240** is a film-form member. The blocking member **240** is formed of a PET plate made from PET resin (polyethylene terephthalate). The blocking member **240** is formed in a rectangular shape of which the longitudinal direction coincides with the direction parallel to the axis of the developing roller **20** (that is, the direction parallel to the axis of the shaft **21**).

[0077] The blocking member **240** blocks the air circulation path in the developer container **200** leading from the second stirring chamber **202** via the space between the inner wall of the developer container **200** and the outer circumferential face of the developing roller **20** (that is, the outer circumferential face of the sleeve **22**) to the intake port **221**. The blocking member **240** blocks circulation of air flowing from the position in the second stirring chamber **202** where the second stirring screw **2021** is provided via the space between the inner wall of the developer container **200** and the outer circumferential face of the developing roller **20** toward the intake port **221**.

[0078] The blocking member **240** is fitted to the inner wall of the developer container **200**. The blocking member **240** keeps its tip end opposite from its tip end fitted to the inner wall of the developer container **200** in contact with the outer circumferential face of the developing roller **20** (that is, the outer circumferential face of the sleeve **22**). In this way, the blocking member **240** blocks the air circulation path leading via the space between the inner wall of the developer container **200** and the outer circumferential face of the developing roller **20** to the intake port **221**.

[0079] With the blocking member **240**, the air circulation path leading from the inside of the developer container **200** (specifically, the second stirring chamber **202**) to the intake port **221** is blocked. As a result, it is possible to prevent the developer in the second stirring chamber **202** from being sucked in unnecessarily through the intake port **221**.

[0080] Here, the developing device **2** includes a vibration generator **250**. For example, the vibration generator **250** includes, although not illustrated, a vibration motor, a control circuit board, and the like. The vibration generator **250** is arranged adjacent to the rear face of the developer container **200**.

[0081] The vibration generator **250** vibrates at least the first filter **231**. For example, the vibration generator **250** vibrates both the first and second filters **231** and **232**. That is, the vibration generator **250** is connected to both the first and second filters **231** and **232**.

[0082] With the vibration generator **250** in the developing device **2**, by vibrating the first filter **231**, it is possible to drop the developer attached to the first filter **231** off from it. That is, it is possible to suppress clogging in the first filter **231**. Likewise, by vibrating the second filter **232**, it is also possible to suppress clogging in the second filter **232**.

[0083] For example, the developer container **200** includes a holding member **230**. The holding member **230** holds the first and second filters **231** and **232**. The vibration generator **250** is connected to the holding member **230**. That is, the vibration generator **250** vibrates the holding member **230**. In this way, it is possible to vibrate both the first and second filters **231** and **232**.

[0084] <Position where a First Filter is Arranged>

[0085] The position where the first filter **231** is arranged will be described below with reference to FIG. **5**. The position where the first filter **231** is arranged is determined based on the positional relationship between the developing roller **20** and the magnet **23**.

[0086] In the following description, the farthest edge of the first filter **231** at one side in the longitudinal direction is identified by the reference sign **2311** and referred to as a first edge **2311**, and the farthest edge of the first filter **231** at the other side in the longitudinal direction is identified by the reference sign **2312** and referred to as a second edge **2312**. The longitudinal direction of the first filter **231** corresponds to the axial direction of the developing roller **20** and is parallel to the axis of the developing roller **20** (that is, the direction parallel to the axis of the shaft **21**). The magnet **23** extends along the axis of the shaft **21**. Thus, the longitudinal direction of the magnet **23** is the direction parallel to the axis of the developing roller **20** (that is, the direction parallel to the axis of the shaft **21**).

[0087] In the following description, the width of the first filter **231** in the longitudinal direction (that is, the width from the first edge **2311** to the second edge **2312**) is referred to as a width W**1**. The width of the magnet **23** in the longitudinal direction is referred to as a width W**2**.

[0088] The width W**1** of the first filter **231** is equal to or smaller than the width W**2** of the magnet **23**. The width W**1** of the first filter **231** may be smaller than the width W**2** of the magnet **23** or be equal to the width W**2** of the magnet **23**. In FIG. **5**, the width W**1** of the first filter **231** is illustrated to be smaller than the width W**2** of the magnet **23**.

[0089] Here, the first and second edges **2311** and **2312** are both located within a range opposite the magnet **23** as seen from the direction perpendicular to the axial direction of the developing roller **20** (that is, the direction parallel to the axial direction of the shaft **21**). As viewed from the direction perpendicular to the axial direction of the developing roller **20**, the sleeve **22** is present between the first filter **231** and the magnet **23**. That is, the first filter **231** faces the magnet **23** across the sleeve **22** over the entire region as seen from the direction perpendicular to the axial direction of the developing roller **20**.

[0090] In other words, the first edge **2311**, which is the edge of the first filter **231** at one side in the longitudinal direction, does not project beyond the edge of the magnet **23** at one side (the same side) in the longitudinal direction toward the one side (out ward) in the longitudinal direction. The second edge **2312**, which is the edge of the first filter **231** at the other side in the longitudinal direction, does not project beyond the edge of the magnet **23** at the other side (the same side) in the longitudinal direction toward the other side (outward) in the longitudinal direction.

[0091] For example, as shown in FIG. **5**, when the width W**1** of the first filter **231** is smaller than the width W**2** of the magnet **23**, the first edge **2311** can be set inward of the edge of the magnet **23** at the same side and the second edge **2312** can be set inward of the edge of the magnet **23** at the same side. Although not illustrated, it is also possible to set one of the first and second edges **2311** and **2312** inward of the edge of the magnet **23** at the same side and the other at a position coinciding with the edge of the magnet **23** at the same side.

[0092] Although not illustrated, when the width W**1** of the first filter **231** is equal to the width W**2** of the magnet **23**, the first edge **2311** can be set at a position coinciding with the edge of the magnet **23** at the same side and the second edge **2312** can be set at a position coinciding with the edge of the magnet **23** at the same side.

[0093] With the configuration according to the embodiment, when the developer attached to the first filter **231** drops from the first filter **231**, it is possible to prevent the developer from scattering out of the developer container **200**. Specifically, on the sleeve **22** of the developing roller **20**, in a range opposite the magnet **23**, a magnetic brush is formed. Thus, when the first and second edges **2311** and **2312** of the first filter **231** are located, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**, that means that the first and second edges **2311** and **2312** are both located within the range opposite the magnetic brush. In other words, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, the entire region of the first filter **231** faces the magnetic brush.

[0094] Since the first filter **231** is located above the developing roller **20** and the magnetic brush is formed below the first filter, the developer that drops from the first filter **231** heads toward the magnetic brush. When the developer drops from the first filter **231**, it is absorbed into the magnetic brush. When, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, the first and second edges **2311** and **2312** of the first filter **231** are both located within the range opposite the magnet **23**, less developer is left unabsorbed into the magnetic brush, and this helps prevent the developer from scattering out of the developer container **200**. In particular, it is possible to suppress scattering of the developer out of the developer container **200** at opposite ends of the developer container **200** in the longitudinal direction. As a result, it is possible to prevent the inside of the image forming apparatus **100** from being soiled with the developer that scatters out of the developer container **200**.

[0095] Hereinafter, a description will be given of tests performed to confirm the effect described above. The results of the tests are shown in FIG. **6**.

[0096] In the confirmation-tests, as the first filter **231**, a non-woven fabric made of fibers having a round section with a fiber diameter of 10 μm to 20 μm was used. As the second filter **232**, a non-woven fabric made of fibers having a round section with a fiber diameter of 20 μm to 40 μm was used.

[0097] In the confirmation-tests, a developing roller **20** including a magnet **23** having a width W**2** of 332 mm in the longitudinal direction was used. Furthermore, in the confirming test, the width W**1** of the first filter **231** in the longitudinal direction was varied within the range of 156 mm to 372 mm, and the width (marked as W**3** in FIG. **6**) of the first filter **231** in the lateral direction was varied within the range of 5 mm to 20 mm. That is, in the confirmation-tests, a plurality of types of first filters **231** with different sizes (shapes) were used. The sizes (shapes of the opening) of the intake port **221** in the longitudinal and lateral directions were adapted to the size of the first filter **231** used.

[0098] In the confirmation-tests, with a plurality of types of structures varying in the size of the first filter **231** (the size of the intake port **221**), printing at a printing rate of 20% was performed on 600,000 sheets; thereafter, how developer scattered out of the developer container **200** was visually checked.

[0099] In the confirmation-tests, as shown in FIG. **6**. Test **1** to **21** were performed. The size of the first filter **231** varied among tests. In the confirmation-tests, the first filter **231** was vibrated at various timings. Specifically, in Test **1** to **4**, the first filter **231** was not vibrated. In Tests **5** to **17**, the first filter **231** was vibrated every time 4000 sheets were printed. In Tests **18** to **21**, the first filter **231** was vibrated every time 1000 sheets were printed.

[0100] In the confirmation-tests, soiling with scattered developer in an upper part of the developer container **200** (hereinafter, referred to as upper part scattering, and, in FIG. **6**, marked simply as UPPER PART) was visually checked, and soiling with scattered developer in end parts of the developer container **200** in the longitudinal direction (hereinafter, referred to as end part scattering, and, in FIG. **6**, marked simply as END PART) was visually checked. For UPPER PART SCATTERING in FIG. **6**, when substantially no soiling with scattered developer occurred, it was evaluated as "NO", when slight soiling with scattered developer occurred, it was evaluated as "SLIGHT", and when evident soiling with scattered developer occurred, it was evaluated as "YES". For END PART SCATTERING in FIG. **6**, when substantially no soiling with scattered developer occurred, it was evaluated as "NO", and when evident soiling with scattered developer occurred, it was evaluated as "YES".

[0101] In Tests **1** to **4**, regardless of the size of the first filter **231**, soiling with scattered developer occurred in an upper part of the developer container **200**. In Tests **1** to **4**, the first filter **231** was not vibrated. By contrast, in Test **5** to **21**, the first filter **231** was vibrated. When the first filter **231** was vibrated, soiling did occasionally occur, but in a comparatively suppressed manner. The soiling in Test **1** to **4** is considered to have occurred because the developer attached to the first filter **231** remained and clogged the first filter **231**. These results confirm that vibrating the first filter **231** drops the developer attached to the first filter **231** off from it and this helps suppress clogging in the first filter **231**.

[0102] In Tests **5** and **6**, the first and second edges **2311** and **2312** were arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**. Specifically, with respect to the width W**2** (=332 mm) of the magnet **23** in the longitudinal direction, the width W**1** of the first filter **231** in the longitudinal direction was set to 312 mm in Test **5** and to 332 mm in Test **6**.

[0103] By contrast, in Test **7** and **8**, at least one of the first and second edges **2311** and **2312** was not arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**. Specifically, the width W**1** of the first filter **231** in the longitudinal direction was set to 352 mm in Test **7** and to 372 mm in Test **8**.

[0104] In Tests **5** and **6**, no soiling by upper part scattering occurred. Furthermore, in Test **5** and **6**, no soiling by end part scattering occurred. By contrast, in Test **7** and **8**, although no soiling by upper part scattering occurred, soiling by end part scattering occurred. In Tests **5** to **8**, the first filter **231** vibrated at an equal frequency. In all of Test **5** to **8**, the width of the first filters **231** in the lateral direction was equal, specifically 20 mm.

[0105] These results confirm that arranging the first and second edges **2311** and **2312** within the range opposite the magnet **23** as viewed from the direction perpendicular to the axial direction of the developing roller **20** helps prevent developer from scattering out of the developer container **200** at opposite ends of the developer container **200** in the longitudinal direction. That is, it can be understood that more of the developer that has dropped from the first filter **231** was absorbed into the magnetic brush in Tests **5** and **6** than in Tests **7** and **8**.

[0106] In Test **9**, as in Test **5** and **6**, the first filter **231** was vibrated every time 4000 sheets were printed. The width of the first filter **231** in the lateral direction was set to 20 mm. By contrast, in Test **9**, the width W**1** of the first filter **231** in the longitudinal direction was reduced to 156 mm.

[0107] In Test **9**, slight soiling by upper part scattering occurred, and, in this regard, the result was poorer than in Test **5** and **6**. This is considered to be because the filter area of the first filter **231** (that is, the area of the intake port **221**) was too small to eliminate clogging with vibration at the same frequency as in other tests. However, in Test **9**, as in Test **5** and **6**, no soiling by end part scattering occurred. This confirms that, even if the width W**1** of the first filter **231** in the longitudinal direction (that is, the width of the intake port **221** in the longitudinal direction) is comparatively small, the expected effect can still be obtained.

[0108] However, reducing the width W**1** of the first filter **231** in the longitudinal direction means reducing the filter area of the first filter **231**. That is, the smaller the width W**1** of the first filter **231** in the longitudinal direction, the more likely clogging occurs. Even so, by increasing the frequency of vibration in the first filter **231**, it is possible to suppress clogging in the first filter **231**.

[0109] For example, the result of Test **9** reveals the following: when the width W**1** of the first filter **231** in the longitudinal direction is 156 mm, vibrating the first filter **231** every time 4000 sheets are printed helps suppress clogging in the first filter **231**. Thus, it can be understood that, when the width W**1** of the first filter **231** in the longitudinal direction is 110 mm (that is, about one third of the width of the magnet **23** in the longitudinal direction), changing the frequency of vibration of the first filter **231** to every 2000 to 3000 printed sheets helps suppress clogging in the first filter **231**.

[0110] Thus, it is preferable that the width W**1** of the first filter **231** in the longitudinal direction be equal to or longer than one third of the width of the magnet **23** in the longitudinal direction. If the width W**1** of the first filter **231** in the longitudinal direction is smaller than one third of the width of the magnet **23** in the longitudinal direction, inconveniently, vibration needs to be performed frequently to suppress clogging. Thus, it is impractical to make the width W**1** of the first filter **231** in the longitudinal direction too small.

[0111] In Tests **10** to **13**, the width of the first filter **231** in the lateral direction was smaller than in Tests **1** to **9**. While, in Tests **1** to **9**, the width of the first filter **231** in the lateral direction was 20 mm, in Tests **10** to **13**, the width of the first filter **231** in the lateral direction was 10 mm.

[0112] In Tests **10** and **11**, the width W**1** of the first filter **231** in the longitudinal direction was 312 mm to 332 mm, and the first and second edges **2311** and **2312** were arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**. In Tests **12** and **13**, the width W**1** of the first filter **231** in the longitudinal direction was 352 mm to 372 mm, and at least one of the first and second edges **2311** and **2312** was not arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**.

[0113] In Tests **10** to **13**, the first filter **231** was vibrated every time 4000 sheets were printed. That is, in Tests **10** to **13**, the first filter **231** was vibrated at the same frequency as in Tests **5** to **9**.

[0114] In Tests **10** to **13**, slight soiling by upper part scattering occurred. However, in Test **10** and **11**, no soiling by end part scattering occurred. By contrast, in Test **12** and **13**, soiling by end part scattering occurred. Also these results confirm that arranging the first and second edges **2311** and **2312** within the range opposite the magnet **23** as viewed from the direction perpendicular to the axial direction of the developing roller **20** helps prevent developer from scattering out of the developer container **200** at opposite ends of the developer container **200** in the longitudinal direction.

[0115] In Tests **14** to **17**, the width of the first filter **231** in the lateral direction was smaller than in Tests **10** to **13**. In Tests **14** to **17**, the width of the first filter **231** in the lateral direction was set to 5 mm.

[0116] In Tests **14** and **15**, the width W**1** of the first filter **231** in the longitudinal direction was 312 mm to 332 mm, and the first and second edges **2311** and **2312** were arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**. In Tests **16** and **17**, the width W**1** of the first filter **231** in the longitudinal direction was 352 mm to 372 mm, and at least one of the first and second edges **2311** and **2312** was not arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**.

[0117] In Tests **14** to **17**, the first filter **231** was vibrated every time 4000 sheets were printed. That is, in Tests **14** to **17**, the first filter **231** was vibrated at the same frequency as in Tests **5** to **13**.

[0118] In Tests **14** to **17**, soiling by upper part scattering occurred. From these results, it can be understood that the smaller the filter area of the first filter **231**, the more likely clogging in the first filter **231** occurs, and the more developer scatters out of the developer container **200**.

[0119] However, while, in Tests **14** and **15**, no soiling by end part scattering occurred, in Tests **16** and **17**, soiling by end part scattering occurred. These results confirm that arranging the first and second edges **2311** and **2312** within the range opposite the magnet **23** as viewed from the direction perpendicular to the axial direction of the developing roller **20** helps prevent developer from scattering out of the developer container **200** at opposite ends of the developer container **200** in the longitudinal direction.

[0120] In Tests **18** to **21**, as in Tests **14** to **17**, the width of the first filter **231** in the lateral direction was smaller than in Tests **10** to **13**. In Tests **18** to **21**, the width of the first filter **231** in the lateral direction was set to 5 mm.

[0121] In Tests **18** and **19**, the width W**1** of the first filter **231** in the longitudinal direction was 312 mm to 332 mm, and the first and second edges **2311** and **2312** were arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**. In Tests **20** and **21**, the width W**1** of the first filter **231** was 352 mm to 372 mm, and at least one of the first and second edges **2311** and **2312** was not arranged, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**.

[0122] In Tests **18** to **21**, the first filter **231** was vibrated every time 1000 sheets were printed. That is, in Tests **18** to **21**, the first filter **231** was vibrated more frequently than in Tests **5** to **17**.

[0123] In Tests **18** and **19**, neither soiling by upper part scattering nor soiling by end part scattering occurred. These results confirm that, even if the filter area of the first filter **231** is small, vibrating the first filter **231** more frequently helps suppress scattering of developer out of the developer container **200**.

[0124] In Tests **20** and **21**, soiling by upper part scattering occurred, but no soiling by end part scattering occurred. From these results, it can be understood that an effective way to suppress scattering of developer out of the developer container **200** at opposite ends of the container **200** in the longitudinal direction is to arrange the first and second edges **2311** and **2312**, as viewed from the direction perpendicular to the axial direction of the developing roller **20**, within the range opposite the magnet **23**.

[0125] The embodiments disclosed herein should be understood to be in every aspect illustrative and not restrictive. The scope of the present disclosure is not limited by the description of the embodiments given above but by the appended claims, and encompasses any modifications made within a sense and scope equivalent to those of the claims.

What is claimed is:

1. A developing device, comprising:

a developer container that stores developer containing toner, the developer container having an opening at a position facing an image carrying member; and

a developer carrying member that is arranged inside the developer container, the developer carrying member being exposed out of the developer container through the opening, the developer carrying member carrying the toner to feed the toner to the image carrying member,

wherein

the developer carrying member includes:

a shaft;

a sleeve that is supported so as to be rotatable about the shaft, the sleeve rotating while carrying the toner on an outer circumferential face thereof; and a magnet that is arranged inside the sleeve and that extends along an axis of the developer carrying member,

the developer container includes:

a duct that lets air in the developer container flow out of it;

an intake port that is open above the developer carrying member and through which an inside of the developer container and an inside of the duct communicating with each other; and

a first filter that covers the intake port, and

edges of the first filter at one side and at another side in an axial direction of the developer carrying member are both located within a range opposite the magnet as seen from a direction perpendicular to the axial direction.

2. The developing device according to claim **1**, further comprising a vibration generator that vibrates the first filter.

3. The developing device according to claim **1**, wherein

the developer container includes a second filter, and

the second filter is arranged downstream of the first filter in an air circulation direction in the duct.

4. The developing device according to claim **3**, wherein

the second filter has higher developer collecting efficiency than the first filter.

5. The developing device according to claim **1**, further comprising a blocking member that blocks an air circulation path leading via a space between an inner wall of the developer container and an outer circumferential face of the developer carrying member to the intake port,

wherein

the blocking member is fitted to the inner wall of the developer container, and

the blocking member keeps a tip end thereof opposite from a tip end thereof fitted to the inner wall of the developer container in contact with the outer circumferential face of the developer carrying member to block the air circulation path.

6. An image forming apparatus comprising the developing device according to claim **1**.

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