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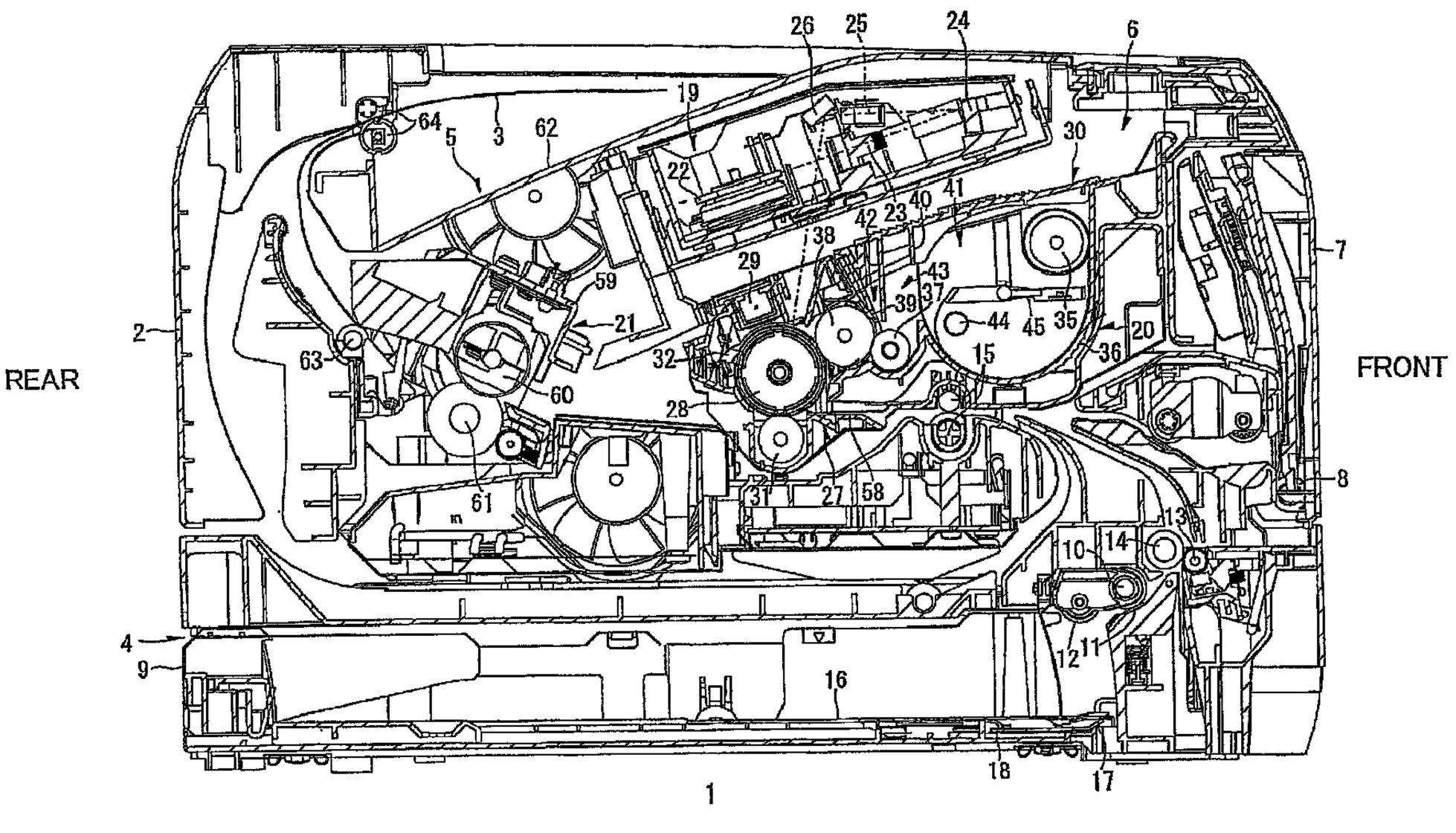
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(54) Titre : CARTOUCHE DE DEVELOPPEMENT
(54) Title: DEVELOPING CARTRIDGE



(57) Abrégé/Abstract:
In a developing cartridge, the contact plate of the electrode member is disposed to contact the developing bias terminal within a plane of projection when a driven coupling part is projected in a first direction. A first axis line, which is an axis of the developing roller shaft, and a second axis line, which is an axis of the input gear, are disposed in parallel and equidistant in the front-rear direction. A part of the contact plate is disposed on the second axis line. A first line connecting an axis about which the input gear rotates and the developing roller shaft and a second line connecting the contact plate and the developing roller shaft are disposed parallel to each other. The distance between the first axis line and the second axis line equals the distance between the first axis line and the contact plate.

ABSTRACT

In a developing cartridge, the contact plate of the electrode member is disposed to contact the developing bias terminal within a plane of projection when a driven coupling part is projected in a first direction. A first axis line, which is an axis of the developing roller shaft, and a second axis line, which is an axis of the input gear, are disposed in parallel and equidistant in the front-rear direction. A part of the contact plate is disposed on the second axis line. A first line connecting an axis about which the input gear rotates and the developing roller shaft and a second line connecting the contact plate and the developing roller shaft are disposed parallel to each other. The distance between the first axis line and the second axis line equals the distance between the first axis line and the contact plate.

DESCRIPTION

DEVELOPING CARTRIDGE

TECHNICAL FIELD

[0001] Aspects of the invention relate to a developing cartridge for use in image forming apparatuses, such as laser printers.

BACKGROUND

[0002] A developing cartridge that generally contains toner is removably installed in a main body of an image forming apparatus, such as a laser printer. The developing cartridge is provided in its case with a toner chamber configured to contain toner, an agitator rotatably disposed in the toner chamber, a supply roller configured to supply the toner, a developing roller configured to carry the toner thereon, a layer-thickness regulating blade configured to form a thin layer of toner on the developing roller.

[0003] As the developing cartridge is driven after being installed in the main body, the toner in the toner chamber is supplied to the supply roller according to the rotation of the agitator. Thereafter, the toner is supplied to the developing roller in accordance with the rotation of the supply roller. Then, the toner passes between the layer-thickness regulating blade and the developing roller in accordance with the rotation of the developing roller, and is carried on the developing roller as a think layer. A developing bias is applied to the developing roller. An electrostatic latent image formed on a photoconductive drum is developed by the toner carried on the developing roller.

[0004] The developing cartridge includes a gear mechanism configured to drive the developing roller, the supply roller, and the agitator. For example, Japanese Laid-Open Patent Publication No. 2003-295614 discloses the gear mechanism provided in one sidewall of the case of the developing cartridge. The gear mechanism in the developing cartridge includes an input gear to which the drive force is input from the main body of the image forming apparatus.

[0005] A bearing member configured to support an end of the developing roller is provided on the other sidewall of the case of the developing cartridge. The bearing member is integrally formed with a feeding member configured to apply developing bias to the developing roller.

[0006] In the developing cartridge disclosed in Japanese Laid-Open Patent Publication No. 2003-295614, a line, parallel to the developing roller shaft, passing through

the input gear provided on one sidewall and another line, parallel to the developing roller shaft, passing through the feeding member provided on the other sidewall, are disposed parallel to each other with some distance therebetween. If such rotation or torsion power is exerted on the developing cartridge that produces rotation or torsion of the developing cartridge about the input gear when drive force is input to the input gear from the main body of the image forming apparatus, the feeding member provided on the other sidewall is placed out of position, resulting in poor power supply or power feeding from the main body of the image forming apparatus.

DISCLOSURE OF THE INVENTION

[0007] Aspects provide a developing cartridge that stably feeds or supplies power to a developing roller shaft even when a drive force is directly transmitted from a drive coupling of an image forming apparatus to a driven coupling of the developing cartridge.

[0008] To achieve the above-described aspects, a developing cartridge according to the present of the invention may include a case including a first sidewall and a second sidewall opposite to the first sidewall; a developing roller disposed between the first sidewall and the second sidewall, the developing roller including a developing roller shaft configured to rotate during development and a developing roller member configured to carry a developing agent thereon, the developing roller member being provided around the developing roller shaft, the developing roller shaft rotating about a first axis line during development; an electrode disposed on the first sidewall adjacent to the developing roller shaft, the electrode being electrically connected to the developing roller member; and a driven coupling disposed on the second sidewall, the driven coupling being connected to a drive coupling of an image forming apparatus and being configured to rotate about a second axis line during development. In one aspect of the present invention, the first axis line and the second axis line may be disposed parallel to each other. At least a part of the electrode may be disposed to intersect with the second axis line.

[0009] With such a structure, when rotation or torsion power is exerted on the developing cartridge that produces rotation or torsion of the developing cartridge about the driven coupling when the drive force from the drive coupling of the image forming apparatus is directly transmitted to the driven coupling, significant influences

of the rotation or torsion power on the electrode may be prevented, because at least a part of the electrode is disposed to intersect with the second axis line. Consequently, the electrode may be prevented from being placed out of position. Thus, power may be stably supplied to the developing roller shaft.

[0010] A developing cartridge according of the present invention may include a case including a first sidewall and a second sidewall opposite to the first sidewall; a developing roller disposed between the first sidewall and the second sidewall, the developing roller including a developing roller shaft configured to rotate during development and a developing roller member configured to carry a developing agent thereon, the developing roller member being provided around the developing roller shaft, the developing roller shaft rotating about a first axis line during development; an electrode disposed on the first sidewall adjacent to the developing roller shaft, the electrode being electrically connected to the developing roller member; and a driven coupling disposed on the second sidewall, the driven coupling being connected to a drive coupling of an image forming apparatus and being configured to rotate about a second axis line during development. In one aspect, a first line extends perpendicular to the first axis line and intersects the second axis line, a second line extends perpendicular to the first axis line and intersects at least a part of the electrode and the second axis line. In a further aspect, a first distance between an intersection of the first line and the first axis line and an intersection of the first line and the second axis line may be equal to a second distance between an intersection of the second line and the first axis line and an intersection of the second line and the second axis line.

[0011] With such a structure, when rotation or torsion power is exerted on the developing cartridge that produces rotation or torsion of the developing cartridge about the driven coupling when the drive force from the drive coupling of the image forming apparatus is transmitted to the driven coupling, significant influences of the rotation or torsion power on the electrode may be prevented, because the first distance and the second distance are equal. Consequently, the electrode may be prevented from being placed out of position. Thus, power may be stably supplied to the developing roller shaft.

[0012] A developing cartridge according to another aspect of the present of the invention may include a case including a first sidewall and a second sidewall opposite to the first sidewall; a developing roller disposed between the first sidewall

and the second sidewall, the developing roller including a developing roller shaft configured to rotate during development and a developing roller member configured to carry a developing agent thereon, the developing roller member being provided around the developing roller shaft; an electrode disposed on the first sidewall adjacent to the developing roller shaft, the electrode being electrically connected to the developing roller member; and a driven coupling disposed on the second sidewall, the driven coupling being connected to a drive coupling of an image forming apparatus. When the driven coupling is projected in a direction parallel to the developing roller shaft, at least a part of the electrode may be disposed within the projection.

[0013] With the aforementioned structure, when rotation or torsion power is exerted on the developing cartridge that produces rotation or torsion of the developing cartridge about the driven coupling when the drive force from the drive coupling of the image forming apparatus is directly transmitted to the driven coupling, significant influences of the rotation or torsion power on the electrode may be prevented, because at least a part of the electrode is disposed within the projection when the driven coupling is projected in a direction parallel to the developing roller shaft. Consequently, the electrode may be prevented from being placed out of position. Thus, power may be stably supplied to the developing roller shaft

[0014] In one variant of the developing cartridge at least an end of the developing roller may be supported by at least one of the first sidewall and the second sidewall.

[0015] With such a structure, at least an end of the developing roller may be supported by at least one of the first sidewall and the second sidewall. Therefore, while the developing roller is securely supported, power may be stably supplied to the developing roller member.

[0016] In another variant of the developing cartridge, each end of the developing roller may be supported by the first sidewall and the second sidewall.

[0017] With such a structure, each end of the developing roller may be supported by the first sidewall and the second sidewall. Therefore, while the developing roller is securely supported, power may be stably supplied to the developing roller member.

[0018] In a further variant of the developing cartridge according, at least an end of the developing roller may be supported by a member disposed adjacent to at least one of the first sidewall and the second sidewall.

[0019] With such a structure, at least an end of the developing roller may be supported by a member disposed adjacent to at least one of the first sidewall and the second sidewall. Therefore, the developing roller may be assembled or secured efficiently to the adjacent member. While the developing roller is securely supported, power may be stably supplied to the developing roller member.

[0020] In a further variant of the developing cartridge, each end of the developing roller may be supported by a first member provided adjacent to the first sidewall and a second member provided adjacent to the second sidewall.

[0021] With such a structure, each end of the developing roller may be supported by the first member provided adjacent to the first sidewall and the second member provided adjacent to the second sidewall. Therefore, the developing roller may be assembled or secured efficiently to the adjacent member. While the developing roller is securely supported, power may be stably supplied to the developing roller member.

[0022] In a further variant of the developing cartridge, the electrode may be formed of metal.

[0023] With such a structure, the electrode may be formed of metal. Therefore, power can be reliably supplied to the electrode.

[0024] In a further variant of the developing cartridge, the electrode may be formed of conductive resin.

[0025] With such a structure, the electrode may be formed of conductive resin. Therefore, the electrode may be formed into any shape and power may be stably supplied to the developing roller member.

[0026] In a further variant of the developing cartridge, the developing roller shaft may include a conductive member. The electrode and the developing roller member may be electrically connected via the developing roller shaft.

[0027] With such a structure, the electrode and the developing roller member may be electrically connected via the developing roller shaft. Therefore, power can be reliably supplied from the electrode to the developing roller member.

[0028] In a further variant of the developing cartridge, the developing roller shaft may be formed of conductive material.

[0029] With such a structure, the developing roller shaft may be formed of conductive material. Therefore, power can be more reliably supplied from the electrode to the developing roller member.

[0030] In a further variant of the developing cartridge, the developing roller shaft may be formed of metal.

[0031] With such a structure, the developing roller shaft may be formed of metal. Therefore, power can be more reliably supplied from the electrode to the developing roller member.

[0032] In a further variant of the developing cartridge, the electrode may be a part of a member that directly contacts the developing roller shaft.

[0033] With such a structure, the electrode may be a part of a member that directly contacts the developing roller shaft. Therefore, power can be reliably supplied from the electrode to the developing roller shaft.

[0034] In a further variant of the developing cartridge, the electrode may indirectly contact the developing roller shaft via at least one conductive member.

[0035] With such a structure, the electrode may indirectly contact the developing roller shaft via at least one conductive member. Therefore, the relative position of the electrode and the developing roller shaft may be freely selected. Thus, while the design efficiency is improved, power can be reliably supplied from the electrode to the developing roller shaft.

[0036] In a further variant of the developing cartridge, the electrode may surround a circumferential portion of the developing roller shaft.

[0037] With such a structure, the developing roller may not have to be supported by other members. Thus, the number of components to be used and costs may be reduced.

[0038] In a further variant of the developing cartridge, the driven coupling may include a first cylindrical portion and a second cylindrical portion disposed around the first cylindrical portion.

[0039] With such a structure, the driven coupling may include the first cylindrical portion and the second cylindrical portion disposed around the first cylindrical portion. Therefore, the first cylindrical portion may reliably receive the

drive force from the drive coupling. The second cylindrical portion may reliably transmit the drive force to the developing roller shaft.

[0040] In a further variant of the developing cartridge, the first cylindrical portion may be substantially hollow and provided with an inner peripheral surface from which a driven part that engages with the drive coupling, protrudes.

[0041] With such a structure, the drive force may be reliably received from the drive coupling by engaging the driven part with the drive coupling.

[0042] In a further variant of the developing cartridge, the first cylindrical portion may include a gear.

[0043] With such a structure, the first cylindrical portion may include the gear. Therefore, the drive force may be reliably received from the drive coupling.

[0044] In a further variant of the developing cartridge, the developing roller may include a developing roller gear connected so as to rotate together with the developing roller shaft. The driven coupling may include a drive gear that directly engages with the developing roller gear.

[0045] With such a structure, the driven coupling may include the drive gear that directly engages with the developing roller gear. Therefore, the drive force received by the driven coupling from the drive coupling may be directly transmitted to the developing roller gear from the driven coupling. Thus, the developing roller may be reliably rotated. In addition, with such a structure, the drive force from the image forming apparatus may not be directly transmitted to the developing roller gear, so that the developing roller shaft may function as a guide during the installation of the developing cartridge. Consequently, a guide may not have to be additionally provided, and the number of components to be used and costs may be reduced.

[0046] In a further variant, the developing cartridge, may further include a supply roller configured to supply the developing agent to the developing roller, the supply roller being disposed parallel to the developing roller. The supply roller may include a supply roller shaft configured to rotate during development, a supply roller member configured to supply the developing agent to the developing roller, the supply roller member being provided around the supply roller shaft, and a supply roller gear connected so as to rotate together with the supply roller shaft, the supply roller gear being configured to engage with the drive gear.

[0047] With such a structure, the supply roller gear may engage with the drive gear. Therefore, the drive force that the driven coupling receives from the drive coupling may be transmitted to the supply roller gear from the driven coupling. Thus, the supply roller may be reliably rotated. Further, with such a structure, the drive force may be transmitted to the developing roller gear and the supply roller gear from the driven coupling. Thus, the drive force may be transmitted effectively, and the developing roller and the supply roller may be effectively rotated.

[0048] In a further variant of the developing cartridge, the electrode may be electrically connected to the supply roller shaft.

[0049] With such a structure, the electrode may be electrically connected to the supply roller shaft. Therefore, power can also be supplied to the supply roller.

[0050] In a further variant of the developing cartridge, the electrode may have a first portion configured to surround a circumferential portion of the developing roller shaft and a second portion configured to surround a circumferential portion of the supply roller shaft.

[0051] With such a structure, the developing roller shaft and the supply roller shaft may be reliably supported by the first portion and second portion, respectively.

[0052] In a further variant of the developing cartridge, the electrode may have a contact portion configured to contact a feeding member of the image forming apparatus, the contact portion being disposed above the first portion and the second portion.

[0053] With such a structure, the electrode may have the contact portion disposed above the first portion and the second portion. Therefore, the electrode may make a reliable contact with the feeding member at the contact portion. Thus, power may be reliably supplied to the electrode from the image forming apparatus.

[0054] In a further variant of the developing cartridge, the developing cartridge may be installable in a photoconductive cartridge including a photoconductive member on which an electrostatic latent image is formed.

[0055] With such a structure, the developing cartridge may be removably installed in the photoconductive cartridge including the photoconductive member. Therefore, only the developing cartridge may be replaced with a new one in accordance with the residual amount of the developing agent, regardless of the life of the photoconductive member. The photoconductive cartridge may be replaced in

accordance with the life of the photoconductive member, regardless of the residual amount of the developing agent contained in the developing cartridge.

[0056] In a further variant, the developing cartridge, may further include a protruding portion that contacts a biased portion provided in a photoconductive cartridge when the developing cartridge is installed in the photoconductive cartridge.

[0057] With such a structure, when the developing cartridge is installed in the photoconductive cartridge, the protruding portion of the developing cartridge may contact the biased portion of the photoconductive cartridge, so that the developing roller may contact the photoconductive member. Therefore, with a reliable contact between the developing roller and the photoconductive member, an electrostatic latent image formed on the photoconductive member may be reliably developed by the developing agent carried on the developing roller.

[0058] In a further variant of the developing cartridge, the protruding portion may extend outward from the first sidewall and the second sidewall.

[0059] With such a structure, the protruding portion may extend outward from the first sidewall and the second sidewall. Therefore, the protruding portion may be reliably made contact with the biased portion. Thus, a reliable contact of the developing roller to the photoconductive member may be ensured.

[0060] In a further variant of the developing cartridge, the driven coupling may include a first cylindrical portion and a second cylindrical portion disposed around the first cylindrical portion. The projection may be formed by projecting the first cylindrical portion; at least a part of the electrode may be disposed within the projection.

[0061] With such a structure, the electrode may further be prevented from being placed out of position. Thus, power may be stably supplied to the developing roller shaft.

[0062] In a further variant of the developing cartridge, the first cylindrical portion may be substantially hollow and provided with an inner peripheral surface from which a driven part that engages with the drive coupling, protrudes.

[0063] With such a structure, the drive force may be reliably received from the drive coupling by engaging the driven part with the drive coupling.

[0064] In a further variant of the developing cartridge, the electrode may include a first portion configured to surround a circumferential portion of the

developing roller shaft. The first portion may be movably provided so as to contact the developing roller shaft.

[0065] With such a structure, power may be supplied reliably to the developing roller shaft.

[0066] In a further variant of the developing cartridge, the electrode may include a second portion attached to the first sidewall with a fixing member. The fixing member side wall includes a portion configured to prevent the electrode from separating from the first sidewall. An end face of the second portion faces an end face of the portion of the fixing member is spatially separated from the end face of the portion of the fixing member.

[0067] With such a structure, the first portion may reliably contact the developing roller shaft.

[0068] In a further variant of the developing cartridge, the fixing member may be a screw and the portion of the fixing member may be a screw head.

[0069] With such a structure, the electrode may be reliably and readily attached to the first sidewall with the screw, so as to allow the electrode to move slightly.

[0070] In a further variant of the developing cartridge, the first sidewall may be provided with a receiving portion configured to allow the second portion to surround the receiving portion and to allow the fixing member to be inserted into the receiving portion. An end face of the receiving portion may be configured to protrude away from the end face of the second portion to contact the end face of the portion of the fixing member.

[0071] With such a structure, the fixing member may be disposed with some distance between the fixing member and the second portion. Therefore, distance between the end face of the second portion and the end face of the fixing member may be precisely and reliably provided. Consequently, the first portion can be reliably made to contact the developing roller shaft while ensuring smooth rotation of the developing roller shaft relative to the first portion.

[0072] In a further variant of the developing cartridge, the first portion and the contact portion may extend from the first sidewall in a direction opposite to the second sidewall, along the first axial line.

[0073] With such a structure, the feeding member of the image forming apparatus may reliably make contact with the contact portion. While ensuring smooth rotation of the developing roller shaft relative to the developing roller shaft supporting portion, the developing roller shaft supporting portion may reliably contact the developing roller shaft.

[0074] In a further variant, the developing cartridge, may further include a supply roller configured to supply the developing agent to the developing roller. The supply roller may be disposed parallel to the developing roller. The supply roller may include a supply roller shaft configured to rotate during development and a supply roller member configured to supply the developing agent to the developing roller. The supply roller member may be provided around the supply roller shaft. The electrode may be provided with a portion configured to surround a circumferential portion of the supply roller shaft.

[0075] With such a structure, power can also be supplied to the supply roller shaft.

[0076] In a further variant of the developing cartridge, a bearing configured to support the developing roller shaft may be provided on the first sidewall separately from the electrode.

[0077] With such a structure, the developing roller shaft may be supported by the bearing. Therefore, the developing roller supporting portion may reliably contact the developing roller shaft, while ensuring smooth rotation of the developing roller shaft. Even when the bearing is not employed as the electrode, power may be reliably supplied to the developing roller-shaft.

[0078] In a further variant of the developing cartridge, the electrode may include a second portion attached to the first sidewall by a screw. The first sidewall may be provided with a screw receiving portion configured to allow the second portion to surround the screw receiving portion and to allow the screw to be screwed into the screw receiving portion. A distance between a center of the screw receiving portion and an axis of the developing roller shaft side wall may differ from a distance between a center of a region surrounded by the second portion in which the screw receiving portion is configured to be surrounded and a center of a region surrounded by the first portion in which the circumferential portion of the developing roller shaft is surrounded sidewall.

[0079] With such a structure, sidewall, the first portion may be reliably made to contact the developing roller shaft.

[0080] According to various aspects of the present invention, the electrode may be prevented from being placed out of position. Thus, power may be stably supplied to the developing roller shaft.

[0081] According to various other aspects of the present invention, while the developing roller is securely supported, power may be supplied stably to the developing roller member.

[0082] According to various other aspects of the present invention, while the developing roller is securely supported, power may be supplied stably to the developing roller member.

[0083] According to various other aspects of the present invention, the developing roller may be assembled or secured efficiently to the adjacent member. While the developing roller is securely supported, power may be stably supplied to the developing roller member.

[0084] According to various other aspects of the present invention, power can be reliably supplied to the electrode.

[0085] According to various other aspects of the present invention, the electrode may be formed into any shape and power may be stably supplied to the developing roller member.

[0086] According to various other aspects of the present invention, power can be reliably supplied from the electrode to the developing roller member.

[0087] According to various other aspects of the present invention, the relative position of the electrode and the developing roller shaft may be freely selected. Thus, while the design efficiency is improved, power can be reliably supplied from the electrode to the developing roller shaft.

[0088] According to various other aspects of the present invention, the developing roller may not have to be supported by other members. Thus, the number of components to be used and costs may be reduced.

[0089] According to various other aspects of the present invention, the first cylindrical portion may reliably receive the drive force from the drive coupling. The second cylindrical portion may reliably transmit the drive force to the developing roller shaft.

[0090] According to various other aspects of the present invention, the drive force may be reliably received from the drive coupling.

[0091] According to various other aspects of the present invention, the developing roller may be reliably rotated. Further, the developing roller shaft may function as a guide during the installation of the developing cartridge. Thus, the number of components to be used and costs may be reduced.

[0092] According to various other aspects of the present invention, the developing roller shaft and the supply roller shaft may be reliably supported by the first portion and the second portion, respectively.

[0093] According to various other aspects of the present invention, power may be reliably supplied to the electrode from the image forming apparatus.

[0094] According to various other aspects of the present invention, only the developing cartridge may be replaced with a new one in accordance with the residual amount of the developing agent, regardless of the life of the photoconductive member. The photoconductive cartridge may be replaced in accordance with the life of the photoconductive member, regardless of the residual amount of the developing agent contained in the developing cartridge.

[0095] According to various other aspects of the present invention, with a reliable contact between the developing roller and the photoconductive member, an electrostatic latent image formed on the photoconductive member may be reliably developed by the developing agent carried on the developing roller.

[0096] According to various other aspects of the present invention, a reliable contact of the developing roller to the photoconductive member may be ensured.

[0097] According to various other aspects of the present invention, the electrode may further be prevented from being placed out of position. Thus, power may be stably supplied to the developing roller shaft.

[0098] According to various other aspects of the present invention, the drive force may be reliably received from the drive coupling.

[0099] According to various other aspects of the present invention, power may be supplied reliably to the developing roller shaft from the feeding member, via the contact portion and the first portion.

[00100] According to various other aspects of the present invention, the first portion may reliably make contact with the developing roller shaft.

[00101] According to various other aspects of the present invention, the electrode may be reliably and readily attached to the first sidewall with the screw.

[00102] According to various other aspects of the present invention, the first portion can reliably make contact with the developing roller shaft while ensuring smooth rotation of the developing roller shaft relative to the first portion.

[00103] According to various other aspects of the present invention, the feeding member of the image forming apparatus may reliably make contact with the contact portion. While ensuring smooth rotation of the developing roller shaft relative to the first portion, the first portion may reliably make contact with the developing roller shaft.

[00104] According to various other aspects of the present invention, power can also be supplied to the supply roller shaft.

[00105] According to various other aspects of the present invention, the first may reliably contact the developing roller shaft, while ensuring smooth rotation of the developing roller shaft. Even when the bearing is not employed as the electrode, power may be reliably supplied to the developing roller shaft.

[00106] According to various other aspects of the present invention, the first portion may reliably make contact with the developing roller shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[00107] Illustrative aspects will be described in detail with reference to the following figures wherein:

[00108] FIG. 1 is a sectional side view of a general configuration of a laser printer, as an image forming apparatus, according to an illustrative aspect;

[00118] FIG. 2 is a sectional side view of a process cartridge for use in the laser printer shown in FIG. 1 according to an illustrative aspect;

[00119] FIG. 3 is a sectional side view of a drum cartridge for use in the laser printer shown in FIG. 1 according to an illustrative aspect;

[00120] FIG. 4 is a sectional side view of a developing cartridge for use in the laser printer shown in FIG. 1 according to an illustrative aspect;

[00121] FIG. 5 is a perspective view of the developing cartridge viewed from an upper rear left side;

[00122] FIG. 6 is a perspective view of the developing cartridge viewed from an upper rear right side;

[00123] FIG. 7 is a perspective view of the developing cartridge viewed from a lower front left side;

[00124] FIG. 8 is a perspective view of the developing cartridge viewed from a lower front right side;

[00125] FIG. 9 is a plan view of the developing cartridge viewed from the rear side;

[00126] FIG. 10 is a plan view of the developing cartridge viewed from the front side;

[00127] FIG. 11 is a plan view of the developing cartridge viewed from the top;

[00128] FIG. 12 is a plan view of the developing cartridge viewed from the bottom;

[00129] FIG. 13 is a left side view of the developing cartridge with a gear cover attached to the developing cartridge;

[00130] FIG. 14 is a left side view of the developing cartridge with a gear cover detached from the developing cartridge;

[00131] FIG. 15 is a right side view of the developing cartridge;

[00132] FIG. 16 is a perspective view of the drum cartridge viewed from an upper rear left side;

[00133] FIG. 17 is a perspective view of the process cartridge viewed from ar upper front right side;

[00134] FIG. 18A and FIG. 18B provide a perspective view showing a part of a developing shaft and a side view of the developing shaft, respectively, according to an illustrative aspect;

[00135] FIG. 19 is a left side view of the developing cartridge corresponding to FIG. 13, with a contact plate projected in a width direction of the developing cartridge according to an illustrative aspect;

[00136] FIG. 20 is a right side view of the developing cartridge corresponding to FIG. 15, with a driven coupling part projected in the width direction of the developing cartridge according to an illustrative aspect;

[00137] FIG. 21 is a perspective view of the developing cartridge, corresponding to FIG. 6, viewed from an upper rear right side, with an electrode member detached from the developing cartridge according to an illustrative aspect;

[00138] FIG. 22 is a perspective view of the developing cartridge, corresponding to FIG. 8, viewed from a lower front right side, with the electrode member detached from the developing cartridge;

[00139] FIG. 23 is a right side view of the developing cartridge, corresponding to FIG. 15;

[00140] FIG. 24 is a sectional view of the developing cartridge taken along line A-A of FIG. 23; and

[00141] FIG. 25 is a sectional view of the developing cartridge taken along line B-B of FIG. 23.

DESCRIPTION OF SYMBOLS

[00142]

1: laser printer

2: main body casing

27: drum cartridge

28: photoconductive drum

30: developing cartridge

36: developing frame

37: supply roller

38: developing roller

50: supply roller shaft

51: sponge roller

52: developing roller shaft

53: rubber roller

69: sidewall

79: cylindrical screw portion

93: gear cover

94: input gear

95: supply roller drive gear

102: engagement stopper portions

100: driven coupling part

101: drive gear

115: developing roller drive gear

117: electrode member

118: developing roller shaft covering portion

119: terminal portion

120: attachment plate

122: contact plate

123: base plate

127: supply roller shaft covering portion

130: screw

130b: screw head

132: boss

140: screw hole

150: pressing lever

201: bearing member

X1: first axis line

X2: second axis line

L1: first line

L2: second line

D1: first distance

D2: second distance

If: inward end face of the screw head with respect to an axial direction of the screws

Ff: free end face of the cylindrical screw portion

Of: outward face of the base plate

BEST MODE FOR CARRYING OUT THE INVENTION

[00143] It is noted that various connections are set forth between elements in the following description. It is noted that these connections in general and, unless specified otherwise, may be direct or indirect and that this specification is not intended to be limiting in this respect.

[00144] Illustrative aspects will be described with reference to the accompanying drawings. FIG. 1 is a sectional side view of a general configuration of a laser printer in which a developing cartridge is installed according to an illustrative aspect. FIG. 2 is a sectional side view of a process cartridge for use in the laser printer shown in FIG. 1 according to an illustrative aspect. FIG. 3 is a sectional side view of a drum cartridge for use in the laser printer shown in FIG. 1 according to an illustrative aspect. FIG. 4 is a sectional side view of the developing cartridge for use in the laser printer shown in FIG. 1 according to an illustrative aspect.

[00145] (0063) As shown in FIG. 1, a laser printer 1 includes a main body casing 2, and a feeder unit 4 that supplies a sheet 3 and an image forming unit 5 that forms an image on the supplied sheet 3. The feeder unit 4 and the image forming unit 5 are disposed in the main body casing 2.

[00146] (1) Main casing

Formed at a front side of the main body casing 2 (left side in FIG. 1) is an opening 6 through which a process cartridge 20 is inserted into or removed from the main body casing 2. A front cover 7 for opening and closing the opening 6 is provided at the front side of the main body casing 2. The front cover 7 is pivotally supported with a cover shaft 8, which is inserted into a lower end portion of the front cover 7. When the front cover 7 is pivotally closed about the cover shaft 8, the opening 6 is closed by the front cover 7. When the front cover 7 is pivotally opened about the cover shaft 8, the opening 6 is open. Thus, the process cartridge 20 can be inserted into or removed from the main body casing 2 through the opening 6.

[00147] In the following description, the side on which the front cover 7 is provided when the process cartridge 20 is installed in the main body casing 2, is defined as the front side of the laser printer 1/process cartridge 20 (including a developing cartridge 30), and the side opposite to the front side is defined as the rear side.

[00148] (2) Feeder unit

As shown in FIG. 1, the feeder unit 4 is provided, at a bottom portion in the main body casing 2, with a sheet supply tray 9 slidably installable in the main body casing 2 along the front-rear direction, a separation roller 10 and a separation pad 11 provided at upper front end portions of the sheet supply tray 9, and a pickup roller 12 provided at a rear side of the separation roller 10 (upstream side of the separation pad 11 in a sheet feeding direction). The feeder unit 4 further includes a sheet powder removing roller 13 provided at an upper front portion of the separation roller 10 (downstream side of the separation roller 10 in the sheet feeding direction) and a pinch roller 14 disposed to face the sheet powder removing roller 13.

[00149] The feeder unit 4 includes a pair of register rollers 15 disposed below the process cartridge 20 when installed, in a sheet feed path downstream of a U-turned portion thereof that makes a U-turn near the sheet powder removing roller 13 toward the rear side. Provided inside the sheet supply tray 9 is a sheet mount plate 16 configured to mount a stack of sheets 3 thereon. The sheet mount plate 16 is pivotable between a mounting position where the sheet mount plate 16 is substantially parallel to a bottom plate of the sheet supply tray 9 with a front end of the sheet mount plate 16 at a lower position and a supply position where the sheet mount plate 16 is at an angle with the front end thereof at a higher position.

[00150] A lever 17 for raising the front end of the sheet mount plate 16 is provided at the front end of the sheet supply tray 9. The lever 17 is supported at an underside of the front end portion of the sheet mount tray 16 so as to pivot about a lever shaft 18 disposed at a rear end of the lever 17. The lever 17 is pivotable between a parallel position where the front end of the lever 17 is substantially parallel to the bottom plate of the sheet supply tray 9 and an angled position where the front end of the lever 17 is at an angle to raise the sheet mount plate 16. When drive force is input to the lever shaft 18, the lever 17 pivots about the lever shaft 18. Accordingly, the front end of the lever 17 raises the front end of the sheet mount plate 16 to move the sheet mount plate 16 to the supply position.

[00151] As the sheet mount plate 16 is placed in the supply position, an uppermost sheet 3 on the sheet mount plate 16 is pressed against the pickup roller 12, and is fed to a separation position between the separation roller 10 and the separation pad 11, by the rotation of the pickup roller 12.

[00152] When the sheet supply tray 9 is removed from the main body casing 2, the sheet mount plate 16 is placed in the mounting position. As the sheet mount plate 16 is in the mounting position, a stack of sheets 3 can be mounted on the sheet mount plate 16.

[00153] The sheets 3 fed toward the separation position by the pickup roller 12 are separated one by one when sandwiched between the separation roller 10 and the separation pad 11 by the rotation of the separation roller 10. The fed sheet 3 passes through a portion between the sheet powder removing roller 13 and the pinch roller 14 where sheet powders or fibers are removed. Then, the sheet 3 is fed along the U-turned sheet feed path toward the register rollers 15.

[00154] The register rollers 15 register the sheet 3 or reduce the skew of the sheet 3. Then, the register rollers 15 feed the sheet 3 to a transfer position between a photoconductive drum 28, as a photoconductive member, and the transfer roller 31 where a toner image on the photoconductive drum 28 is transferred to the sheet 3.

[00155] Image forming unit

The image forming unit 5 includes a scanner unit 19, the process cartridge 20, and a fixing unit 21.

[00156] (a) Scanner unit

The scanner unit 19 is disposed at an upper portion in the main body casing 2. The scanner unit 19 includes a laser light source (not shown), a polygon mirror 22 that is

driven so as to spin, an fθ lens 23, a reflecting mirror 24, a lens 25, and a reflecting mirror 26. As shown in chain lines in FIG. 1, a laser beam emitted from the laser light source based on image data is deflected by the polygon mirror 22 and passes through the fθ lens 23. Then, the laser beam is reflected off the reflecting mirror 24, and directed, through the lens 25, to the reflecting mirror 26 where the laser beam is bent downward toward the surface of the photoconductive drum 28 of the process cartridge 20. Thus, the surface of the photoconductive drum 28 is irradiated with the laser beam.

[00157] (b) Process cartridge

The process cartridge 20 is removably installed in the main body casing 2 below the scanner unit 19, through the opening 6. As shown in FIG. 2, the process cartridge 20 includes a drum cartridge 27, as a photoconductive cartridge, and a developing cartridge 30 according to at least one illustrative aspect, that is removably set in the drum cartridge 27.

[00158] (b-1) Drum cartridge

As shown in FIG. 3, the drum cartridge 27 includes a drum frame 58, and the photoconductive drum 28, a scorotron charger 29, the transfer roller 31 and a cleaning member 32 that are disposed in the drum frame 58.

[00159] The drum frame 58 includes an upper frame 141 that supports the charger 29 and the cleaning member 32, and a lower frame 142 that supports the photoconductive drum 28 and the transfer roller 31.

[00160] As shown in FIGS. 3 and 16, the lower frame 142 is provided with a bottom wall 143, left and right sidewalls 144L, 144R, a front wall 15 and a rear wall 146 that are integrally formed so as to open upward. The bottom wall 143 is of substantially rectangular plate shape. The left and right sidewalls 144L, 144R are disposed so as to face each other at the left and right ends of the bottom wall 143. The front wall 145 is disposed at the front end of the bottom wall 143. The rear wall 146 is disposed at the rear end of the bottom wall 143.

[00161] The front part of the lower frame 142 is defined as a developing cartridge installation portion 147 in which the developing cartridge 30 is installed. The rear part of the lower frame 142 is defined as a drum supporting portion 148 where the lower frame 142 and the upper frame 141 face each other in the vertical direction and the photoconductive drum 28 is supported.

[00162] As shown in FIG. 3, the photoconductive drum 28 includes a cylindrical drum body 33 having at its outermost surface a positively chargeable photoconductive layer made from, for example, polycarbonate and the metal drum shaft 34 disposed at an axis of the drum body 33 along an axial direction of the drum body 33. The drum shaft 34 is supported by the left sidewall 144L and the right sidewall 144R of the lower frame 142. The drum body 33 is rotatably supported on the drum shaft 34. The photoconductive drum 28 is driven so as to rotate on the drum shaft 34 by the input of the drive force from a motor (not shown) during image formation.

[00163] The scorotron charger 29 is supported by the upper frame 141 at an upper rear portion of the photoconductive drum 28. The scorotron charger 29 is disposed so as to face the photoconductive drum 28 with a predetermined distance therebetween, tc prevent the scorotron charger 29 from contacting the photoconductive drum 28. The charger 29 includes a wire 67 disposed to face the photoconductive drum 28 with a predetermined distance therebetween and a grid 68 disposed between the wire 67 and the photoconductive drum 28 to control the amount of electric charge from the wire 67 to the photoconductive drum 28. During image formation, bias voltage is applied to the grid 68. At the same time, high voltage is applied to the wire 67, to generate corona discharge from the wire 67. Thus, the surface of the photoconductive drum 28 is uniformly and positively charged by the charger 29.

[00164] The transfer roller 31 is disposed in the lower frame 142 below the photoconductive drum 28. The transfer roller 31 contacts the photoconductive drum 28 in the vertical direction so as to form a nip portion between the transfer roller 31 and the photoconductive drum 28. The transfer roller 31 includes a metal transfer roller shaft 56 covered by a rubber roller 57 formed of a conductive rubber material. The transfer roller shaft 56 is rotatably supported by the left and right sidewalls 144L, 142R of the lower frame 142. During transfer of the toner on the sheet 3 (during image formation), drive force is input from a motor (not shown) to rotate the transfer roller 31. A transfer bias is applied to the transfer roller 31 during transfer of the toner onto the sheet 3.

[00165] The cleaning member 32 is supported by the upper frame 141 behind the photoconductive drum 28 so as to face the drum 28. The cleaning member 32 includes a cleaning brush 65 to catch the sheet powders or fibers on the photoconductive drum 28, and a supporting plate 66 that supports the cleaning brush 65 opposite to the

photoconductive drum 28 with respect to the cleaning brush 65 (behind the photoconductive drum 28).

[00166] The cleaning brush 65 includes non-woven fabric with many conductive fiber-like brush bristles fixed thereon. The cleaning brush 65 is attached to the supporting plate 66 by double-sided adhesive tape. The cleaning brush 65 is disposed to contact the photoconductive drum 28. The supporting plate 66 is supported by the upper frame 141 while supporting the cleaning brush 65.

[00167] The direction parallel to the drum shaft 34 of the photoconductive drum 28 may be referred to as the "first direction". The direction perpendicular to the first direction directed toward the front side of the main body casing 2 may be referred to as the "second direction". In the developing cartridge installation portion 147, a handle 149, which is held during installation or removal of the drum cartridge 27, is formed on the substantially central portion of the front wall 145 in the first direction.

[00168] Disposed at each end of the front wall 145 with respect to the first direction is a pressing lever 150 that presses the developing cartridge 30 installed in the developing cartridge installation portion 147 toward the rear side, to firmly press the developing roller 38 against the photoconductive drum 28. Each pressing lever 150 is formed of a thick plate and into a substantially triangular shape in side view. The lower end of each pressing lever 150 is pivotally supported by a fixed shaft (not shown) extending inwardly in the first direction from each sidewall 144L, 144R.

[00169] A compression spring (not shown) is disposed between each pressing lever 150 and the front wall 145. Therefore, each pressing lever 150 is always pressed or inclined rearward by an urging force of the compression spring.

[00170] A lock lever 151 is provided on one sidewall (right sidewall 144R) with some distance between the lock lever 151 and one of the pressing levers 150 in the front-rear direction. The lock lever 151 is of substantially a rectangular shape in side view. The lock lever 151 is provided with a flexible portion 152 extending downward from the lock lever 151. The lock lever 151 is pivotally supported by the right sidewall 144R with the flexible portion 152 engaged with a rib (not shown) formed on the bottom wall 143.

[00171] Disposed in the developing cartridge installation portion 147 at the rear ends of the left and right sidewalls 144L, 144R are guide grooves 153 along which a collar member 116 and a developing roller shaft covering portion 118, which will be described below, are guided to install the developing cartridge 30 in the developing cartridge

installation portion 147. As shown in FIGS. 2 and 3, formed in the developing cartridge installation portion 147 slightly forward of the central portion of the bottom wall 143 in the second direction are installation bases 155 on which installation portions 133 of the developing cartridge 30 are placed.

[00172] (b-2) Developing cartridge

As shown in FIGS. 16 and 17, the developing cartridge 30 is removably installed in the developing cartridge installation portion 147 of the lower frame 142 when the process cartridge 20 is separated or removed from the main body casing 2. As shown in FIG. 4, the developing cartridge 30 includes a developing frame 36 and a supply roller 37, a developing roller 38, and a layer-thickness regulating blade 39 that are disposed in the developing frame 36.

[00173] The developing frame 36 is formed into a box-shape that is open rearward. Disposed in the developing frame 36 are a partition plate 40, and a toner chamber 41 and a developing chamber 42 that are partitioned by the partition plate 40. The partition plate 40 is disposed in the middle of the developing frame 36 in the second direction, so as to divide the developing frame 36 in the front-rear direction. A port 43 is formed in the middle portion of the partition plate 40 in the vertical direction.

[00174] The toner chamber 41 is defined in an internal space of the developing frame 36 on the front side thereof partitioned by the partition plate 40. The toner chamber 41 contains positively chargeable nonmagnetic single-component toner as a developing agent. The toner is, for example, polymerized toner that is obtained by copolymerizing polymerizable monomers using a polymerization method, such as a suspension polymerization method. The polymerizable monomers may be styrene-based monomers, such as styrene, and acrylic-based monomers, such as acrylic acid, alkyl (C1-C4) acrylate, and alkyl (C1-C4) methacrylate. The particle of such polymerized toner is of a substantially spherical shape, and thus the polymerized toner has excellent fluidity and contributes to high-quality image formation.

[00175] The toner is mixed with wax and a coloring agent, such as carbon black, as well as an external additive, such as silica, to improve the fluidity of the toner. Average toner particle sizes are approximately 6 to 10 μm.

[00176] A toner filling port through which the toner is supplied into the toner chamber 41 is formed at left and right sidewalls 69L, 69R (described below) of the

developing frame 36 in the toner chamber 41. The toner filling port is covered with a toner cap 35, as shown in FIG. 15.

[00177] A toner detection window 44 for detecting a residual toner amount is provided on each of the left and right sidewalls 69L, 69R of the developing frame 36 in the toner chamber 41. The toner detection windows 44 are formed on the left and right sidewalls 69L, 69R of the developing frame 36 near the partition plate 40 so as to face each other along a width direction of the developing cartridge 30 (perpendicular to the front-rear direction and the vertical direction). Each toner detection window 44 is formed by embedding a transparent disk plate in an opening formed in the left and right sidewalls 69L, 69R of the developing frame 36, as shown in FIGS. 13, 14 and 15.

[00178] An agitator 45 that agitates the toner in the toner chamber 41 is provided in the toner chamber 41. The agitator 45 is provided with an agitator rotating shaft 46 and an agitating member 47. The agitator rotating shaft 46 is rotatably supported by the left and right sidewalls 69L, 69R of the developing frame 36 at a substantially central portion of the toner chamber 41. The agitating member 47 is provided on the agitator rotating shaft 46. Drive force from a motor (not shown) is input to the agitator rotating shaft 46 to rotate the agitator 45 during development (during image formation).

[00179] The agitator 45 is provided with wipers 48. Each wiper 48 is provided on each end of the agitator rotating shaft 46 with respect to its axial direction. When the agitator rotating shaft 46 rotates, each wiper 48 pivotally moves about the agitator rotating shaft 46 in a circumferential direction in the toner chamber 41, to wipe off the toner detection windows 44 provided on the left and right sidewalls 69L, 69R of the developing frame 36. Thus, the toner detection windows 44 are wiped off by the wipers 48.

[00180] The developing chamber 42 is defined in an internal space of the developing frame 36 on the rear side thereof partitioned by the partition plate 40. The supply roller 37 is disposed behind the port 43 above a central bottom wall 75 (described below). The supply roller 37 includes a metal supply roller shaft 50 covered by a sponge roller 51, as a supply roller member, formed of a conductive foaming material. The supply roller shaft 50 is rotatably supported by the left and right sidewalls 69L, 69R of the developing frame 36 in the developing chamber 42. Each end of the supply roller shaft 50 extends outward from the left and right sidewall 69L, 69R. Drive force from a motor (not shown) is input to the supply roller shaft 50 to rotate the supply roller 37 during development (during image formation). The same bias as the developing bias, which is

applied to the developing roller 38, is applied to the supply roller 37 during development (during image formation).

[00181] The developing roller 38 is disposed in the developing chamber 42 behind the supply roller 37 and above a rear bottom wall 76 (described below), as shown in FIG. 4. The developing roller 38 contacts the supply roller 37, so as to apply some pressures to each other. The developing roller 38 includes a metal developing roller shaft 52 covered by a rubber roller 53, as a developing roller member, formed of conductive rubber material. The developing roller shaft 52 extends parallel to the supply roller shaft 50. The developing roller shaft 52 is rotatably supported by the left and right sidewalls 69L, 69R (described below) of the developing frame 36 in the developing chamber 42.

[00182] Each end of the developing roller shaft 52 extends outward from the left and right sidewall 69L, 69R (described below). The rubber roller 53 is formed of a conductive urethane or silicone rubber including fine carbon particles. A surface of the rubber roller 53 is coated with urethane rubber or silicone rubber including fluorine. Drive force is input to the developing roller shaft 52 from a motor (not shown) to rotate the developing roller 38 during development (during image formation). The developing bias is applied to the developing roller 38 during development (during image formation).

[00183] The layer-thickness regulating blade 39 includes a blade body 54 formed of metal leaf spring member and a pressing portion 55 that has a semicircular cross-sectional shape and is formed of insulating silicone rubber. The pressing portion 55 is provided at a free end of the blade body 54. A base end, opposite to the free end, of the blade body 54 of the layer-thickness regulating blade 39 is supported above the developing roller 38 in a blade attachment portion 77 (described below) by an attachment member 134. The free end of the blade body 54 extends obliquely downward and frontward toward the supply roller 37. The pressing portion 55 is pressed against the developing roller 38 by elastic force of the blade body 54.

[00184] (b-3) Development and transfer operations

During image formation, drive force from a motor (not shown) is input to the agitator rotating shaft 46, the agitator rotating shaft 46 is rotated, so that the agitating member 47 is pivotally moved about the agitator rotating shaft 46 in a circumferential direction in the toner chamber 41. Accordingly, toner in the toner chamber 41 is agitated by the agitating member 47, and is discharged toward the developing chamber 42, through

the port 43 formed in the middle portion of the partition plate 40 in the vertical direction so as to allow the fluid communication in the front-rear direction.

[00185] The toner discharged through the port 43 toward the developing chamber 42 is supplied to the rubber roller 53 of the developing roller 38 by the sponge roller 51 of the supply roller 37, in accordance with the rotation of the supply roller shaft 50. At this time, the toner is positively charged by the friction between the sponge roller 51 of the supply roller 37 and the rubber roller 53 of the developing roller 38. The toner supplied onto the rubber roller 53 of the developing roller 38 passes between the pressing portion 55 of the layer-thickness regulating blade 39 and the rubber roller 53 of the developing roller 38, in accordance with the rotation of the developing roller shaft 52. The toner is carried on the rubber roller 53 of the developing roller 38, as a thin layer whose thickness has been regulated.

[00186] As shown in FIG. 2, while the photoconductive drum 28 rotates, the surface of the drum body 33 is uniformly and positively charged by the scorotron charger 29. Then, a laser beam from the scanner unit 19 scans across the surface of the drum body 33 at high speed, thereby forming, on the surface of the drum body 33, an electrostatic latent image corresponding to an image to be formed on the sheet 3.

[00187] Thereafter, as the toner, which is carried on the rubber roller 53 of the developing roller 38 and positively charged, makes contact with the drum body 33 of the photoconductive drum 28 in accordance with the rotation of the developing roller shaft 52, the toner is supplied to the electrostatic latent image formed on the surface of the drum body 33, that is, parts exposed to the laser beam, where the potential level is lower than the remaining part of the drum body 33 surface uniformly positively charged. Thus, the electrostatic latent image on the drum body 33 is made visible. Thus, a toner image is formed on the drum body 33 by reverse developing.

[00188] Then, the toner image carried on the surface of the drum body 33 is transferred onto the sheet 3, with the application of the transfer bias to the rubber roller 57 of the transfer roller 31, while the sheet 3 conveyed by the register rollers 15 passes through the transfer position between the drum body 33 and the rubber roller 57 of the transfer roller 31. The sheet 3 having the toner image transferred thereon is fed to the fixing unit 21.

[00189] The toner remaining on the surface of the drum body 33 after the toner image transfer is collected by the rubber roller 53 of the developing roller 38. Sheet powders or fibers attached to the surface of the drum body 33 after the toner image transfer

due to the contact to the sheet 3, is removed by the cleaning brush 65 of the cleaning member 32 from the surface of the drum body 33 of the photoconductive drum 28.

[00190] (c) Fixing unit

As shown in FIG. 1, the fixing unit 21 is provided behind the process cartridge 20, with some distance between the photoconductive drum 28 of the process cartridge 20 and the fixing unit 21 in the substantially horizontal direction. The fixing unit 21 includes a unit frame 59, and a heat roller 60 and a pressure roller 61 that are disposed in the unit frame 59.

[00191] The heat roller 60 includes a metal tube whose surface is coated with fluorocarbon resin and a halogen lamp inserted into the metal tube for heat application. The heat roller 60 is rotated by an input of power from a motor (not shown) during fixing (during image formation).

[00192] The pressure roller 61 is disposed below the heat roller 60 opposite to the heat roller 60, so as to press against the heat roller 60. The pressure roller 61 includes a metal roller shaft covered by a rubber roller formed of a rubber material. The pressure roller 61 is driven by the rotation of the heat roller 60.

[00193] In the fixing unit 21, the toner image transferred onto the sheet 3 at the transfer position is thermally fixed while the sheet 3 passes between the heat roller 60 and the pressure roller 61. The sheet 3 having the toner image fixed thereon is conveyed toward a sheet output tray 62 formed on the top surface of the main body casing 2. A sheet output path from the fixing unit 21 to the sheet output tray 62 is formed into a substantially "U" shape, so as to turn toward the front side from the fixing unit 21. A feeding roller 63 is disposed in the sheet output path. Output rollers 64 are disposed at downstream end portions of the sheet output path.

[00194] The sheet 3 that is subjected to the thermal fixing process in the fixing unit 21 is conveyed to the sheet output path. The sheet 3 is fed to the output rollers 64 by the feeding roller 63. Then, the sheet 3 is output on the sheet output tray 62 by the output rollers 64.

[00195] 2. Developing cartridge

FIG. 5 is a perspective view of the developing cartridge viewed from an upper rear left side. FIG. 6 is a perspective view of the developing cartridge viewed from an upper rear right side. FIG. 7 is a perspective view of the developing cartridge viewed from a lower front left side. FIG. 8 is a perspective view of the developing cartridge

viewed from a lower front right side. FIG. 9 is a plan view of the developing cartridge viewed from the rear side. FIG. 10 is a plan view of the developing cartridge viewed from the front side. FIG. 11 is a plan view of the developing cartridge viewed from the top. FIG. 12 is a plan view of the developing cartridge viewed from the bottom. FIG. 13 is a left side view of the developing cartridge with a gear cover attached to the developing cartridge. FIG. 14 is a left side view of the developing cartridge with a gear cover unattached to the developing cartridge. FIG. 15 is a right side view of the developing cartridge. FIG. 19 is a left side view of the developing cartridge corresponding to FIG. 13, with a contact plate projected in a width direction of the developing cartridge. FIG. 20 is a right side view of the developing cartridge corresponding to FIG. 15, with a driven coupling part projected in the width direction of the developing cartridge.

[00196] The developing cartridge 30 will be described in detail below with reference to FIGS. 4-15 and FIGS. 19 and 20.

[00197] (1) Developing frame

As shown in FIGS. 4 and 5, the developing frame 36 includes a pair of left and right sidewalls 69L, 69R, an upper wall 70, a bottom wall 71 and a front wall 72 that are integrally formed. The developing frame 36 is formed into a box shape with a rear opening portion 73 formed thereon.

[00198] The left and right sidewalls 69L, 69R are of a flat plate shape. As shown in FIG. 11, the left and right sidewalls 69L, 69R are disposed opposite to each other in the first direction, so as to interpose the toner chamber 41 and the developing chamber 42 between the left and right sidewalls 69L, 69R. As shown in FIGS. 14 and 15, the left and right sidewalls 69L, 69R close each end of the toner chamber 41 and the developing chamber 42. As shown in FIGS. 4 and 11, the upper wall 70 is of a flat plate shape. The upper wall 70 is connected to upper ends of the left and right sidewalls 69L, 69R, so as to extend between the left and right sidewalls 69L, 69R. The upper wall 70 closes an upper portion of the toner chamber 41 and the developing chamber 42.

[00199] As shown in FIGS. 4 and 7, the bottom wall 71 is of a curved plate shape. The bottom wall 71 is connected to lower ends of the left and right sidewalls 69L, 69R, so as to extend between the left and right sidewalls 69L, 69R. The bottom wall 71 closes a lower portion of the toner chamber 41 and the developing chamber 42. The bottom wall 71 includes a front bottom wall 74, a middle bottom wall 75, and a rear bottom wall 76 that are integrally formed.

[00200] The front bottom wall 74 is formed into a substantially semicircular cross-sectional shape in association with the rotating path of the agitator 45 in the toner chamber 41.

[00201] The middle bottom wall 75 is disposed behind the front bottom wall 74. The middle bottom wall 75 is formed into a substantially semicircular cross-sectional shape in association with the supply roller 37 in the developing chamber 42.

[00202] The rear bottom wall 76 is disposed behind the middle bottom wall 75. The rear bottom wall 76 is tilted downward from the front side to the rear side.

[00203] The front wall 72 is of a flat plate shape. The front wall 72 is connected to front ends of the left and right sidewalls 69L, 69R, so as to extend between the left and right sidewalls 69L, 69R. The front wall 72 closes a front portion of the toner chamber 41.

[00204] As shown in FIG. 4, the blade attachment portion 77 is provided at an upper rear portion of the left and right sidewalls 69L, 69R between the left and right sidewalls 69L, 69R. The blade attachment portion 77 is formed into a substantially triangular shape in sectional side view, such that the width of the blade attachment portion 77 becomes narrower toward the lower side. A rear end face of the blade attachment portion 77 is formed as an inclined surface that is inclined obliquely toward the front side from an upper end to a lower end of the blade attachment portion 77.

[00205] As shown in FIGS. 4 and 9, the base end of the blade body 54 is fixed to the rear end face of the blade attachment portion 77 by the attachment member 134, with a sealing member 135 interposed between the rear end face of the blade attachment portion 77 and the base end of the blade body 54. The sealing member 135 is provided on the rear end face of the blade attachment portion 77 to prevent toner from leaking from the portion between the rear end face of the blade attachment portion 77 and the attachment member 134.

[00206] The attachment member 134 includes a front supporting member 138 shaped like a plate, a back supporting member 136 of a substantially "L" shape in a sectional view, and screws 137. The front supporting member 138 is disposed on the rear side of the sealing member 135. The base end of the blade body 54 is disposed on the rear side of the front supporting member 138. The back supporting member 136 is disposed on the rear side of the base end of the blade body 54. The screws 137 pass through the back supporting member 136, the base end of the blade body 54, and the front supporting

member 138 in the front-rear direction, to integrally secure the back supporting member 136, the base end of the blade body 54, and the front supporting member 138. With fixing screws 139, the base end of the blade body 54 is fixed to the blade attachment portion 77 while the base end of the blade body 54 and the attachment member 134 sandwich the sealing member 135 between the base end of the blade body 54 and the blade attachment portion 77.

[00207] (0109) As shown in FIGS. 4 and 5, the rear opening portion 73 is defined by the back supporting member 136 of the attachment member 134, the rear ends of the left and right sidewalls 69L, 69R, and the rear end of the rear bottom wall 76. The rear opening portion 73 is of a substantially rectangular shape extending in the first direction. A part of the developing roller 38 is exposed from the rear opening portion 73. More specifically, as shown in FIG. 13, a part of the developing roller 38 protrudes, in side view, from the inside to the outside of the developing frame 36, through the rear opening portion 73.

[00208] As shown in FIG. 9, the developing roller 38 is provided such that each end of the developing roller shaft 52 is rotatably supported in the opposing sidewalls 69L, 69R. A collar member 116 is mounted on an end of the developing roller shaft 52 extending from the left sidewall 69L. As shown in FIGS. 5 and 7, the end of the developing roller shaft 52 is inserted, together with the collar member 116, into a developing roller shaft inserting portion 111 of a gear cover 93 (described below), which is disposed on the side of the left sidewall 69L. The end of the developing roller shaft 52 is rotatably supported in the developing roller shaft inserting portion 111 of the gear cover 93.

[00209] As shown in FIGS. 6 and 8 and described in detail below, a bearing member 201, which is provided on the side of the right sidewall 69R, is fitted over the other end of the developing roller shaft 52 extending from the right sidewall 69R. The other end of the developing roller shaft 52 extends through the bearing member 201. An electrode member 117 is disposed on the side of the bearing member 201. A developing roller shaft covering portion 118 that is formed in the electrode member 117 is fitted over the other end of the developing roller shaft 52 passing through the bearing member 201. The developing roller shaft 52 is rotatably supported in the developing roller shaft covering portion 118 of the electrode member 117. Thus, the ends of the developing roller 38 is supported by the developing roller shaft inserting portion 111 of the gear cover 93, as well as the developing roller shaft covering portion 118 of the electrode member 117.

[00210] When the developing cartridge 30 is installed in the developing cartridge installation portion 147, the collar member 116 and the developing roller shaft covering portion 118 are guided by the guide grooves 153, as shown in FIG. 17, formed in the sidewalls 144L, 144R of the developing cartridge installation portion 147. Thus, smooth installation of the developing cartridge 30 into the developing cartridge installation portion 147 can be ensured.

[00211] As shown in FIGS. 5 and 9, a rear side-end wall 78 is disposed below the rear opening portion 73 on the rear end of the rear bottom wall 76 at its right and left sides with respect to the width direction of the developing cartridge 30. Each rear side-end wall 78 is formed into a substantially "L" shape with an inward lower portion thereof being cut out. A reinforcing portion 80 is disposed between the rear side-end walls 78 on the rear end of the rear bottom wall 76, which is disposed below the rear opening portion 73.

[00212] The reinforcing portion 80 extends, along the width direction of the developing cartridge 30, between the rear side-end walls 78. The reinforcing portion 80 fits in the cut-out portions of the rear side-end walls 78. As shown in FIGS. 4 and 5, the reinforcing portion 80 is formed continuously from the rear end of the rear bottom wall 76. The reinforcing portion 80 includes a reinforcing upper wall 82, a reinforcing front wall 85, a reinforcing bottom wall 83, and reinforcing sidewalls 84. Those walls 82-85 are integrally formed into a substantially box shape that is open rearward. More specifically, in a sectional side view when taken along a direction perpendicular to the width direction of the developing cartridge 30, the reinforcing portion 80 is formed into a substantially "U" shape with a rear portion being open.

[00213] The reinforcing upper wall 82 is integrally formed with the rear end of the rear bottom wall 76, to extend rearward. The reinforcing front wall 85 is integrally formed with the rear end of the rear bottom wall 76, to extend downward from the front end of the reinforcing upper wall 82. The reinforcing bottom wall 83 is disposed to face the reinforcing upper wall 82 in the vertical direction. The reinforcing bottom wall 83 is integrally formed with the lower end of the reinforcing front wall 85 to extend rearward and downward.

[00214] The reinforcing sidewalls 84 are integrally formed with the ends of the reinforcing upper wall 82, the reinforcing front wall 85, and the reinforcing bottom wall 83, with respect to the width direction of the developing cartridge 30. As shown in FIG. 4, a lower film 87 is attached to the reinforcing upper wall 82. The lower film 87 is formed of

for example, polyethylene terephthalate. The rear end of the lower film 87 is attached to the upper surface of the reinforcing upper wall 82, extending frontward and upward to contact the lower surface of the rubber roller 53 of the developing roller 38. Accordingly, the lower film 87 closes a gap between the reinforcing upper wall 82 and the developing roller 38, to prevent toner from leaking from the gap.

[00215] As show in FIGS. 4 and 7, guide plates 81 are provided on the bottom wall 71 of the developing frame 36 continuously from the reinforcing portion 80. The guide plates 81 are formed into a rib or flat plate shape extending in the front-rear direction, as well as downward from the bottom wall 71. The adjacent guide plates 81 are provided parallel to each other with some distance therebetween in the width direction of the developing cartridge 30.

[00216] More specifically, the rear end of each guide plate 81 is connected to the reinforcing front wall 85 and the reinforcing bottom wall 83. The front end of each guide plate 81 is connected to the rear end portion of the front bottom wall 74. Each guide plate 81 extends downward from the rear bottom wall 76, the central bottom wall 75 and the front bottom wall 74. Each guide plate 81 is integrally formed with the reinforcing bottom wall 83, the reinforcing front wall 85, the rear bottom wall 76, the central bottom wall 75, and the front bottom wall 74. The lower end of each guide plate 81 extends in a substantially straight manner toward the front side from the rear end of the reinforcing bottom wall 83, and curves upward and frontward below the central bottom wall 75, reaching the rear end portion of the front bottom wall 74.

[00217] As show in FIGS. 7 and 12, a guide reinforcing plate 86 for reinforcing each guide plate 81 is provided on the central bottom wall 75. The guide reinforcing plate 86 is of a plate shape extending downward from the central bottom wall 75 at some middle portion of the guide plates 81 with respect to its front-rear direction, along a direction substantially perpendicular to the front-rear direction. The guide reinforcing plate 86 connects the guide plates 81 in the width direction of the developing cartridge 30 to reinforce each guide plate 81.

[00218] The front bottom wall 74 is provided with installation portions 133 and installation plates 88 for installing the developing cartridge 30 in the developing cartridge installation portion 147 of the drum frame 58. Each installation portion 133 is disposed on the middle portion, with respect to the front-rear direction, of the front bottom wall 74 at its each end, with respect to the width direction of the developing cartridge 30. Each

installation portion 133 is formed on the bottom of the front bottom wall 74 into a substantially rectangular plate shape in a bottom view.

[00219] A pair of installation plates 88, which face each other in the width direction of the developing cartridge 30, is formed on the front ends of the front bottom wall 74 at each end, with respect to the width direction of the developing cartridge 30. Each installation plate 88 is formed into a substantially triangular shape extending downward from the front bottom wall 74. The lower end of each installation plate 88 extends in the front-rear direction slightly above each installation portion 133.

[00220] As shown in FIGS. 7 and 10, the front wall 72 of the developing frame 36 is provided with a grip portion 89. The grip portion 89 is formed into a substantially "U" shape in plane view. The handle 89 includes two handle supporting plates 90 disposed on the front wall 72 with some distance therebetween in the width direction of the developing cartridge 30 and a handle 91 disposed between the handle supporting plates 90. Each handle supporting plate 90 is of a plate shape extending forwardly from the upper portion of the front wall 72. The handle 91 is connected to the front ends of the handle supporting plates 90.

[00221] A boss 132, as a pressed portion, is provided on each left and right sidewall 69L, 69R of the developing frame 36. When the developing cartridge 30 is installed in the developing cartridge installation portion 147 of the drum frame 58, the bosses 132 contact the relevant pressing levers 150. Each boss 132 is provided at a front lower portion of each left and right sidewall 69L, 69R, so as to protrude outward from the outer surface of the sidewall 69L, 69R. As shown in FIGS. 14 and 15, each boss 132 is formed into a substantially "U" shape in side view that is open rearward. Each boss 132 is disposed on the left and right sidewall 69L, 69R at positions symmetric with respect to the first direction.

[00222] When the developing cartridge 30 is installed in the developing cartridge installation portion 147 of the drum frame 58, the installation portions 133 are placed on the relevant installation bases 155, as shown in FIG. 2 and the installation plates 88 are placed on the bottom wall 143 of the developing cartridge installation portion 147.

[00223] As shown in FIGS. 8, 16, and 17, the front end of each boss 132 contacts the relevant pressing lever 150. By the urging force of the compression spring that urges the pressing lever 150, each boss 132 is pressed rearward by the relevant pressing lever 150. Accordingly, the developing frame 36 moves rearward relative to the developing

cartridge installation portion 147, so that the rubber roller 53 of the developing roller 38 is pressed against the photoconductive drum 28.

[00224] As shown in FIGS. 6 and 8, an engagement portion 181 is disposed integrally with the right sidewall 69R behind the boss 132 so as to extend outward. When the developing cartridge 30 is installed in the developing cartridge installation portion 147 of the drum cartridge 27, the engagement portion 181 is positioned below the lock lever 151. The lock lever 151 engages with the engagement portion 181 with the urging force of the flexible portion 152. When the developing cartridge 30 is removed from the developing cartridge installation portion 147, the lock lever 151 is pressed down to disengage the engagement portion 181 from the lock lever 151.

[00225] (2) Gear mechanism portion and gear cover

As shown in FIG. 14, ends of the agitator rotating shaft 46, the supply roller shaft 50, and the developing roller shaft 52 protrude outward in the first direction from the left sidewall 69L, as a second sidewall. Disposed on the left sidewall 69L are a gear mechanism portion 92 for driving the agitator rotating shaft 46, the supply roller shaft 50, and the developing roller shaft 52 to rotate, and a gear cover 93 that covers the gear mechanism portion 92 as shown in FIGS. 5 and 13.

[00226] As shown in FIG. 14, the gear mechanism portion 92 is disposed on the left sidewall 69L. The gear mechanism portion 92 includes an input gear 94, as a driven coupling, a supply roller drive gear 95, as a supply roller gear, a developing roller drive gear 115, as a developing roller gear, an intermediate gear 96, an agitator drive gear 97 and a detection gear 98.

[00227] The input gear 94 is rotatably supported between the developing roller shaft 52 and the agitator rotating shaft 46 by an input gear supporting shaft 99 that extends outward from the left sidewall 69L in the first direction.

[00228] The input gear 94 is integrally provided with a driven coupling part 100, as a first cylindrical portion, and a drive gear 101, as a second cylindrical portion, that is concentrically disposed with the driven coupling part 100 around the driven coupling part 100. The driven coupling part 100 is of a hollow cylindrical shape. Engagement stopper portions 102, as driven parts, that engage with a drive coupling part 200 (in FIG. 5), as a drive coupling, extend radially inward from the inner peripheral surface of the driven coupling part 100. The engagement stopper portions 102 are disposed opposite to each

other with respect to the input gear supporting shaft 99. Thus, the driven coupling part 100 is formed as gear teeth that engage with the drive coupling part 200 (in FIG. 5).

[00229] The drive gear 101 is placed adjacent to the driven coupling part 100 in the first direction between the driven coupling part 100 and the left sidewall 69L.

[00230] The supply roller drive gear 95 is mounted on an end of the supply roller shaft 50 to engage with the input gear 94 below the input gear 94. The supply roller drive gear 95 is provided to rotate together with the supply roller shaft 50, so that the supply roller drive gear 95 does not rotate relative to the supply roller shaft 50.

[00231] The developing roller drive gear 115 is mounted on an end of the developing roller shaft 52 to engage with the input gear 94 on the lower rear side of the input gear 94. The developing roller drive gear 115 is provided to rotate together with the developing roller shaft 52, so that the developing roller drive gear 115 does not rotate relatively to the developing roller shaft 52.

[00232] The intermediate gear 96 is rotatably supported in front of the input gear 94 on an intermediate gear supporting shaft 103 extending outward in the first direction from the left sidewall 69L. The intermediate gear 96 is integrally provided with an external gear 104 that engages with the input gear 94 and an internal gear 105 that engages with the agitator drive gear 97. The internal gear 105 is disposed on the inner side of the external gear 104 with respect to the width direction of the developing cartridge 30.

[00233] The agitator drive gear 97 is mounted on an end of the agitator rotating shaft 46 to rotate together with the agitator rotating shaft 46, so that the agitator drive gear 97 does not rotate relative to the agitator rotating shaft 46. The agitator drive gear 97 is positioned at the lower front side of the intermediate gear 96. The agitator drive gear 97 is integrally provided with an internal gear 106 that engages with the internal gear 105 of the intermediate gear 96 and an external gear 107 that engages with the detection gear 98. The external gear 107 is disposed on the outer side of the internal gear 106 in the width direction of the developing cartridge 30.

[00234] The detection gear 98 is rotatably supported by a detection gear supporting shaft 108 that extends outward in the first direction from the left sidewall 69L at the upper front side of the agitator drive gear 97. The detection gear 98 is a partly tooth missing gear. The detection gear 98 is integrally formed with a usage determination projection 109 that extends outwardly in the radial direction of the detection gear supporting shaft 108. The detection gear 98 is urged by a coiled spring 110 wound around

the detection gear supporting shaft 108 to engage with the external gear 107 of the agitator drive gear 97.

[00235] As shown in FIG. 13, the gear cover 93 is attached to the left sidewall 69L of the developing cartridge 30 to cover the gear mechanism portion 92 from its outside with respect to the width direction of the developing cartridge 30. The gear cover 93 has a developing roller shaft insertion hole 111 that the developing roller shaft 52 and the collar member 116are inserted into, and an input hole 112 that exposes the driven coupling part 100 therethrough. In addition, the gear cover 93 is provided with a detection gear covering portion 113 that covers the detection gear 98 on the front side of the input hole 112.

[00236] The detection gear covering portion 113 extends outwardly in the first direction. The detection gear 98 fits into the extended portion of the detection gear covering portion 113. A sector-shaped detection window 114 is formed on the rear side of the detection gear covering portion 113. The usage determination projection 109, which moves along the circumferential direction of the detection gear 98 in accordance with the rotation of the detection gear 98, is exposed from the detection window 114.

[00237] When the process cartridge 20 having the developing cartridge 30 set therein is installed in the main body casing 2, the drive coupling part 200 is inserted into the driven coupling part 100 of the input gear 94 of the developing cartridge 30, as shown in FIG. 5, to which drive force from a motor (not shown) provided in the main body casing 2 is transmitted. Thus, the driven coupling part 100 engages with the drive coupling part 200.

[00238] The drive coupling part 200 is removably inserted into the driven coupling part 100, in association with operations of opening/closing the front cover 7 of the main body casing 2. More specifically, when the front cover 7 is open, the drive coupling part 200 withdraws from the driven coupling part 100, so that the process cartridge 20 can be removed from the main body casing 2. When the process cartridge 20 having the developing cartridge 30 set therein is installed in the main body casing 2 through the opening 6 and then the front cover 7 is closed, the drive coupling part 200 advances toward and is inserted into the driven coupling part 100.

[00239] When the drive force from the motor is input from the drive coupling part 200 to the driven coupling part 100, the input gear 94 is rotated. Then, the supply roller drive gear 95, which is directly engaged with the drive gear 101 of the input gear 94, is rotated. Accordingly, the supply roller shaft 50 causes the supply roller 37 to rotate. Further, the developing roller drive gear 115, which is directly engaged with the drive gear

101 of the input gear 94, is rotated. Accordingly, the developing roller shaft 52 causes the supply roller 37 to rotate.

[00240] Further, the external gear 104 of the intermediate gear 96, which is engaged with the drive gear 101 of the input gear 94, is rotated. The internal gear 105 of the intermediate gear 96, which is integrally formed with the external gear 104, is rotated. When the internal gear 105 of the intermediate gear 96 is rotated, the internal gear 106 of the agitator drive gear 97, which is engaged with the internal gear 105 of the intermediate gear 96, is rotated. Accordingly, the agitator rotating shaft 46 cause the agitator 45to rotate.

[00241] When the internal gear 106 of the agitator drive gear 97 is rotated, the external gear 107 of the agitator drive gear 97 integrally formed with the internal gear 106 is rotated. Then, the detection gear 98 engaged with the external gear 107 of the agitator drive gear 97 rotates.

[00242] When the developing cartridge 30 is unused, the detection gear 98 is placed in such a position as shown in FIG. 14, where the detection gear 98 is urged by the coiled spring 110 to engage with the external gear 107 of the agitator drive gear 97. Once the detection gear 98 is rotated, the tooth missing portion of the detection gear 98 faces the external gear 107 of the agitator drive gear 97, so that the detection gear 98 does not engage with the external gear 107. Consequently, the detection gear 98 will not be rotated again. The usage determination projection 109 of the unused developing cartridge 30 moves across the detection window 114 only once in one direction. In the laser printer 1, the determination as to whether the installed developing cartridge 30 is used or unused is made by detecting whether the usage determination projection 109 has been moved, with a usage detection sensor (not shown) provided in the main body casing 2

[00243] (3) Electrode member

As shown in FIGS. 6, 8 and 15, the bearing member 201 that supports an end of the developing roller shaft 52 is provided on the right sidewall 69R as a first sidewall. The bearing member 201 is formed of non-conductive resin material into a flat plate shape. A collar portion 202, which has an inside diameter substantially same as the diameter of the developing roller shaft 52, is integrally formed on the bearing member 201 at its rear end. The collar portion 202 is formed into a cylindrical shape and inserts therein the developing roller shaft 52. The end of the developing roller shaft 52 is slidably and rotatably supported on the inner peripheral surface of the collar portion 202.

[00244] (0138) Two engagement openings 128 are formed on the rear side of the bearing member 201, so as to interpose the collar portion 202 between the engagement openings 128 in the vertical direction. An opening (not shown) for receiving the supply roller shaft 50 is formed on the front side of the bearing member 201. Two engagement projections 129 are formed on the right sidewall 69R at positions corresponding to the engagement openings 128. The bearing member 201 is attached to the right sidewall 69R such that the rear end of the bearing member 201 becomes flush with the rear end of the right sidewall 69R. With the bearing member 201 attached to the right sidewall 69R, the developing roller shaft 52 and the supply roller shaft 50 are inserted into the collar portion 202 and the opening (not shown), respectively, and the engagement projections 129 are fitted into the relevant the engagement openings 128.

[00245] The electrode member 117 as an electrode for applying the developing bias to the developing roller shaft 52 is formed on the surface of the bearing member 201. The electrode member 117 is formed of a conductive resin including carbon powders. The electrode member 117 is provided integrally with an attachment plate 120, the developing roller shaft covering portion 118, as a developing roller shaft supporting portion, and a terminal portion 119.

[00246] The attachment plate 120 is formed of a thin plate into a substantially triangular shape in side view. The developing roller shaft covering portion 118 is provided on the rear end of the attachment plate 120. The developing roller shaft covering portion 118 is formed into a cylindrical shape to receive an end of the developing roller shaft 52 and is disposed concentrically with the collar portion 202. The developing roller shaft covering portion 118 extends in the first direction from the rear end of the attachment plate 120.

[00247] The developing roller shaft 52 has a large diameter portion, which is supported by the collar portion 202, and a small diameter portion, which is supported by the developing roller shaft covering portion 118. The diameter of the large diameter portion is greater than that of the small diameter portion. The outside diameter of the developing roller shaft covering portion 118 is substantially the same as the inside diameter of the collar portion 202. When the developing roller shaft covering portion 118 is inserted over the developing roller shaft 52, a part of the developing roller shaft covering portion 118 is fitted into the collar portion 202.

[00248] The terminal portion 119 is provided on the front end of the attachment plate 120 with some distance between the terminal portion 119 and the developing roller shaft covering portion 118 in the front-rear direction. The terminal portion 119 is provided with a base 121, a contact plate 122, as a contact portion.

[00249] The base 121 is provided integrally with a base plate 123 that extends in the vertical direction to form a substantially elliptical shape in side view, and a loop-shaped outer rim plate 124 that extends outward in the width direction of the developing cartridge 30 from the outer periphery of the base plate 123. A part of the outer rim plate 124 formed on the upper end of the base plate 123, extends outward in the first direction longer than the remaining part of the outer rim plate 124.

[00250] The contact plate 122 is of a substantially "U" shape in side view that is open downward. The contact plate 122 extends outward in the first direction from the outer rim plate 124 formed on the upper end of the base 121.

[00251] The attachment plate 120 is formed with an upper reinforcing rib 125, a lower reinforcing rib 126, and a supply roller shaft covering portion 127, as a supply roller supporting portion. The upper reinforcing rib 125 extends outward in the first direction from the attachment plate 120. The upper reinforcing rib 125 is formed such that it extends rearward and downward toward the developing roller shaft covering portion 118 from the rear end of the contact plate 122 and is connected to the developing roller shaft covering portion 118.

[00252] The lower reinforcing rib 126 extends outward in the first direction from the attachment plate 120 to form a substantially upward-open "U" shape in side view while covering the lower part of the terminal portion 119. More specifically, the lower reinforcing rib 126 includes a first lower reinforcing rib 126A, a second lower reinforcing rib 126B, and a third lower reinforcing rib 126C that are continuously formed.

[00253] The first lower reinforcing rib 126A extends rearward and downward from its upper end. The upper end of the first lower reinforcing rib 126A is connected to the upper reinforcing rib 125 provided between the developing roller shaft covering portion 118 and the terminal portion 119. The lower end of the first lower reinforcing rib 126A is connected to the third lower reinforcing rib 126C.

[00254] The upper end of the second lower reinforcing rib 126B is connected to the front lower end of the base 121. The upper end of the second lower reinforcing rib 126B extends rearward and downward parallel to the first lower reinforcing rib 126A. The

lower end of the second lower reinforcing rib 126B is connected to the third lower reinforcing rib 126C.

[00255] The third lower reinforcing rib 126C is disposed below the base 121 so as to connect the lower ends of the first lower reinforcing rib 126A and the second lower reinforcing rib 126B.

[00256] (0145) The supply roller shaft covering portion 127 is disposed between the base 121 and the third lower reinforcing rib 126C. The supply roller shaft covering portion 127 is formed into a cylindrical shape to receive an end of the supply roller shaft 50. The supply roller shaft covering portion 127 extends outward in the first direction from the attachment plate 120 shorter than the outer rim plate 124.

[00257] A screw hole (not shown) is formed on the base plate 123 of the base 121. A screw hole (not shown) is formed on the bearing member 201 at a position corresponding to the screw hole on the base plate 123. A threaded hole (not shown) is formed on the right sidewall 69R at a position corresponding to the screw hole on the base plate 123.

[00258] The electrode member 117 is attached to the right sidewall 69R, while inserting ends of the developing roller shaft 52 and the supply roller shaft 50 into the developing roller shaft covering portion 118 and the supply roller shaft covering portion 127, respectively, using a screw 130 that is inserted into the screw hole on the base plate 123 and screwed into the threaded hole of the right wide wall 69R, through the screw hole on the bearing member 201.

[00259] With such a structure, the end of the developing roller shaft 52 slidably contacts the inner peripheral surface of the developing roller shaft covering portion 118. Similarly, the end of the supply roller supply shaft 50 slidably contacts the inner peripheral surface of the supply roller shaft covering portion 127.

[00260] When the process cartridge 20 having the developing cartridge 30 set therein is installed in the main body casing 2, a developing bias terminal 131, as a feeding member, provided in the main body casing 2, elastically contacts the upper surface of the contact plate 122, as shown in FIG. 15 by the imaginary line.

[00261] More specifically, the contact plate 122 is disposed near the supply roller shaft 50 inserted into the supply roller shaft covering portion 127 with respect to the vertical direction. The developing bias terminal 131 elastically contacts the contact plate 122 on its surface opposite to the surface facing the supply roller supply shaft 50.

[00262] The developing bias terminal 131 is connected to a high-voltage circuit board (not shown) that is provided in the main body casing 2 to apply the developing bias. When the developing bias terminal 131 elastically contacts the upper surface of the contact plate 122, the developing bias from the high-voltage circuit board is applied to the developing roller shaft 52, via the electrode member 117 formed of conductive resin. Then, the developing bias is applied to the conductive rubber roller 53 from the developing roller shaft 52.

[00263] The electrode member 117 supports both the developing roller shaft 52 and the supply roller shaft 50, so that the same bias as the developing bias is applied to the conductive sponge roller 51, via the supply roller shaft 50.

[00264] (4) Relative positions of input gear and electrode member

In the developing cartridge 30, the contact plate 122 of the electrode member 117 is disposed within a plane of projection when the input gear 94 is projected in a direction parallel to the developing roller shaft 52, that is in the first direction, as shown in FIGS. 11, 13, and 15.

[00265] More specifically, as shown in FIGS. 19 and 20, the contact plate 122 of the electrode member 117 is disposed within a plane of projection when the driven coupling part 100 of the input gear 94 is projected in the first direction. Further, the contact plate 122 is disposed to contact the developing bias terminal 131 in a plane of projection when the driven coupling part 100 is projected in the first direction. Especially, the contact plate 122 is disposed to contact the developing bias terminal 131 on the extension line (a second axis line X2 as will be described below) of the input gear supporting shaft 99 on which the driven coupling part 100 rotates.

[00266] As shown in FIG. 11, a first axis line X1, which is an axis of the developing roller shaft 52, and the second axis line X2 which is an axis of the input gear 94 are disposed parallelly and equidistantly in the front-rear direction. A part of the contact plate 122 of the electrode member 117 is disposed on the second axis line X2. More specifically, as shown in FIG. 13, a first line L1 connects, in a direction perpendicular to the axial direction of the developing roller shaft 52, an axis of the input gear supporting shaft 99, on which the input gear 94 rotates, and an axis of the developing roller shaft 52, on which the developing roller 38 rotates. As shown in FIG. 15, a second line L2 connects, in a direction perpendicular to the axial direction of the developing roller shaft 52, a contact point of the contact plate 122 to the developing bias terminal 131, which is a part of the

contact plate 122 of the electrode member 117, and the axis of the developing roller shaft 52, on which the developing roller 38 rotates. As shown in FIG. 11, the first line L1 and the second line L2 are parallel to each other. A first distance D1 between the first axis line X1 and the second axis line X2 on the first line L1, as shown in FIG. 13, and a second distance D2 between the first axis line X1 and the second axis line X2 on the second line L2, as shown in FIG. 15, are equal.

[00267] (5) Effects of developing cartridge

In the above-structured developing cartridge 30, the contact plate 122 of the electrode member 117 is disposed within a plane of projection when the input gear 94 is projected in a direction parallel to the developing roller shaft 52, which is in the first direction. More specifically, the contact plate 122 of the electrode member 117 is disposed in a plane of projection when the driven coupling part 100 is projected in the first direction. In some aspects, the contact plate 122 contacts the developing bias terminal 131 within a plane of projection when the driven coupling part 100 is projected in the first direction. Especially, the contact plate 122 contacts the developing bias terminal 131 on the extension line of the input gear supporting shaft 99 on which the driven coupling part 100 rotates. Further, the first axis line X1 and the second axis line X2 are parallel to each other. A part of the contact plate 122 of the electrode member 117 is disposed on the second axis line X2. More specifically, the first line L1 and the second first line L2 are parallel to each other and the first distance D1 and the second distance D2 are equal.

[00268] Therefore, even when such rotation or torsion power is exerted on the developing cartridge 30 that produces rotation or torsion of the developing cartridge 30 about the input gear 94 when the drive force from the motor is input to the driven coupling part 100 from the drive coupling part 200, significant influences of the rotation or torsion power on the contact plate 122 of the electrode member 117 can be prevented. Consequently, the contact plate 122 is prevented from being placed out of position. Thus, the contact plate 122 and the developing bias terminal 131 stably contact each other, so that power can be stably supplied to the developing roller shaft 52 from the electrode member 117.

[00269] If the contact point between the contact plate 122 and the developing bias terminal 131 is placed at any position within a plane of projection when the driven coupling part 100 is projected in the first direction, influences by the rotation or torsion power can be minimized.

[00270] Further, in the developing cartridge 30, each end of the developing roller 38 is supported in the left or right sidewalls 69L, 69R by rotatably supporting each end of the developing roller shaft 52 in the left or right sidewalls 69L, 69R. Accordingly, while the developing roller 38 is securely supported, the developing bias can be stably applied to the rubber roller 53.

[00271] One end of the developing roller shaft 52 is rotatably supported in the developing roller shaft inserting portion 111 of the gear cover 93, via the collar member 116. The other end of the developing roller shaft 52 is rotatably supported in the developing roller shaft covering portion 118 of the electrode member 117. Each end of the developing roller 38 is also supported by the developing roller shaft inserting portion 111 of the gear cover 93 or the developing roller shaft covering portion 118 of the electrode member 117. Thus, the developing roller 38 can be securely supported while the developing roller shaft 52 is efficiently inserted into the developing roller shaft inserting portion 111 of the gear cover 93 and the developing roller shaft covering portion 118 of the electrode member 117. Therefore, the developing bias can be stably applied to the rubber roller 53.

[00272] In the developing cartridge 30, the electrode member 117 is formed of conductive resin. Therefore, the electrode member 117 can be formed into any shape to stably apply the developing bias to the rubber roller 53.

[00273] When the process cartridge 20 having the developing cartridge 30 set therein is installed in the main body casing 2, the developing bias terminal 131 elastically contacts the upper surface of the contact plate 122. The developing bias is applied from the developing bias terminal 131 to the developing roller shaft 52 by the high-voltage circuit board, via the electrode member 117. Then, the developing bias is applied from the developing roller shaft 52 to the conductive rubber roller 53. Thus, the developing bias can be reliably applied from the electrode member 117 to the rubber roller 53.

[00274] The developing roller shaft 52 is formed of metal, so that the developing bias can be further reliably applied from the electrode member 117 to the rubber roller 53. In addition, in the developing cartridge 30, the developing roller shaft covering portion 118 of the electrode member 117 rotatably supports the developing roller shaft 52. Therefore, it is not necessary to support the developing roller shaft 52 with another member or components. Thus, reduction of the number of components and costs can be achieved.

[00275] In the developing cartridge 30, the input gear 94 is provided integrally with the driven coupling part 100 and the drive gear 101. Therefore, while the driven

coupling part 100 can reliably receive the drive force from the drive coupling part 200, the drive gear 101 conveys the drive force to the supply roller drive gear 95, the developing roller drive gear 115, and the intermediate gear 96. Thus, the supply roller shaft 50 and the developing roller shaft 52, as well as the agitator rotating shaft 46 can be reliably rotated.

[00276] The driven coupling part 100 is of a hollow cylindrical shape. The driven coupling part 100 is formed as gear teeth with the engagement stopper portions 102 extending radially inward from the inner peripheral surface of the driven coupling part 100. Therefore, as the engagement stopper portions 102 are engaged with the drive coupling part 200, the drive force can be reliably received from the drive coupling part 200.

[00277] As the drive gear 101 of the input gear 94 is engaged directly with the developing roller drive gear 115, the drive force, which is input from the drive coupling part 200 to the input gear 94, is directly transmitted to the developing roller drive gear 115 from the input gear 94. Therefore, the developing roller 38 can be reliably rotated. Further, as the drive force is thus transmitted, drive force from the main body casing 2 is not directly transmitted to the developing roller drive gear 115, so that the developing roller shaft 52 can be used as a guide. More specifically, when the developing cartridge 30 is installed in the developing cartridge installation portion 147, the collar member 116 and the developing roller shaft covering portion 118 provided on the developing roller shaft 52 are guided along the guide grooves 153. Thus, the developing roller shaft 52 can be used as a guide. Consequently, a guide does not have to be additionally provided, and the number of components to be used and costs can be reduced.

[00278] The drive gear 101 of the input gear 94 also engages directly with the supply roller drive gear 95, so that the drive force input from the drive coupling part 200 to the input gear 94 is transmitted directly to the supply roller drive gear 95. Therefore, the supply roller 37 can be reliably rotated. Further, as the drive force is thus transmitted, the drive force is directly transmitted from the input gear 94 to the developing roller drive gear 115 and the supply roller drive gear 95. Thus, the drive force can be transmitted effectively, and the developing roller 38 and the supply roller 37 can be effectively rotated.

[00279] The electrode member 117 is provided with the developing roller shaft covering portion 118 and the supply roller shaft covering portion 127. Accordingly, the developing roller shaft 52 and the supply roller shaft 50 can be reliably supported by the developing roller shaft covering portion 118 and the supply roller shaft covering portion 127, respectively.

[00280] When the developing cartridge 30 is installed in the main body casing 2, the developing bias terminal 131 elastically contacts the upper surface of the contact plate 122, which is positioned above the developing roller shaft covering portion 118 and the supply roller shaft covering portion 127 and is opposite to the surface facing the supply roller shaft 50. Therefore, reliable contact between the developing bias terminal 131 and the contact plate 121 can be achieved. Thus, the developing bias can be reliably applied by the high-voltage circuit board (not shown) to the contact plate 122, via the developing bias terminal 131.

[00281] When the developing cartridge 30 is installed in the developing cartridge installation portion 147 of the drum frame 58, the front ends of the bosses 132 contact the relevant pressing levers 150. By the urging force of the compression springs that urge the pressing levers 150, each boss 132 is pressed rearward by the relevant pressing lever 150. Thus, the developing roller 38 is pressed against the photoconductive drum 28. With the reliable contact between the developing roller 38 and the photoconductive drum 28, the electrostatic latent image formed on the photoconductive drum 28 can be reliably developed by the toner carried on the developing roller 38.

[00282] Each boss 132 extends outwardly in the first direction from the outer surface of each left and right sidewall 69L, 69R at a front lower side of each sidewall 69L, 69R. With such a structure, the bosses 132 can reliably contact the relevant pressing levers 150, so that reliable contact between the developing roller 38 and the photoconductive drum 28 can be ensured.

[00283] The developing cartridge 30 is removably installed in the drum cartridge 27. The developing cartridge 30 can be replaced with a new one in accordance with the residual amount of the toner, regardless of the life of the photoconductive drum 28. The drum cartridge 27 can be replaced in accordance with the life of the photoconductive drum 28, regardless of the residual amount of the toner contained in the developing cartridge 30.

[00284] 3. Other Aspects

(1) Electrode member according to other aspects

In the above description, the electrode member 117, as an electrode, including the attachment plate 120, the developing roller shaft covering portion 118, and the terminal portion 119, is integrally formed of conductive resin, as shown in FIGS. 6, 8 and 15. However, the attachment plate 120, the developing roller shaft covering portion

118, and the terminal portion 119 may be separately formed and then assembled together into the electrode member 117.

[00285] For example, the terminal portion 119 provided with the base 121 and the contact plate 122 may be integrally formed of metal, as an electrode. The attachment plate 120 and the developing roller shaft covering portion 118 may be integrally formed of conductive resin, as a conductive member. Then, the terminal portion 119 may be secured to the attachment plate 120 using the screw 130. Thus, the electrode member 117 may be formed.

[00286] With such electrode member 117, the developing bias can be reliably applied to the contact plate 122 from the developing bias terminal 131 because the terminal portion 119 is formed of metal. Power can be reliably supplied to the developing shaft 52, via the attachment plate 120 and the developing roller shaft covering portion 118, from the terminal portion 119, which is a part of the electrode member 117.

[00287] The terminal portion 119 indirectly contacts the developing shaft 52, via the attachment plate 120 and the developing roller shaft covering portion 118. Therefore, the position of the terminal portion 119 relative to the developing roller shaft 52 or the position of the developing roller shaft 52 relative to the terminal portion 119 can be selected freely. Thus, while improving the design efficiency, power can be reliably supplied from the contact plate 122 to the developing roller shaft 52.

[00288] (2) Developing roller shaft according to other aspects

In the above description, the developing roller shaft 52 is formed of metal. However, the developing roller shaft 52 may be formed of conductive resin. Further, the developing roller shaft 52 may be formed of an insulating material, such as an insulating resin material.

[00289] When the developing roller shaft 52 is formed of an insulating material, the electrode member 117 and the rubber roller 53 may be electrically connected and the developing bias may be directly applied from the electrode member 117 to the rubber roller 53. In this case, the resistance of the rubber roller 53 may be set lower than that of the rubber roller 53 according to the above-described aspects.

[00290] For example, as shown in FIG. 18, the surface of an insulating developing roller shaft 52A, may be covered with a conductive sheet 154 formed of metal foil, such as an aluminum foil, so as to contact the rubber roller 53. The conductive sheet 154 may contact the inner peripheral surface of the developing roller shaft covering portion

118. With such a structure, the developing bias may be applied from the electrode member 117 to the rubber roller 53, via the conductive sheet 154.

[00291] (3) Input gear according to other aspects

In the above description, the input gear 94 is integrally formed with the driven coupling part 100 and the drive gear 101. However, the input gear 94 may be integrally formed with, for example, the drive gear 101 and the engagement stopper portions 102.

[00292] FIG. 21 is a perspective view of the developing cartridge, corresponding to FIG. 6, with an electrode member detached from the developing cartridge. FIG. 22 is a perspective view of the developing cartridge, corresponding to FIG. 8, with the electrode member detached from the developing cartridge. FIG. 23 is a right side view of the developing cartridge, corresponding to FIG. 15. FIG. 24 is a sectional view of the developing cartridge taken along line A-A of FIG. 23. FIG. 25 is a sectional view of the developing cartridge taken along line B-B of FIG. 23.

[00293] With reference to FIGS. 21 to 25, the developing cartridge according to some further aspects will be described in detail below. It is to be noted that the similar reference numerals designate similar components, and a detailed explanation thereof is omitted.

[00294] (1) Developing frame

The developing cartridge 30 according to some aspects has the developing frame 36 similar to that of the developing cartridge 30 according to above-described aspects, except for the following structures.

[00295] As shown in FIGS. 21 and 22, the developing frame 36 according to some aspects has a cylindrical screw portion 79, as a screw portion, for attaching the electrode member 117 to the right sidewall 69R closing the side (right side) of the developing chamber 42. The cylindrical screw portion 79 is of a cylindrical shape extending outward from the right sidewall 69R. Threaded grooves are formed on the inner circumferential surface of the cylindrical screw portion 79 for screwing a shaft 130a of the screw 130 into the cylindrical screw portion 79. Upper and lower ends of a free end 79a of the cylindrical screw portion 79 are cut out along the front-rear direction. Thus, the free end 79a is of substantially oval shape having flat portions on the upper and lower end thereof extending in the front-rear direction.

[00296] (2) Gear mechanism portion and gear cover

The developing cartridge 30 according to some aspects has the gear mechanism portion 92 and the gear cover 93 similar to those of the developing cartridge 30 according to earlier described aspects.

[00297] (3) Electrode member

The developing cartridge 30 according to some aspects has the electrode member 117 similar to that of the developing cartridge 30 according to earlier described aspects, except for the following structures.

[00298] An opening 161 is formed on the front side of the bearing member 201. When the bearing member 201 is attached to the right sidewall 69R, the developing roller shaft 52 is inserted into the collar portion 202 and the supply roller shaft 50 is inserted into the opening 161. To prevent the cylindrical screw portion 79, which extends outward from the right sidewall 69R in the first direction from interfering with the bearing member 201, a part of the outer periphery of the bearing member 201 where the cylindrical screw portion 79 extends, is cut out. When the bearing member 201 is attached to the right sidewall 69R, the cylindrical screw portion 79 is exposed from the outer periphery of the bearing member 201.

[00299] The electrode member 117, as an electrode for applying developing bias to the developing roller shaft 52, is provided separately from the bearing member 201 on the right sidewall 69R, such that a part of the bearing member 201 is interposed between the right sidewall 69R and the electrode member 117. As shown in FIG. 24, the base plate 123, as an attached portion, of the electrode member 117, is disposed parallel to the attachment plate 120 at a position outward of the attachment plate 120 with respect to the first direction. As shown FIGS. 21 and 22, a screw hole 140, as an insertion portion, is formed at a substantially central portion of the base plate 123. In association with the free end 79a of the cylindrical screw portion 79, the screw hole 140 is of a substantially oval shape having flat portions that extend in the front-rear direction.

[00300] The outer rim plate 124 extends in the first direction from the outer periphery of the base plate 123 so as to connect the base plate 123 and the attachment plate 120. In the developing cartridge 30 according to some aspects, the electrode member 117 is attached to the right sidewall 69R in the following manner. First, ends of the developing roller shaft 52 and the supply roller shaft 50 are inserted into the developing roller shaft covering portion 118 and the supply roller shaft covering portion 127, respectively. At the

same time, the cylindrical screw portion 79 provided on the right sidewall 69R is inserted into the screw hole 140 on the base plate 123, to fit the free end 79a of the cylindrical screw portion 79 in the screw hole 140. Thereafter, the screw 130, as a fixing member, is screwed into the cylindrical screw portion 79 exposed from the base plate 123.

[00301] The screw 130 is integrally formed with the shaft 130a having screw threads formed along an axial direction thereof and a screw head 130b provided on an end of the shaft 130a, as a separation prevention part, that extends, like a mushroom, in the radial direction of the shaft 130a. The diameter of the screw head 130b is the same as or slightly larger than the diameter of the cylindrical screw portion 79.

[00302] As shown in FIGS. 24 and 25, the screw 130 is screwed into the cylindrical screw portion 79, until an inward end face If, as a second end face, of the screw head 130b with respect to the axial direction of the screws 130 contacts a free end face Ff, as a third end face, of the cylindrical screw portion 79.

[00303] As the electrode member 117 is thus attached to the right sidewall 69R, the attachment plate 120 disposed between the developing roller shaft covering portion 118 and the base 121 contacts the bearing member 201, so that the electrode member 117 is positioned with respect to the first direction (width direction of the developing cartridge 30). The free end face Ff of the cylindrical screw portion 79 is disposed to protrude outward in the first direction toward the side of the screw head 130b slightly (e.g., 0.2 mm) from an outward face Of, as a first end face, of the base plate 123.

[00304] The inward end face If of the screw head 130b with respect to the axial direction of the screws 130 is disposed so as to contact the free end face Ff of the cylindrical screw portion 79 and to face the outward face Of of the base plate 123 with a small distance (e.g., 0.2 mm) above and below the screw shaft 130a. The screw head 130b restricts or prevents, at a position opposite to the free end face Ff of the cylindrical screw portion 79, the separation or removal of the base plate 123 from the cylindrical screw portion 79.

[00305] Due to the distance between the inward end face If of the screw head 130b and the outward face Of of the base plate 123, the electrode member 117 does not make intimate contact with the outward face Of of the base plate 123. Accordingly, the electrode member 117 can move slightly, in association with a small clearance between the electrode member 117 and the cylindrical screw portion 79. When the developing bias terminal 131 provided in the main body casing 2 elastically contacts the upper surface of

the contact plate 122, the developing roller shaft covering portion 118 moves slightly within the range of the small clearance between the electrode member 117 and the cylindrical screw portion 79. Accordingly, the outer circumferential surface of the end of the developing roller shaft 52 makes slidable and intimate contact with the inner circumferential surface of the developing roller shaft covering portion 118. Thus, the end of the developing roller shaft 52 is rotatably supported by the developing roller shaft covering portion 118. The supply roller shaft covering portion 127 also moves within the range of the small clearance. Therefore, the outer circumferential surface of the end of the supply roller shaft 50 also makes slidable and intimate contact with the inner circumferential surface of the supply roller shaft covering portion 127. Thus, the end of the supply roller shaft 50 is rotatably supported by the supply roller shaft covering portion 127.

[00306] (4) Effects of developing cartridge

As described above, in the developing cartridge 30, the electrode member 117 can move slightly within the range of the small clearance. When the developing bias terminal 131 provided in the main body casing 2 elastically contacts the upper surface of the contact plate 122, the developing roller shaft covering portion 118 moves within the range of the small clearance. Accordingly, while the outer circumferential surface of the end of the developing roller shaft 52 reliably makes contact with the inner circumferential surface of the developing roller shaft covering portion 118, the developing roller shaft 52 is rotated. In other words, the developing roller shaft covering portion 118 rotatably supports the developing roller shaft 52, and the electrode member 117 is moved such that the developing roller shaft covering portion 118 makes reliable contact with the developing roller 52 when the developing bias terminal 131 contacts the contact plates 122. Therefore, the developing bias is reliably applied from the developing bias terminal 131 to the developing shaft 52, via the contact plate 122 and the developing roller shaft covering portion 118.

[00307] In the developing cartridge 30, the electrode member 117 is attached to the right sidewall 69R readily using the screw 130, such that the electrode member can move slightly by the small clearance.

[00308] More specifically, when the inward end face If of the screw head 130b with respect to the axial direction of the screws 130 contacts the free end face Ff of the cylindrical screw portion 79, the screw head 130b and the base plate 123 are disposed with some distance therebetween. Thus, the distance between the outward face Of of the base

plate 123 and the inward end face If of the screw head 130b can be provided precisely and reliably. Consequently, the developing roller shaft covering portion 118 can make reliable contact with the developing roller shaft 52 while ensuring smooth rotation of the developing roller shaft 52 relative to the developing roller shaft covering portion 118.

[00309] In the developing cartridge 30, the developing roller shaft covering portion 118 and the contact plate 122 are provided so as to extend outward in the first direction from the right sidewall 69R along the developing roller shaft 52. Therefore, while the contact plate 122 reliably makes contact with the developing bias terminal 131, the smooth rotation of the developing roller shaft 52 relative to the developing roller shaft covering portion 118 can be ensured and the developing roller shaft covering portion 118 can reliably make contact with the developing roller shaft 52.

[00310] In the developing cartridge 30, the supply roller shaft covering portion 127 is provided in the electrode member 117. While the supply roller shaft 50 is rotatably supported by the supply roller shaft covering portion 127, the developing bias can be applied to the supply roller shaft 50 as well.

[00311] In the developing cartridge 30, the bearing member 201 is provided on the right sidewall 69R separately from the electrode member 117. As the bearing member 201 can bear or support the developing roller shaft 52, the developing roller shaft covering portion 118 can reliably make contact with the developing roller shaft 52 while ensuring smooth rotation of the developing roller shaft 52. Even when a bearing cannot be used as the electrode member 117, power can be reliably supplied to the developing roller shaft 52.

[00312] (5) Electrode member according to other aspects

In the above-described description, with the distance between the inward end face If of the screw head 130b and the outward face Of of the base plate 123, the developing roller shaft covering portion 118 is moved such that its inner peripheral surface reliably contacts the outer peripheral surface of the end of the developing roller shaft 52. However, the developing roller shaft covering portion 118 may be moved by a different manner, such that its inner peripheral surface reliably contacts the outer peripheral surface of the end of the developing roller shaft 52.

[00313] For example, before the electrode member 117 is attached to the right sidewall 69R, the electrode member 117 may be formed such that distance between a center of the screw hole 140 of the electrode member 117 and an axis of the developing roller shaft covering portion 118 slightly differs from distance between an axis of the cylindrical

screw portion 79 and an axis of the developing roller shaft 52. As the thus-formed electrode member 117 is attached to the right sidewall 69R, the center of the screw hole 140 and the axis of the cylindrical screw portion 79 match with each other. However, the axis of the developing roller shaft covering portion 118 and the axis of the developing roller shaft 52 slightly differs from each other and does not match. Therefore, the outer peripheral surface of the end of the developing roller shaft 52 reliably contacts the inner peripheral surface of the developing roller shaft covering portion 118.

[00314] While this disclosure has been described in conjunction with the exemplary aspects outlined above, various alternatives, modifications, variations, improvements and/or substantial equivalents, whether known or may be presently unforeseeable, may become apparent to those having at least ordinary skill in the art. Accordingly, the exemplary aspects of the disclosure, as set forth above, are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the disclosure. Therefore, the disclosure is intended to embrace all known or later developed alternatives, modifications, variations, improvements and/or substantial equivalents.

INDUSTRIAL APPLICABILITY

[00315] In the developing cartridge according to the present invention, the electrode is maintained at a position, so that power can be stably supplied to the developing roller shaft. When such developing cartridge is assembled into an image forming device, excellent output image can be provided. Thus, the developing cartridge is clearly beneficial for the image forming device such as a laser printer.

What is claimed is:

1. A developing cartridge, comprising:

a case including a first sidewall and a second sidewall opposite to the first sidewall;

a developing roller disposed between the first sidewall and the second sidewall, the developing roller configured to carry a developing agent thereon, and to rotate about a first axIs line;

an electrode disposed on the first sidewall and including a terminal electrically connected to the developing roller; and

a driven coupling disposed on the second sidewall and configured to rotate about a second axis line upon receipt of a driving force, the second axis line being parallel to the first axis line and being positioned with a prescribed distance from the first axis line, an outermost periphery of the driven coupling defines a projection plane projecting in a direction of the second axis line towards the electrode,

wherein the terminal is disposed within the projection plane.

2. The developing cartridge according to claim 1,

wherein the electrode includes a base portion in contact with the first sidewall and extending portion extending in a direction away from the base portion,

wherein the terminal disposes on the extending portion.

3. The developing cartridge according to claim 1,

wherein the developing roller includes:

a developing roller shaft configured to rotate about the first axis line, and

a developing roller member configured to carry a developing agent thereon, and be disposed around the developing roller shaft.

4. The developing cartridge according to claim 3,

wherein the electrode includes a portion which surrounds a portion of the developing roller shaft.

5. The developing cartridge according to claim 4,

wherein the portion of electrode is disposed outside the projection plane.

6. The developing cartridge according to claim 3,

wherein the developing roller further includes:

a developing roller gear configured to rotate together with the developing roller shaft,

wherein the driven coupling includes a driven gear that engages with the developing roller gear.

7. The developing cartridge according to claim 1, further comprises:

a supply roller configured to supply the developing agent to the developing roller, the supply roller includes:

a supply roller shaft configured to rotate the supply roller about a third axis line,

a supply roller member configured to supply the developing agent to the developing roller, the supply roller member being disposed around the supply roller shaft, and

a supply roller gear configured to rotate together with the supply roller shaft,

wherein the third axis line is parallel to the first axis line and the second axis line.

8. The developing cartridge according to claim 7,

wherein the terminal is electrically connected to the supply roller shaft.

9. The developing cartridge according to claim 8,

wherein the developing roller includes:

a developing roller shaft configured to rotate about the first axis line, and

a developing roller member configured to carry a developing agent thereon, and be disposed around the developing roller shaft.

10. The developing cartridge according to claim 9,

wherein the electrode includes a first portion configured to surround the developing roller shaft and the second portion configured to surround the supply roller shaft.

11. The developing cartridge according to claim 9,

wherein the electrode includes a first portion configured to surround a circumferential portion of the developing roller shaft and the second portion configured to surround a circumferential portion of the supply roller shaft.

12. The developing cartridge according to claim 11,

wherein the terminal is disposed above the first portion and the second portion.

13. The developing cartridge according to claim 11,

wherein in operational state, the terminal is disposed above the first portion and the second portion.

14. The developing cartridge according to claim 1,

wherein the driven coupling includes a coupling part disposed within the outermost periphery and within the projecting plane .

15. The developing cartridge according to claim 7,

wherein a distance between the second axis line and the third axis line is smaller than a distance between the second axis line and the first axis line.

16. The developing cartridge according to claim 1,

wherein the terminal is not on the second axis line.

17. The developing cartridge according to claim 1, wherein the terminal is on the second axis line.

18. A developing cartridge, comprising:

a case including a first sidewall and a second sidewall opposite to the first sidewall;

a developing roller disposed between the first sidewall and the second sidewall, the developing roller configured to carry a developing agent thereon, and to rotate about a first axis line;

an electrode disposed on the first sidewall and including a electrical contact electrically connected to the developing roller; and

a driven coupling disposed on the second sidewall and configured to rotate about a second axis line upon receipt of a driving force, the second axis line being parallel to the first axis line and being positioned with a prescribed distance from the first axis line, an outermost periphery of the driven coupling defines a projection plane projecting in a direction of the second axis line towards the electrode,

wherein the electrical contact is disposed within the projection plane.

19. The developing cartridge according to claim 18,

wherein the electrode includes a base portion in contact with the first sidewall and extending portion extending in a direction away from the base portion,

wherein the electrical contact disposes on the extending portion.

20. The developing cartridge according to claim 18,

wherein the developing roller includes:

a developing roller shaft configured to rotate about the first axis line, and

a developing roller member configured to carry a developing agent thereon, and be disposed around the developing roller shaft.

21. The developing cartridge according to claim 20,

wherein the electrode includes a portion which surrounds a portion of the developing roller shaft.

22. The developing cartridge according to claim 21,

wherein the portion of electrode is disposed outside the projection plane ..

23. The developing cartridge according to claim 20,

wherein the developing roller further includes:

a developing roller gear configured to rotate together with the developing roller shaft,

wherein the driven coupling includes a driven gear that engages with the developing roller gear.

24. The developing cartridge according to claim 18, further comprises:

a supply roller configured to supply the developing agent to the developing roller, the supply roller includes:

a supply roller shaft configured to rotate the supply roller about a third axis line,

a supply roller member configured to supply the developing agent to the developing roller, the supply roller member being disposed around the supply roller shaft, and

a supply roller gear configured to rotate together with the supply roller shaft,

wherein the third axis line is parallel to the first axis line and the second axis line.

25. The developing cartridge according to claim 24,

wherein the electrical contact is electrically connected to the supply roller shaft.

26. The developing cartridge according to claim 25,

wherein the developing roller includes:

a developing roller shaft configured to rotate about the first axis line, and

a developing roller member configured to carry a developing agent thereon, and be disposed around the developing roller shaft.

27. The developing cartridge according to claim 26,

wherein the electrode includes a first portion configured to surround the developing roller shaft and the second portion configured to surround the supply roller shaft.

28. The developing cartridge according to claim 26,

wherein the electrode includes a first portion configured to surround a circumferential portion of the developing roller shaft and the second portion configured to surround a circumferential portion of the supply roller shaft.

29. The developing cartridge according to claim 28,

wherein the electrical contact is disposed above the first portion and the second portion.

30. The developing cartridge according to claim 28,

wherein in operational state, the electrical contact is disposed above the first portion and the second portion.

31. The developing cartridge according to claim 18,

wherein the driven coupling includes a coupling part disposed within the outermost periphery and within the projecting plane.

32. The developing cartridge according to claim 24,

wherein a distance between the second axis line and the third axis line is smaller than a distance between the second axis line and the first axis line.

33. The developing cartridge according to claim 17,

wherein the electrical contact is not on the second axis line.

34. The developing cartridge according to claim 17,
wherein the electrical contact is on the second axis line.

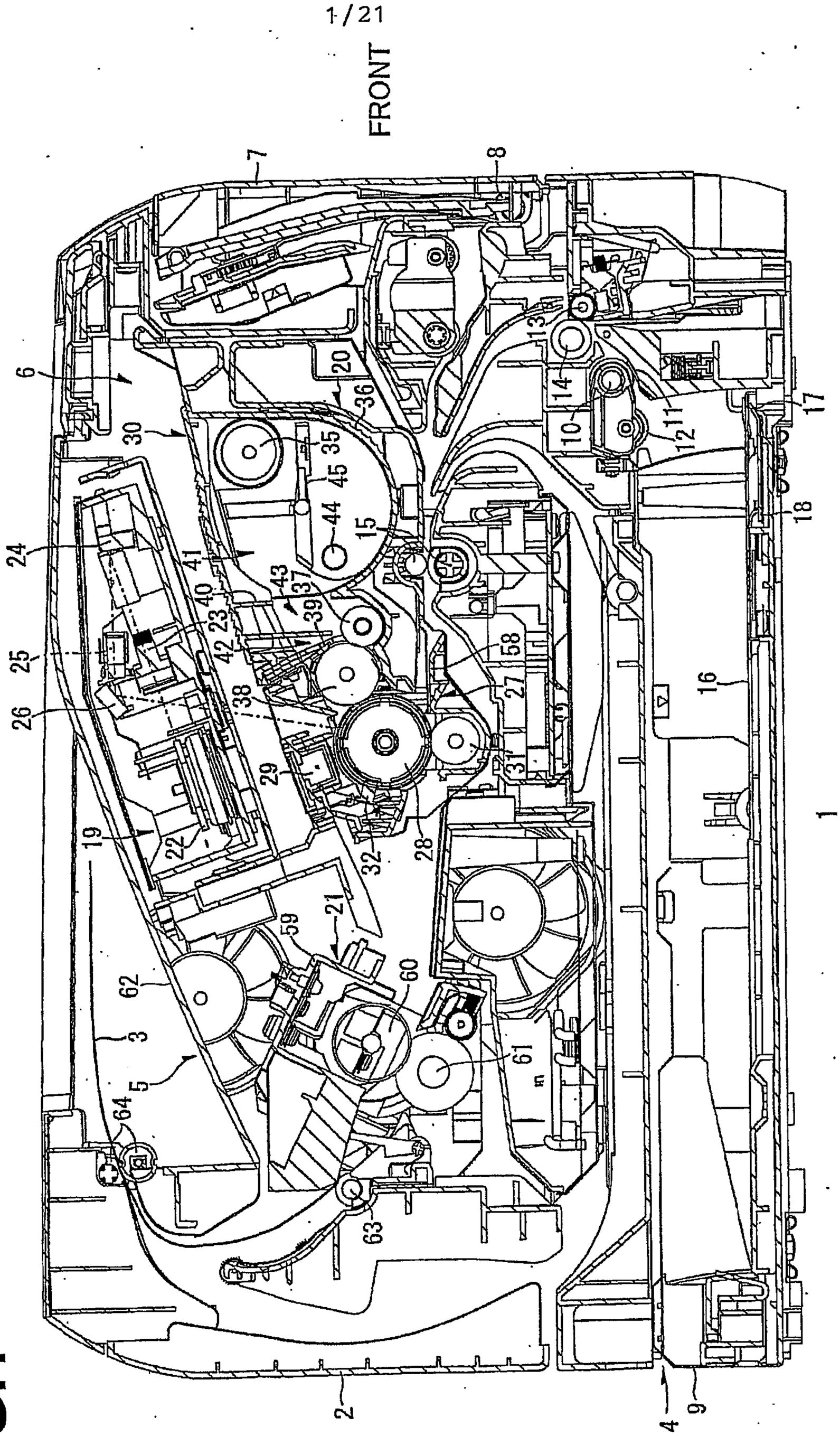

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FIG.1

FIG.2

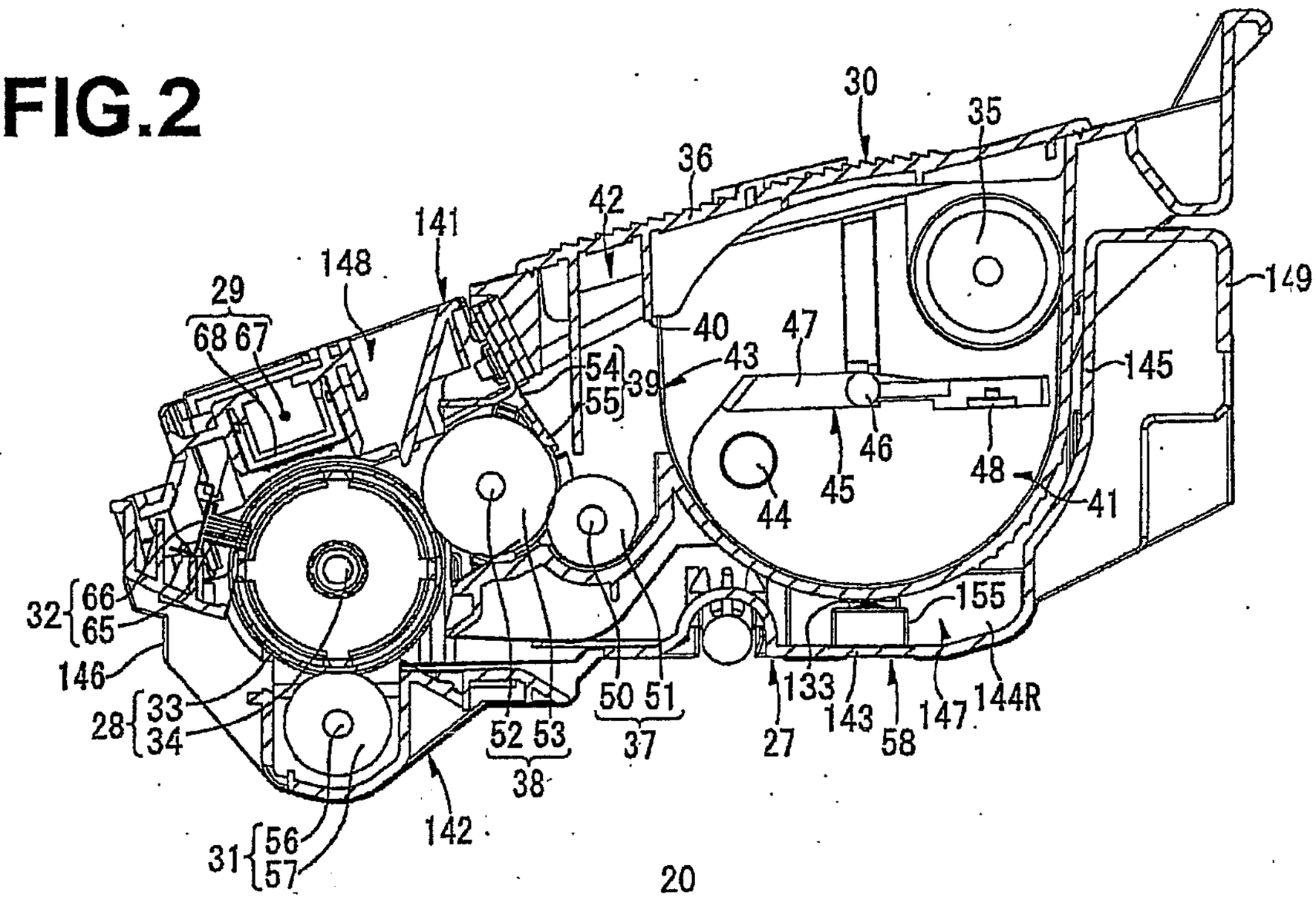
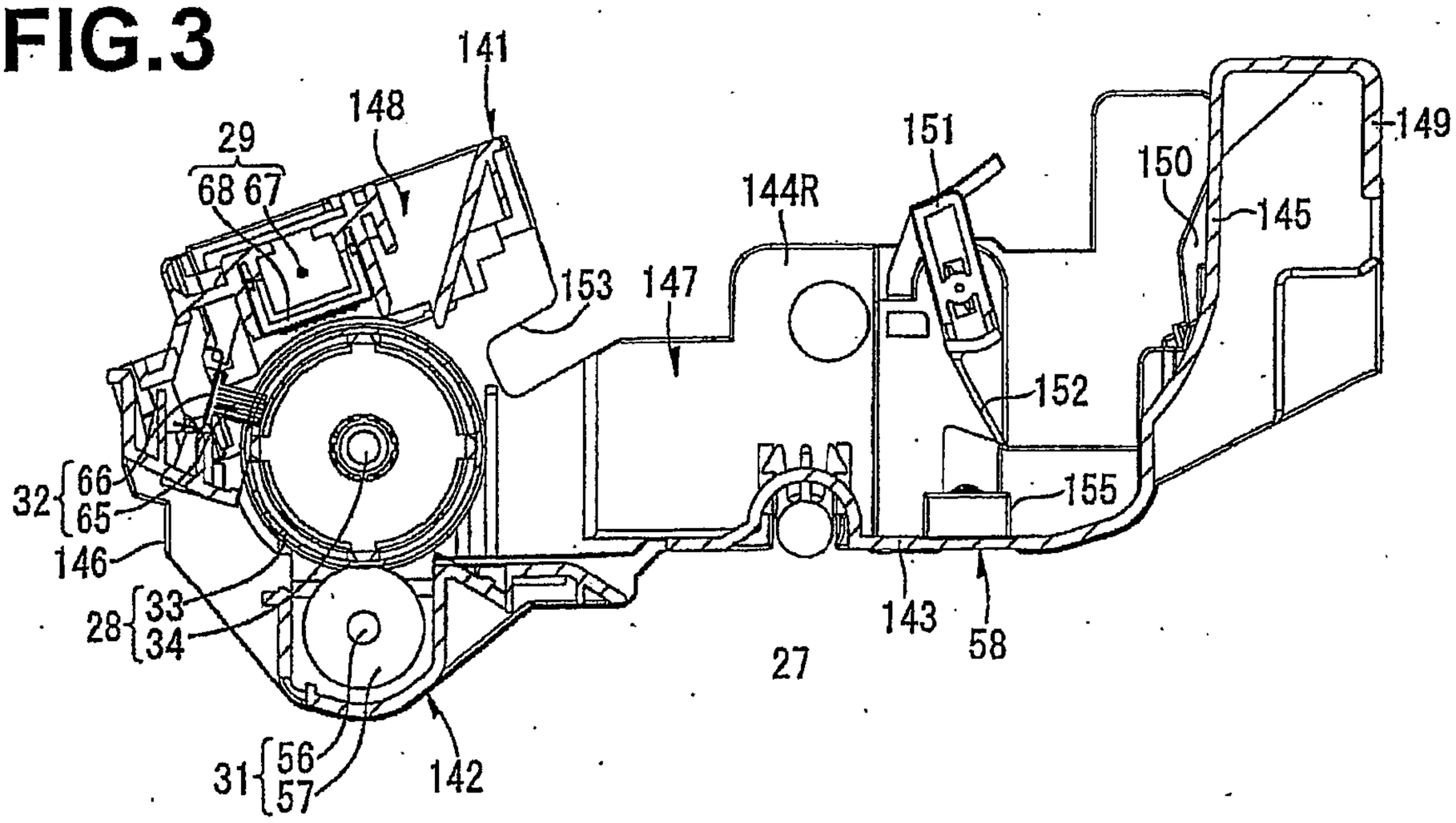

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FIG.3


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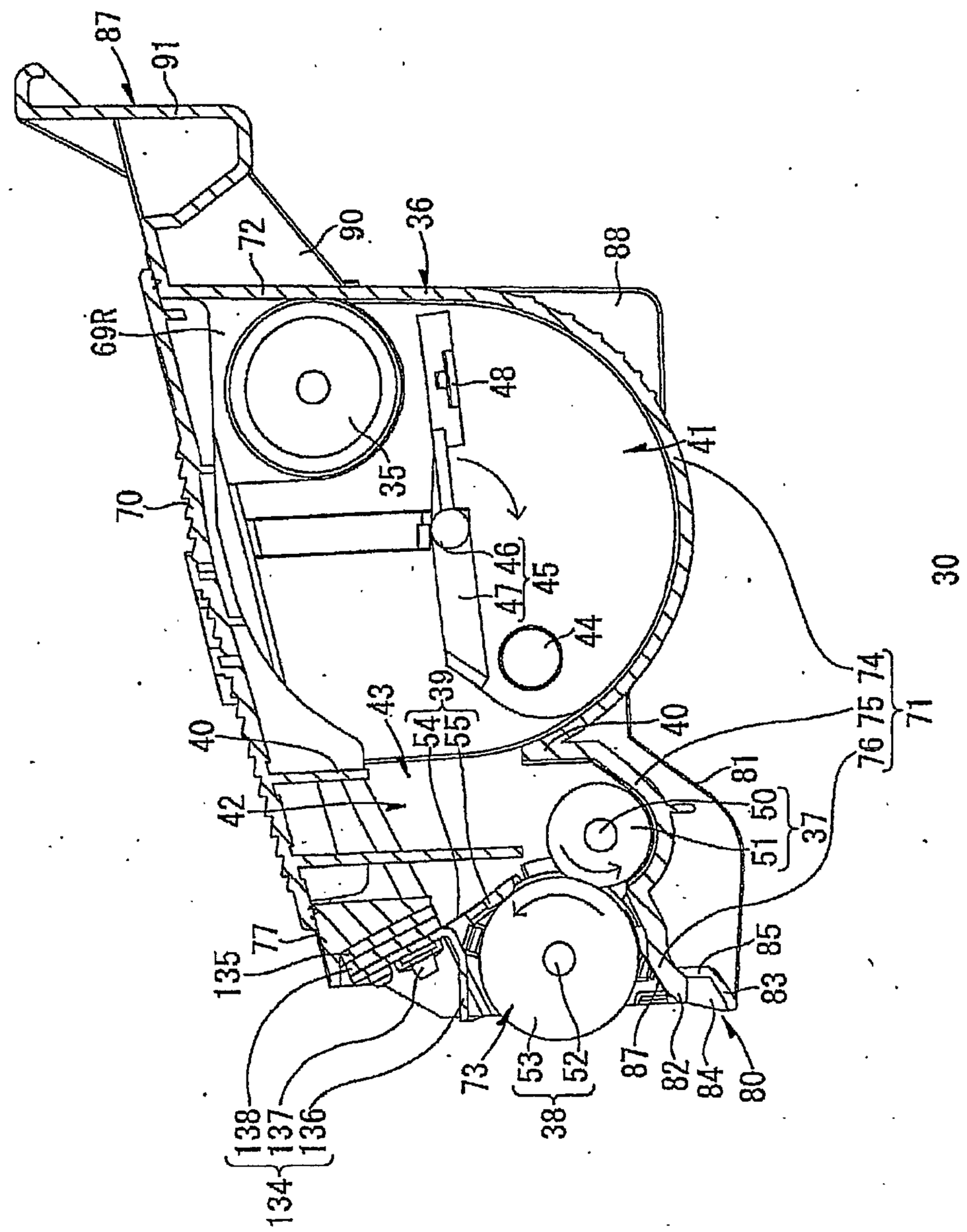

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FIG.4

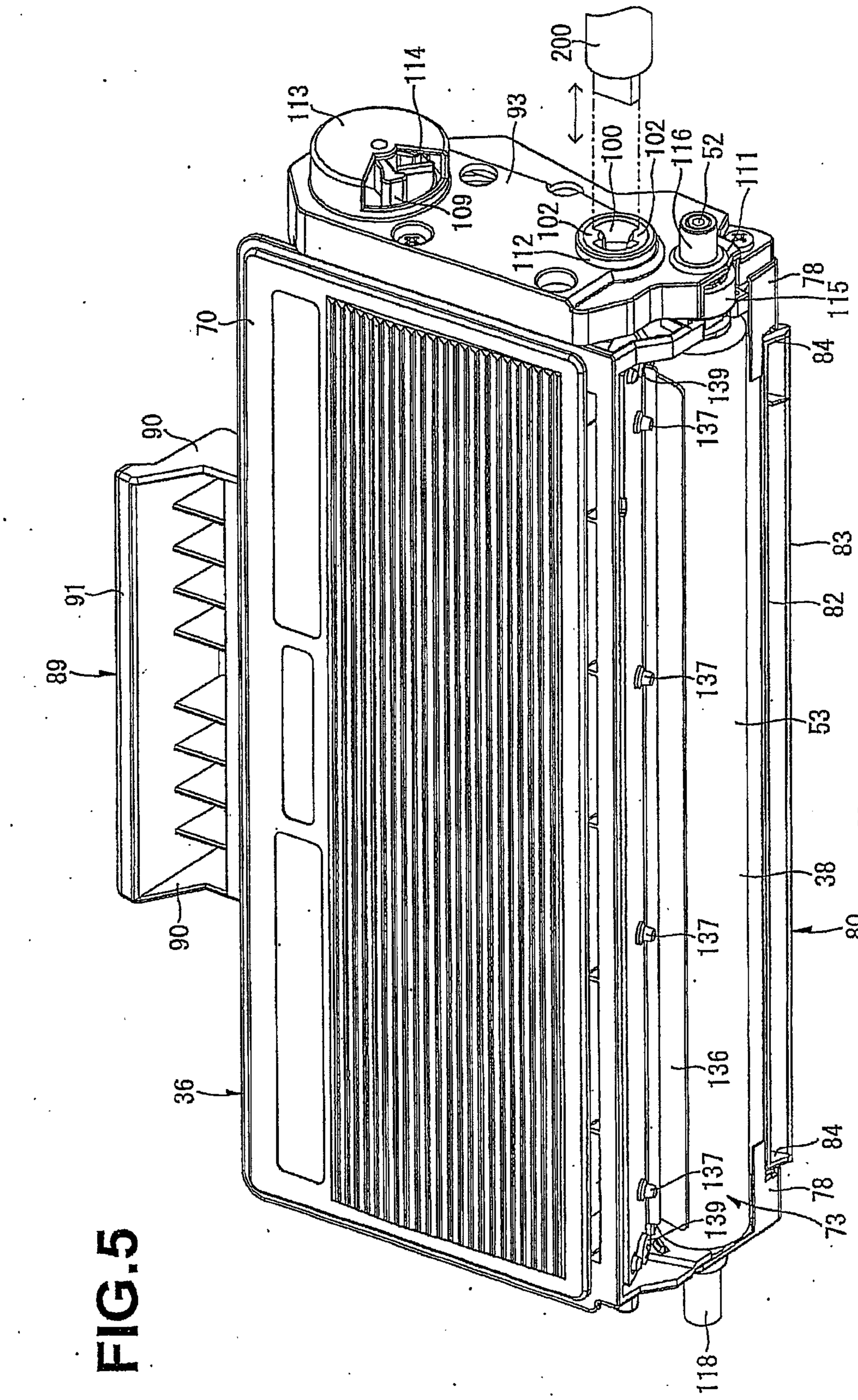

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FIG.5

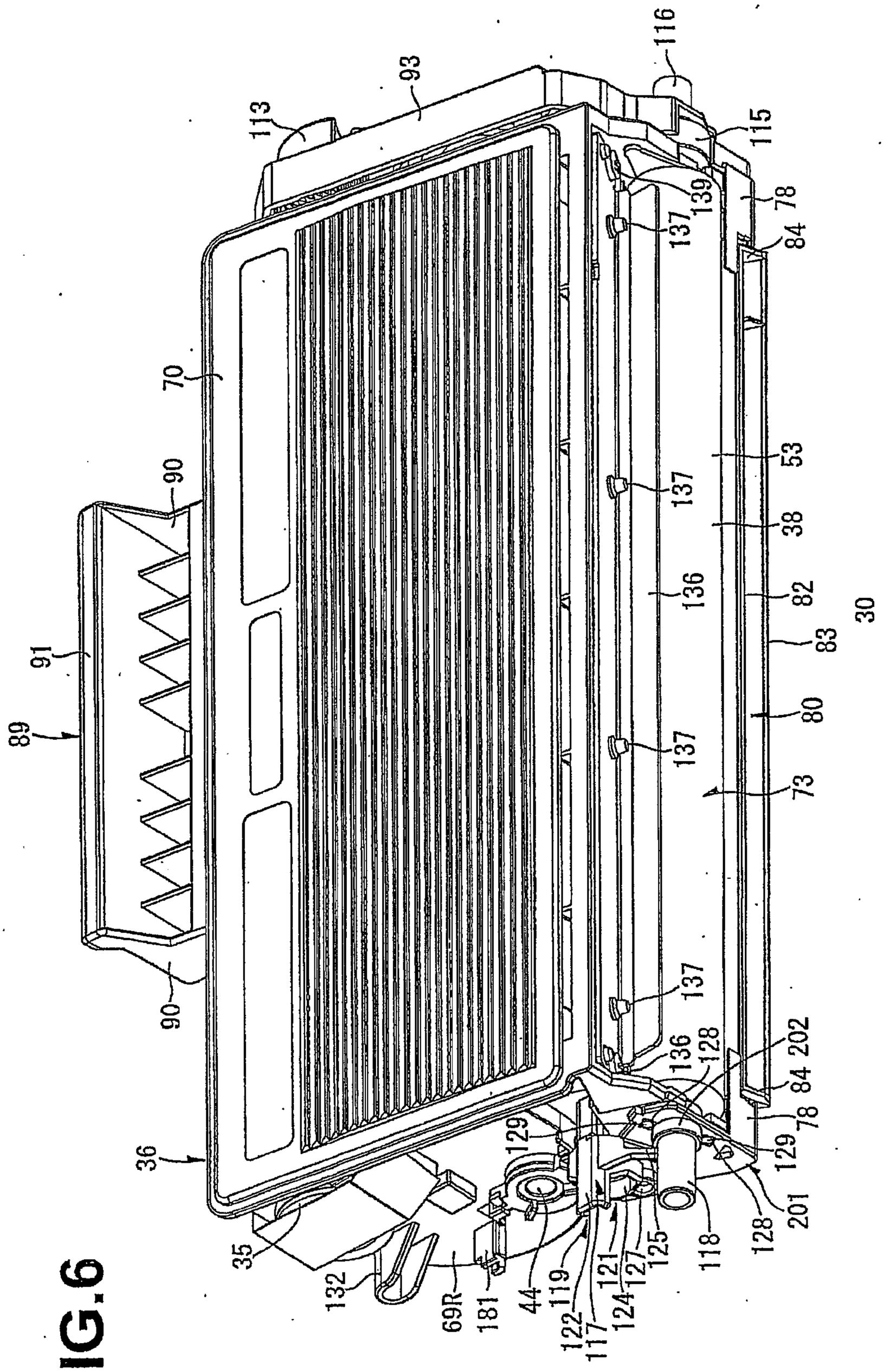

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202
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129
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69R
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FIG.6

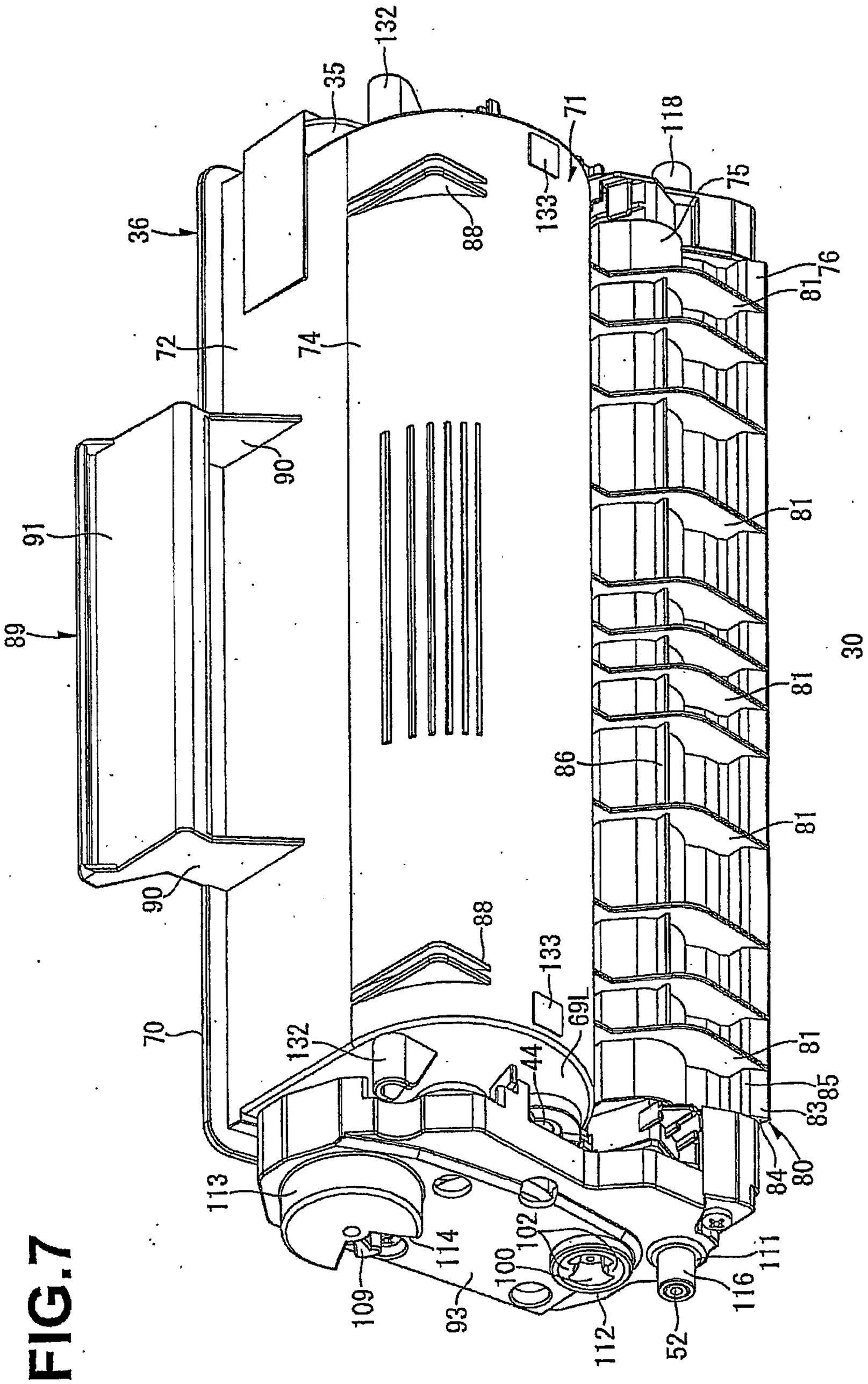

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FIG.7

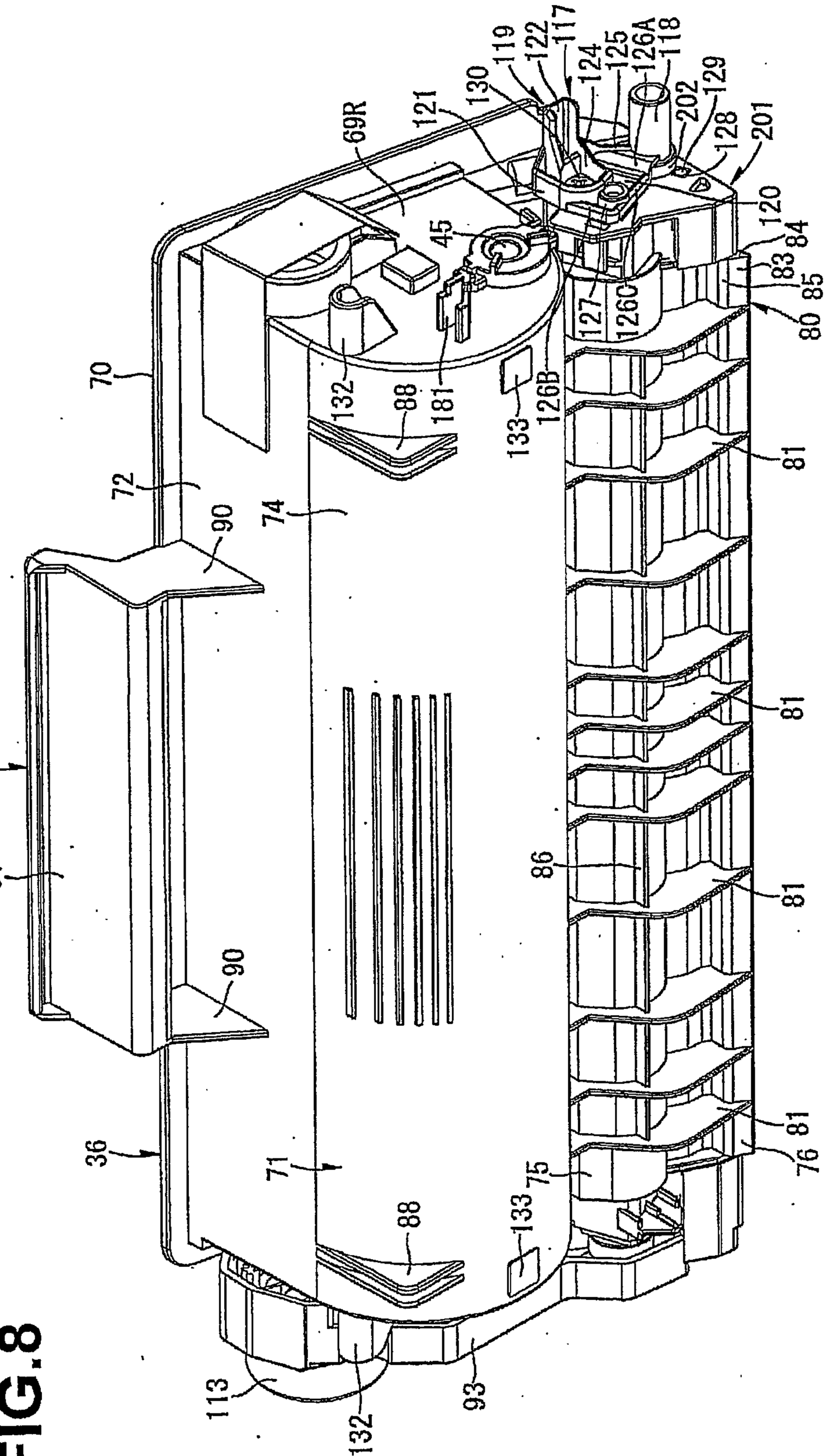

69R
121
130
119
122
117
124
125
126A
118
202
129
128
201
120
84
83
85
80
45
127
126C
126B
70
132
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181
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72
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FIG.8

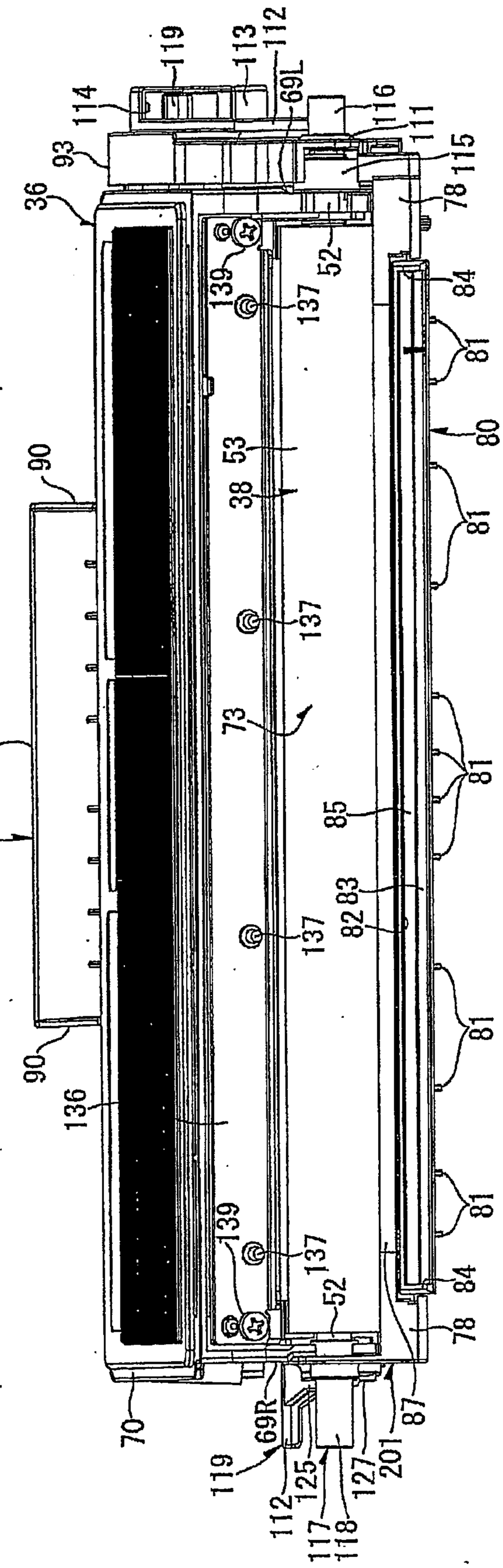

119
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69L
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73
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30
89
85
83
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137
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84
78
70
69R
87
119
125
127
201
112
117
118

FIG.9

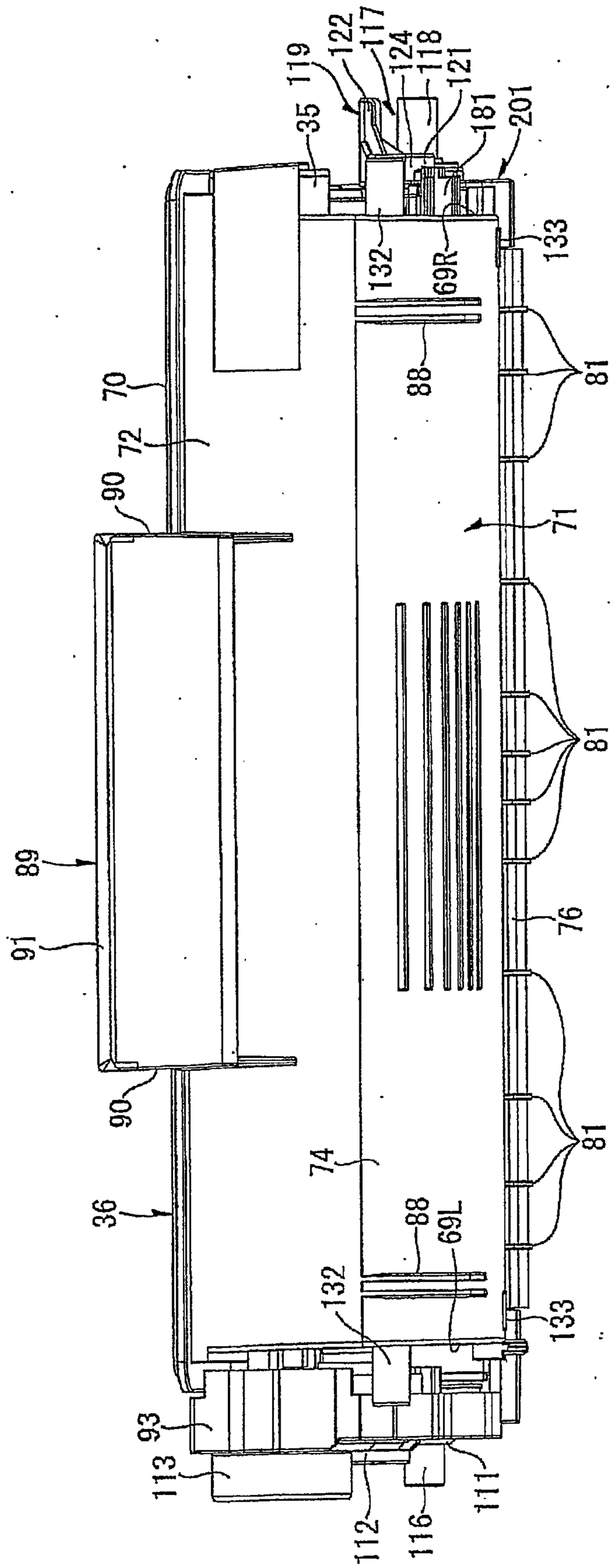

119
122
117
124
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121
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181
201
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69R
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72
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90
74
88
69L
132
133
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113
112
116
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FIG.10

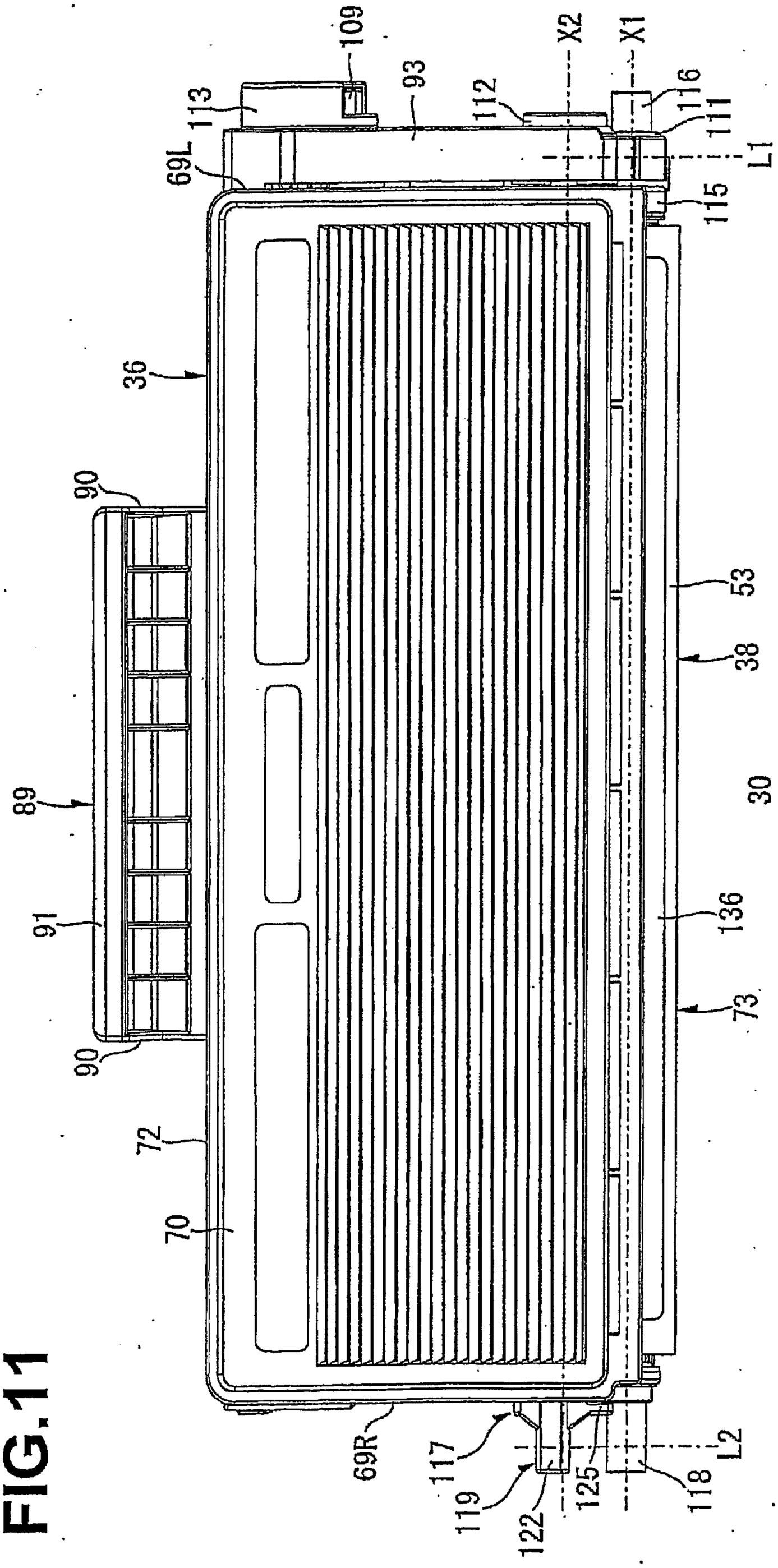

109
X2
X1
93
112
116
113
111
69L
L1
15
115
36
90
53
38
89
30
91
136
90
73
72
70
69R
117
119
122
125
118
L2

FIG.11

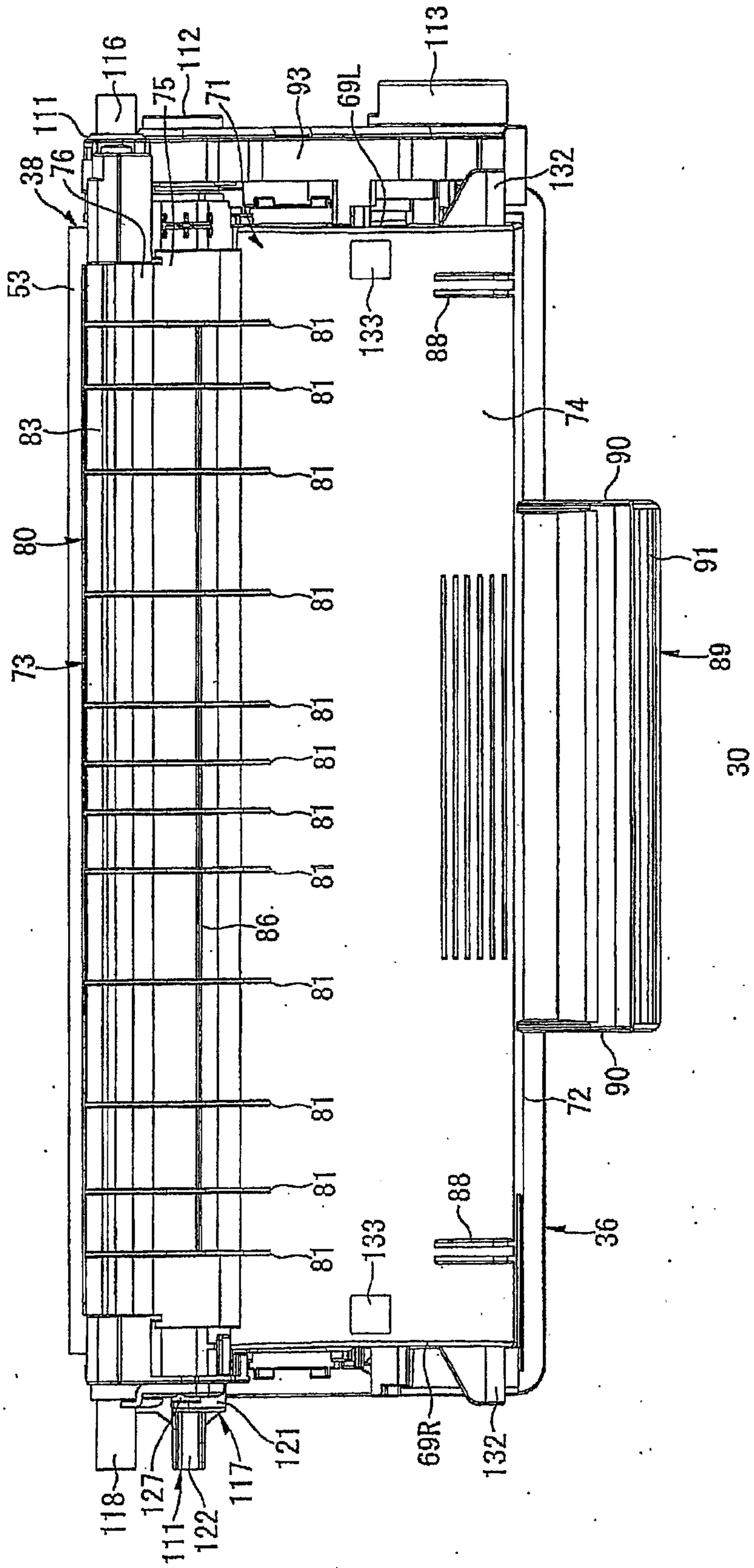
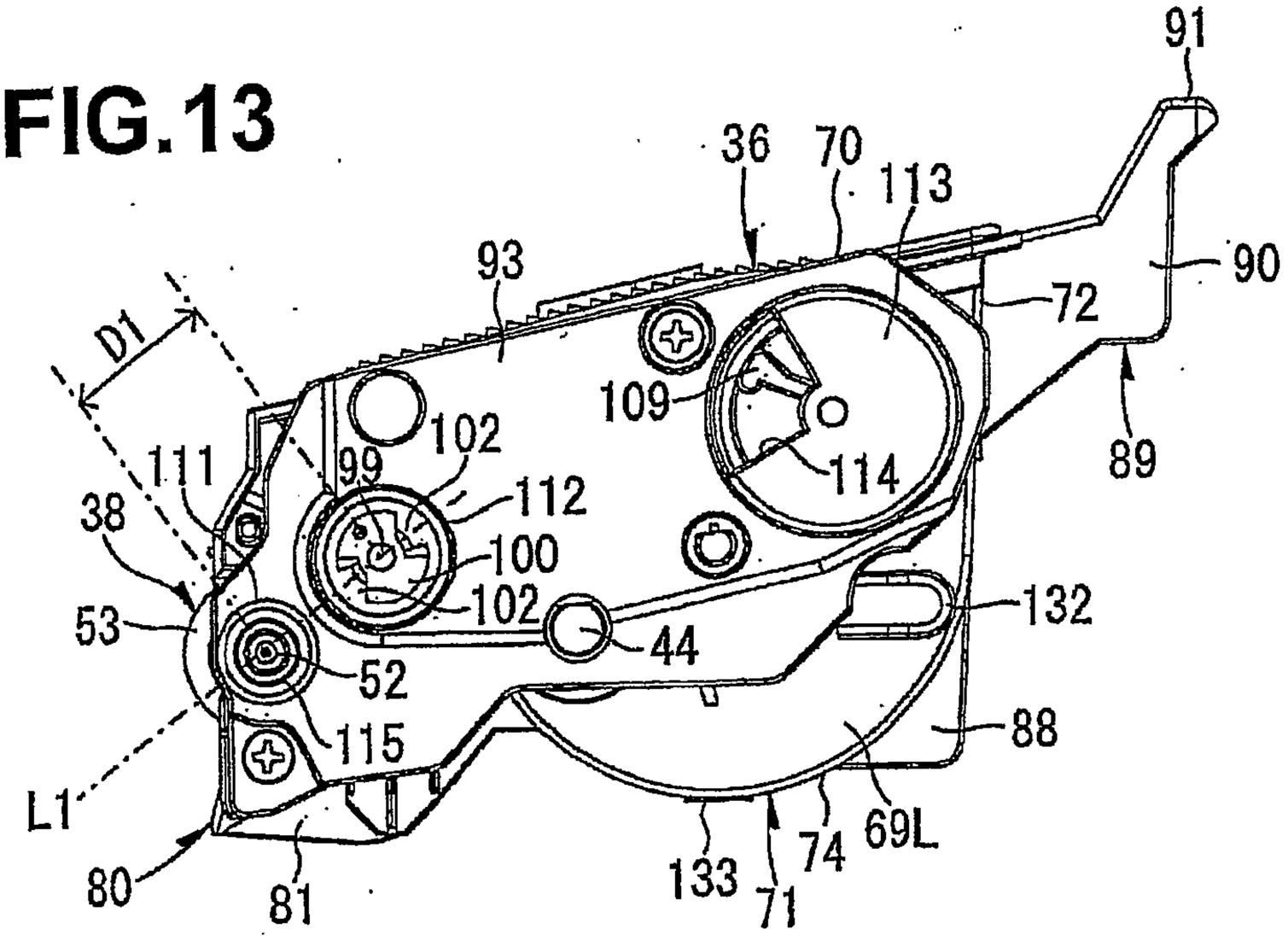

116
112
75
71
93
69L
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111
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76
132
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81
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72
68
36
69R
118
127
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122
117
121

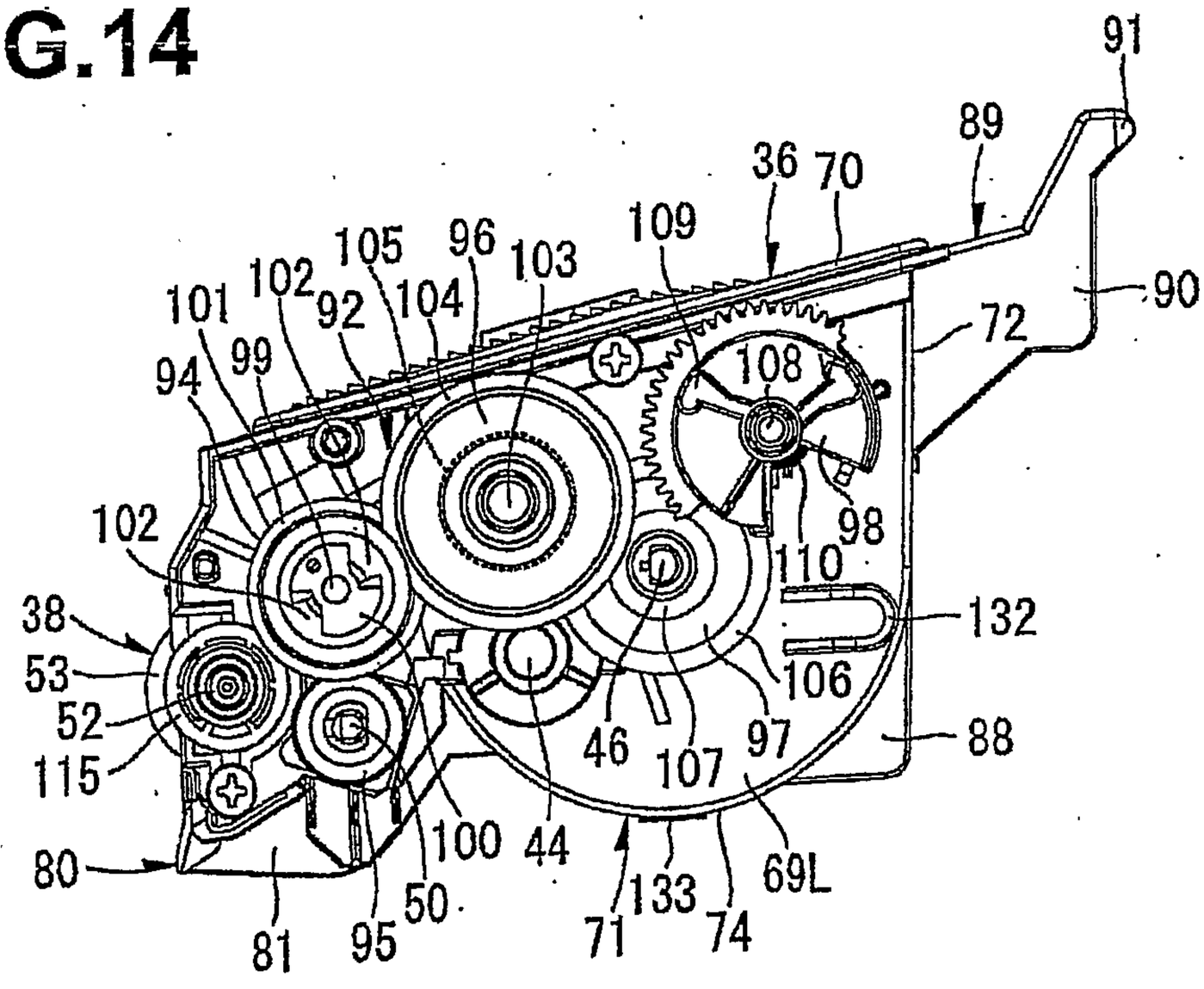
FIG.12

FIG.13



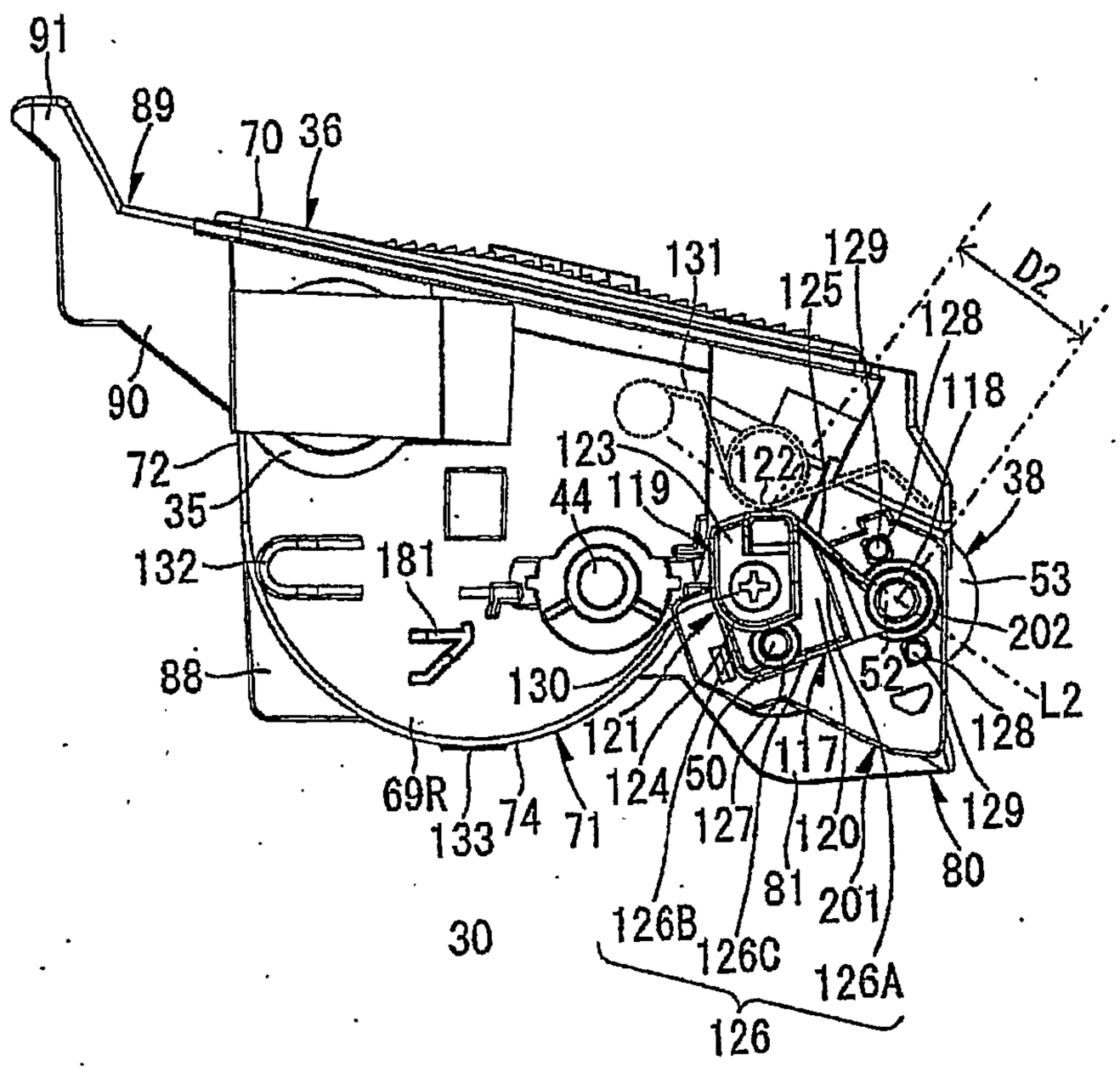
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FIG.14



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FIG.15


91
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119
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181
53
202
88
130
52
L2
121
117
128
124
50
69R
133
74
71
127
120
129
80
81
201
30
126B
126C
126A
126

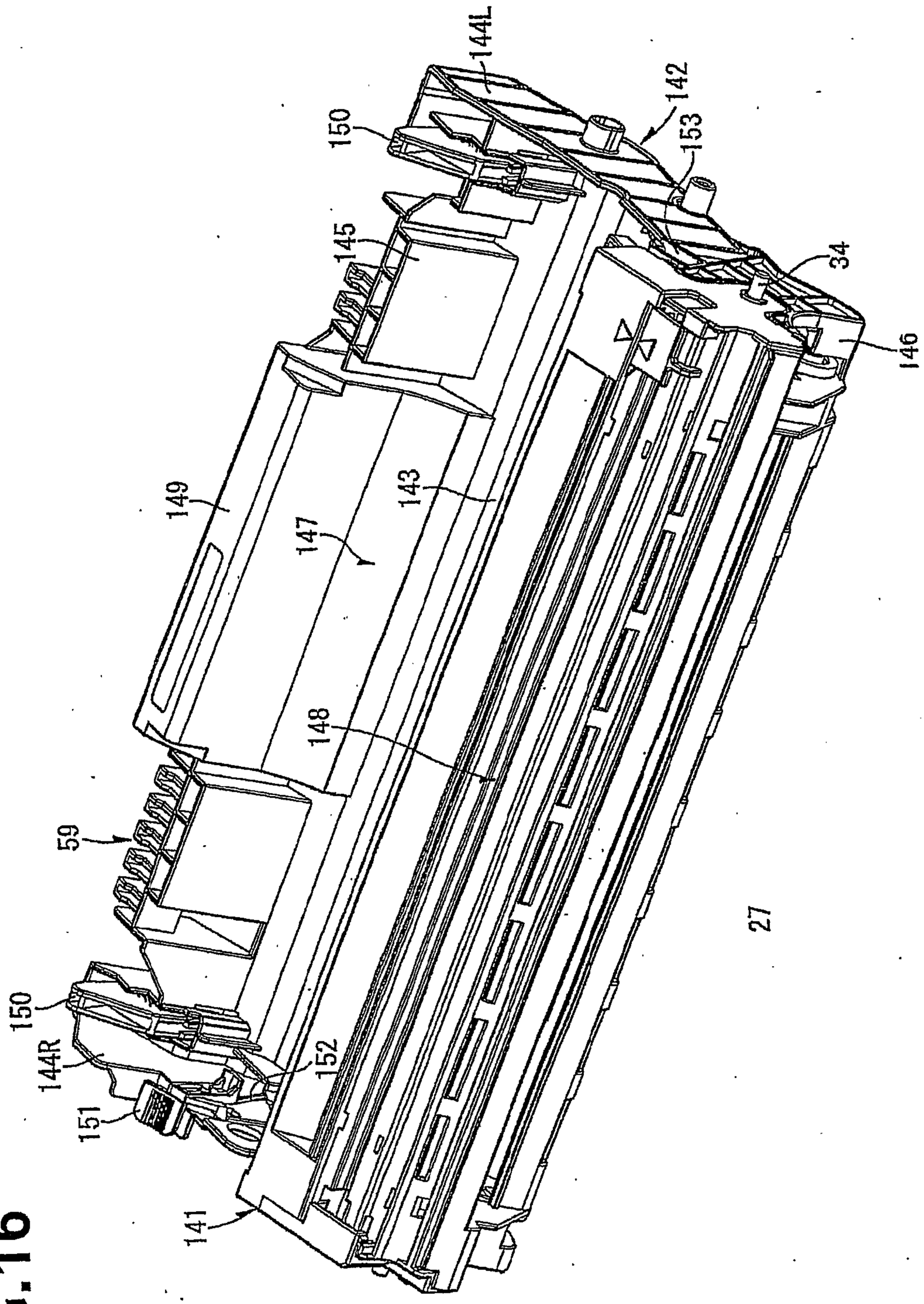

144L
142
150
153
145
34
146
149
143
147
148
59
150
144R
152
151
141

FIG.16

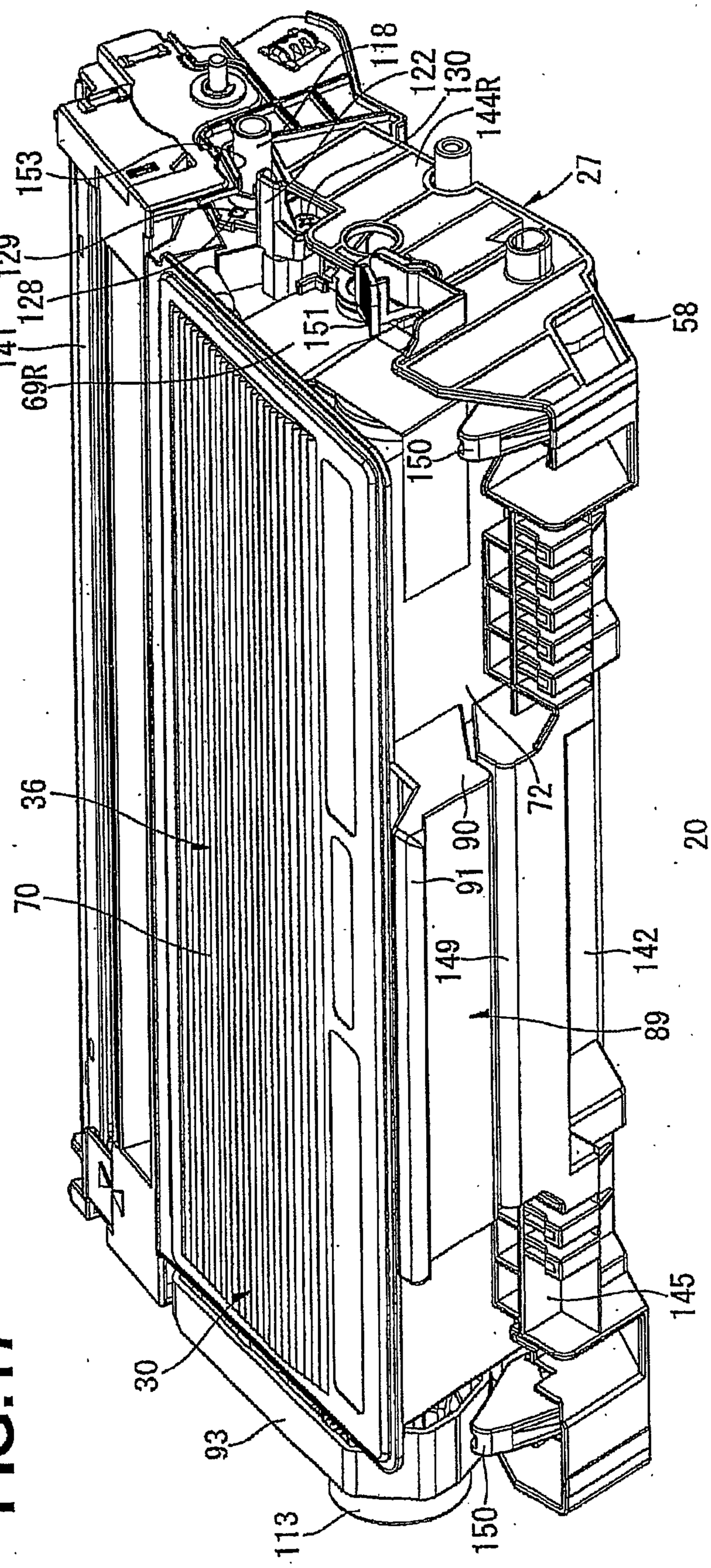

118
122
130
144R
153
27
129
128
141
69R
151
58
150
36
70
72
90
91
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149
142
89
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145
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93
113
150

FIG.17

FIG.18A

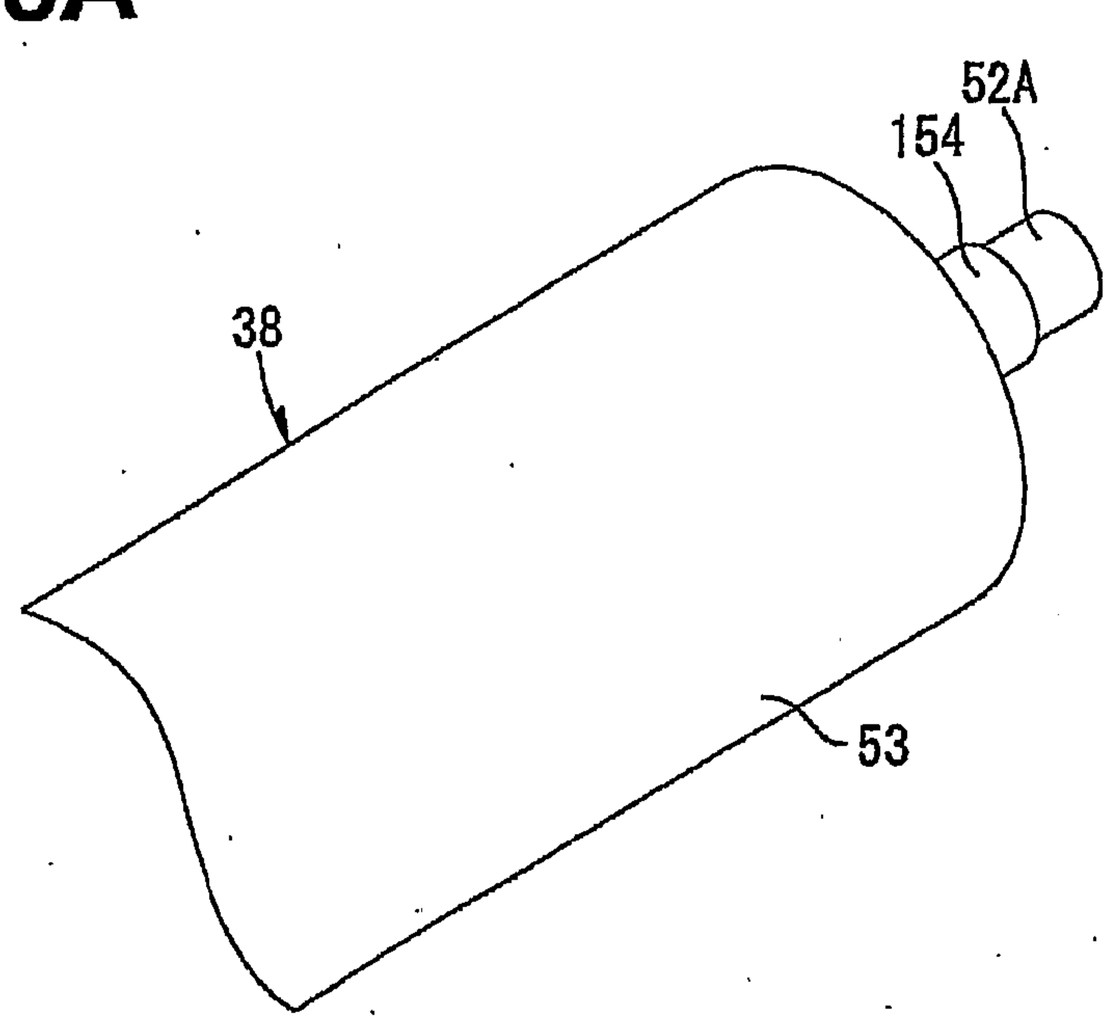


FIG.18B

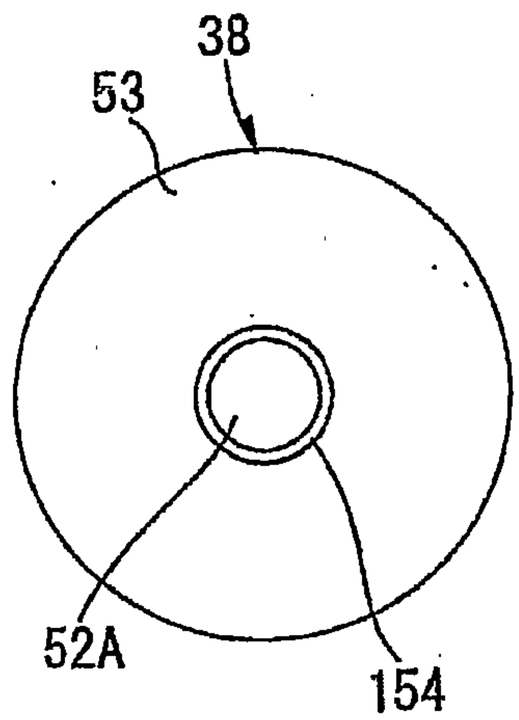


FIG.19

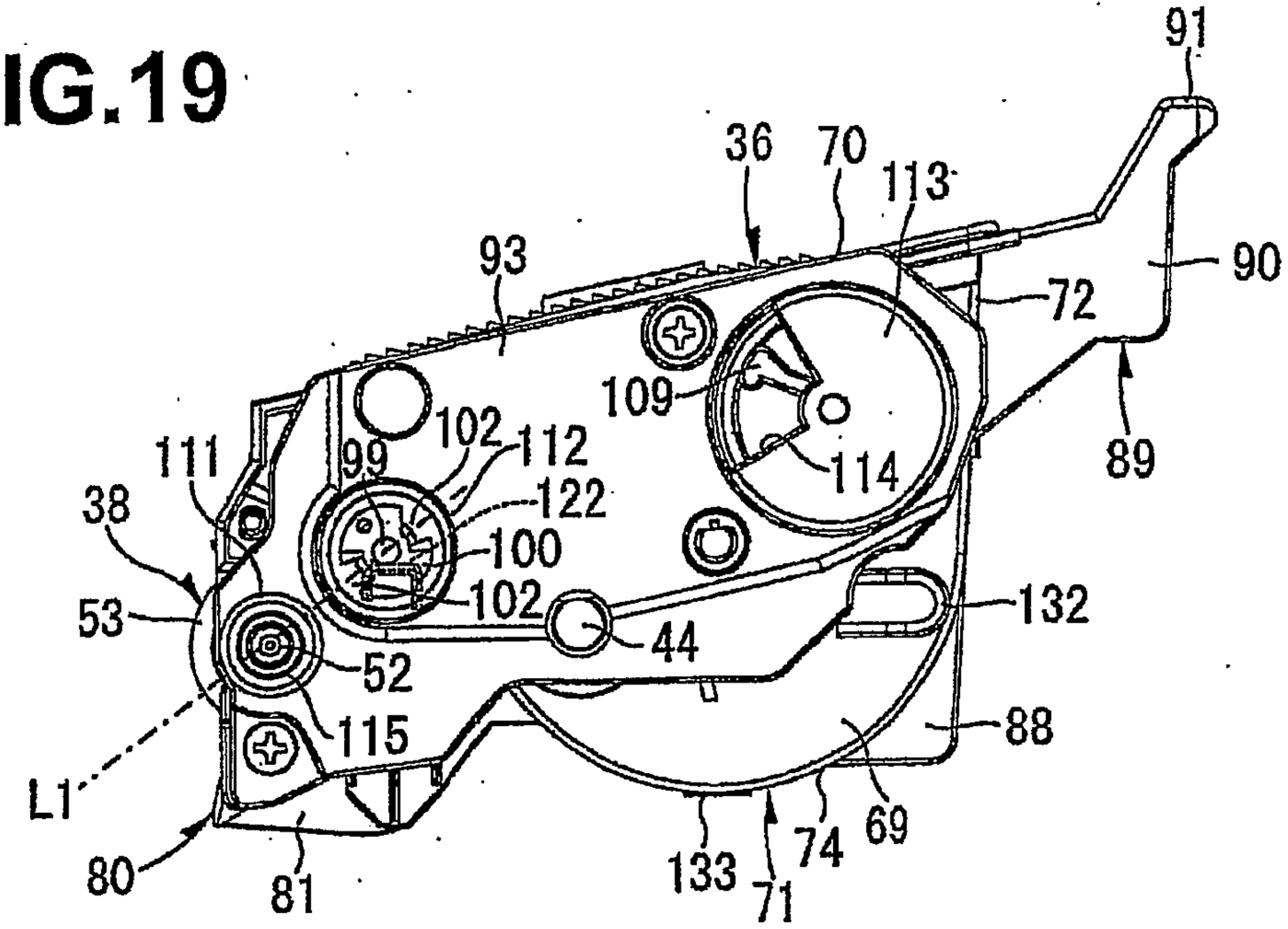
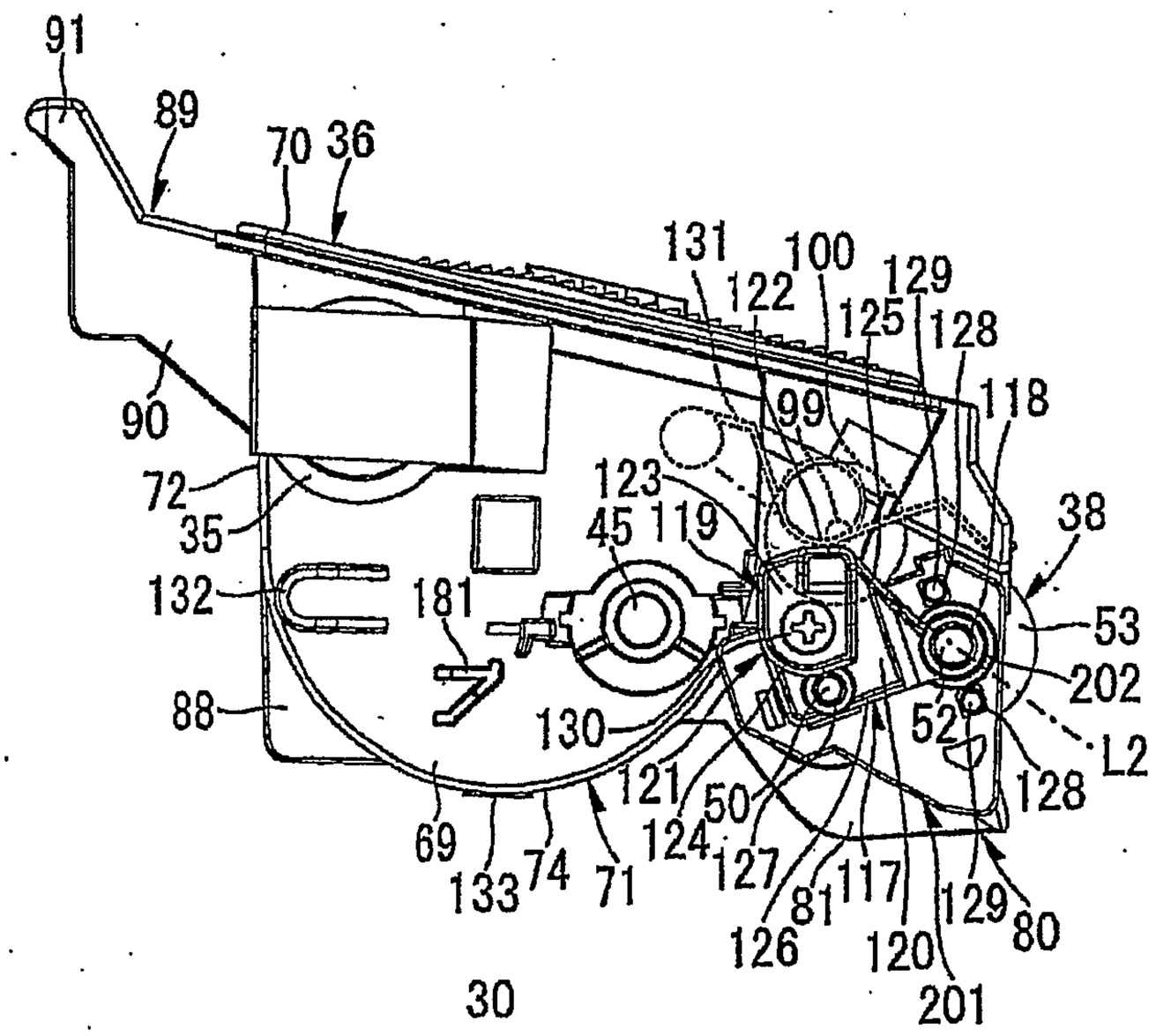

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122
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100
102
132
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115
L1
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133
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FIG.20


91
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100
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125
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123
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181
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202
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130
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L2
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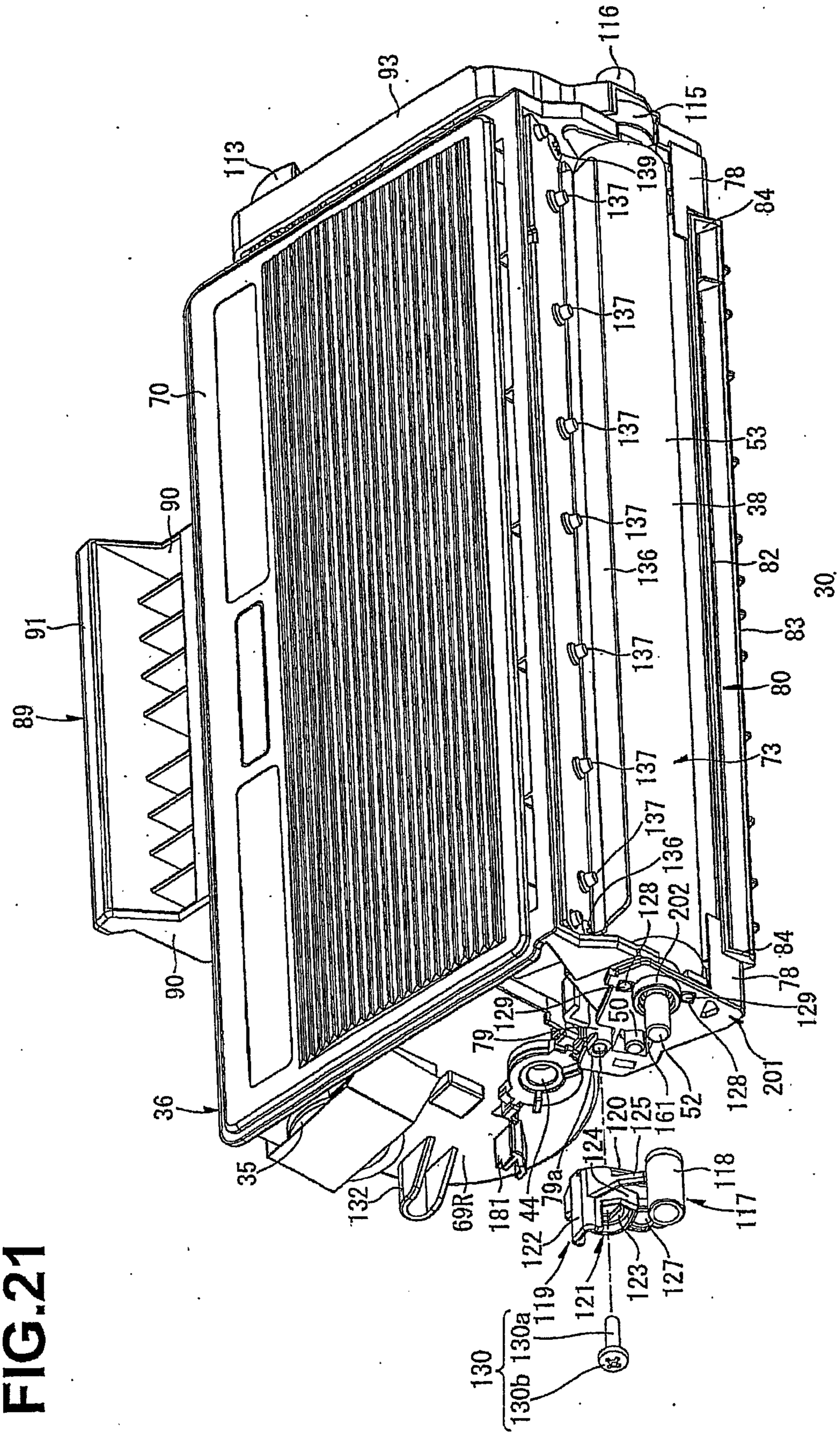

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89
80
73
137
136
137
128
202
84
78
90
129
50
129
79
201
128
52
36
161
125
120
124
118
35
132
69R
181
44
79a
122
117
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121
123
127
130
130a
130b

FIG.21

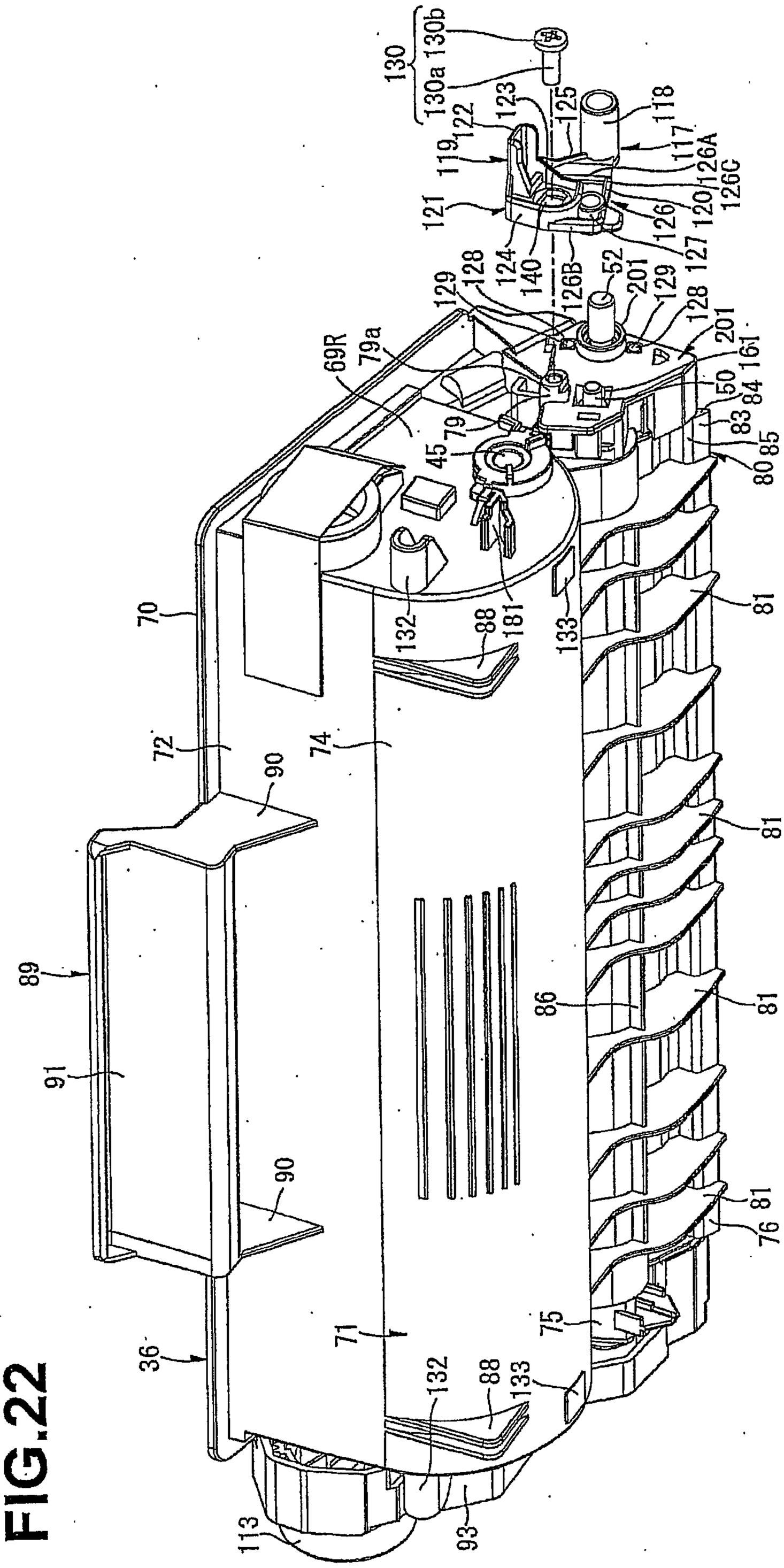

130
130a
130b
123
122
125
118
119
117
126A
126C
121
126
120
127
124
140
126B
52
201
129
128
69R
79a
79
45
50
84
161
83
85
80
70
132
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133
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86
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113
93

FIG.22

FIG.23

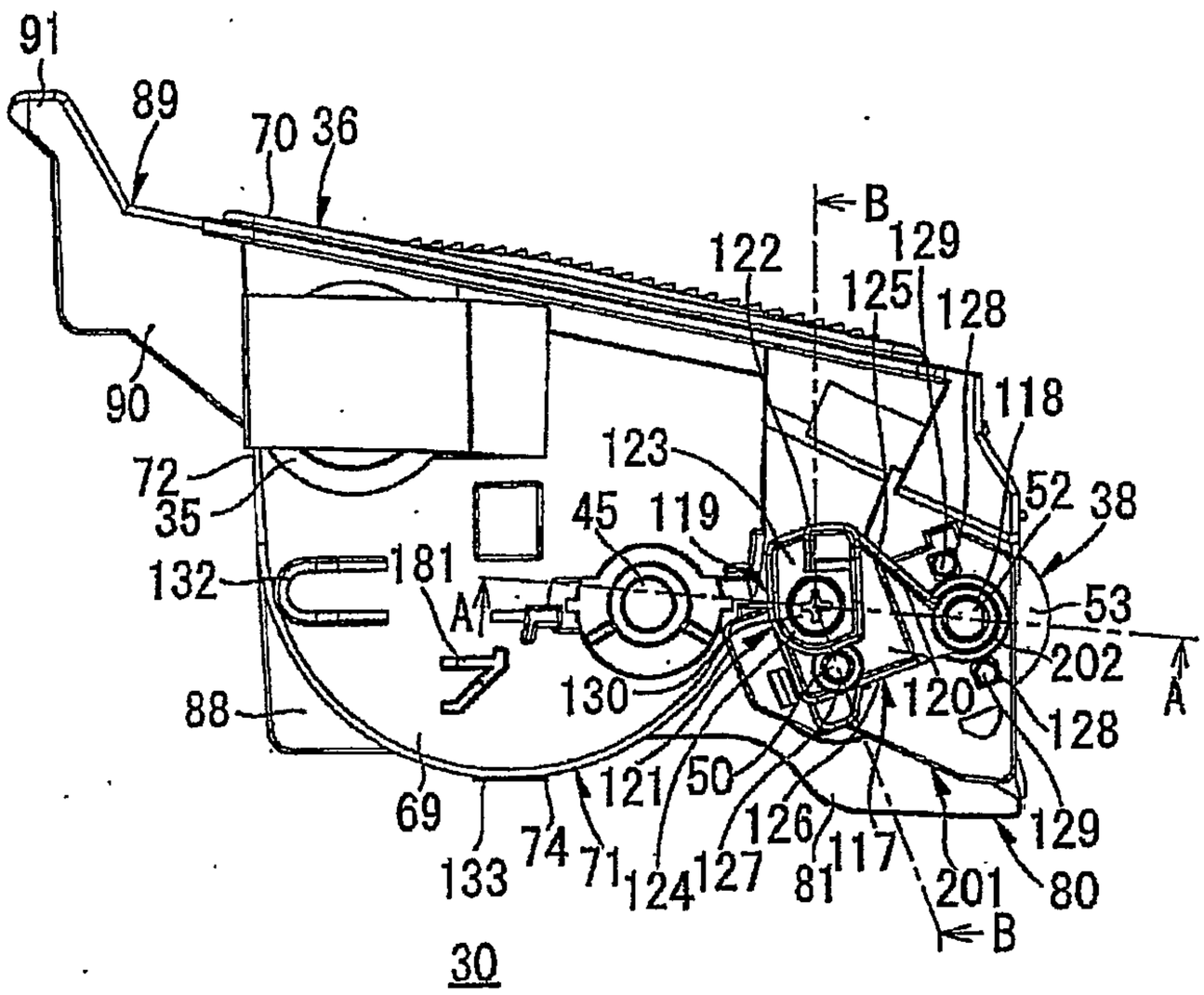

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201
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133
B
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FIG.24

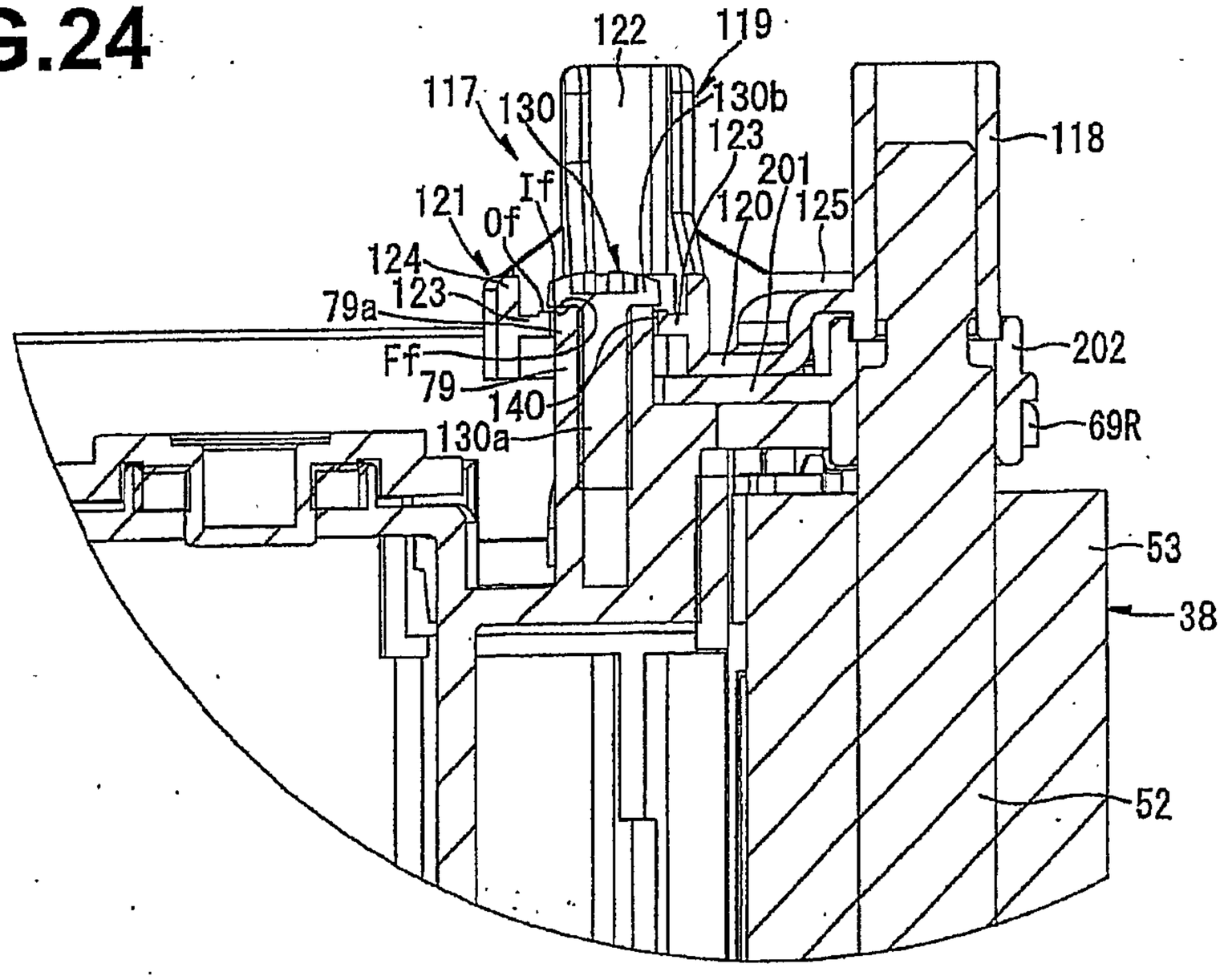
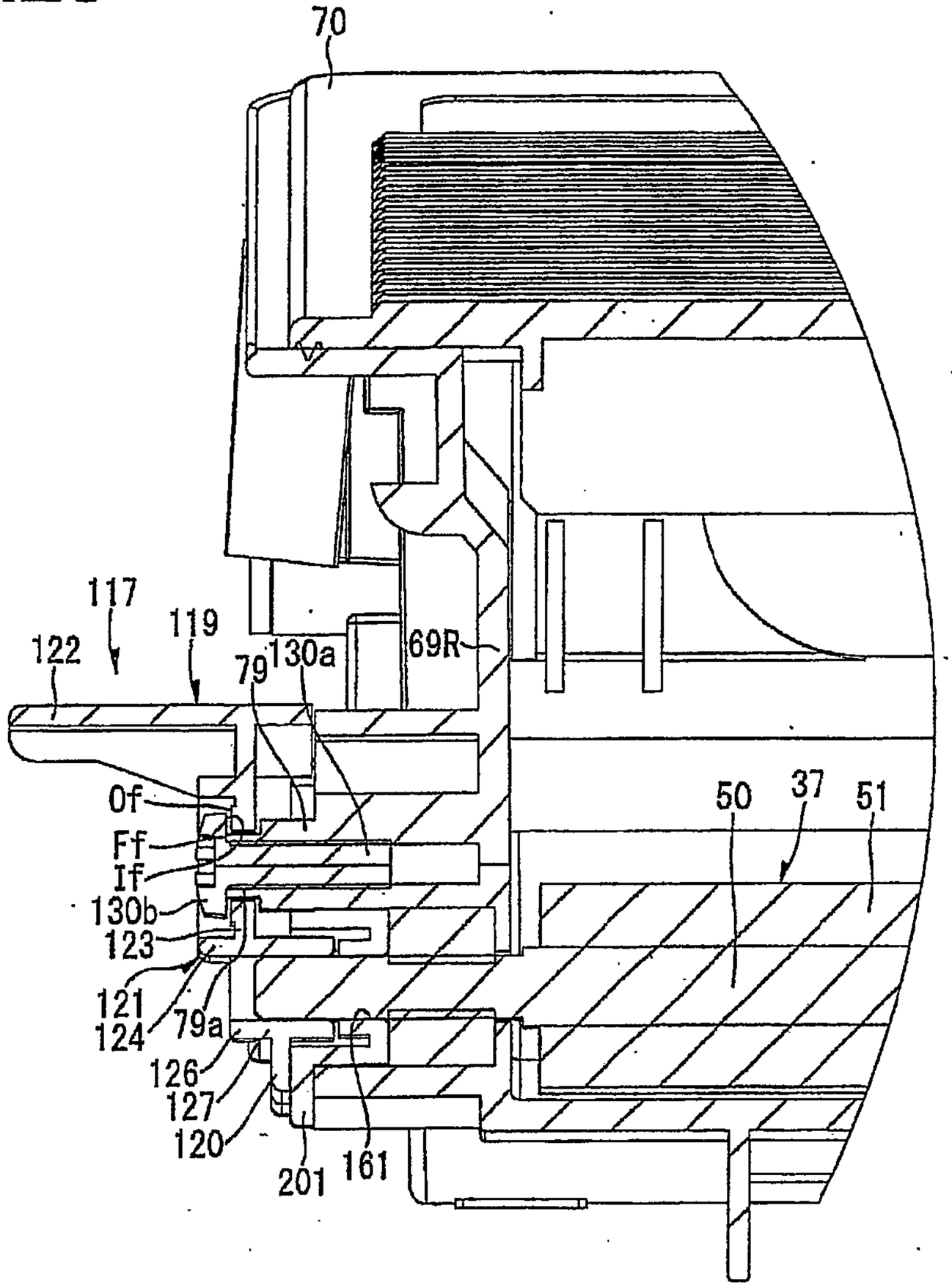
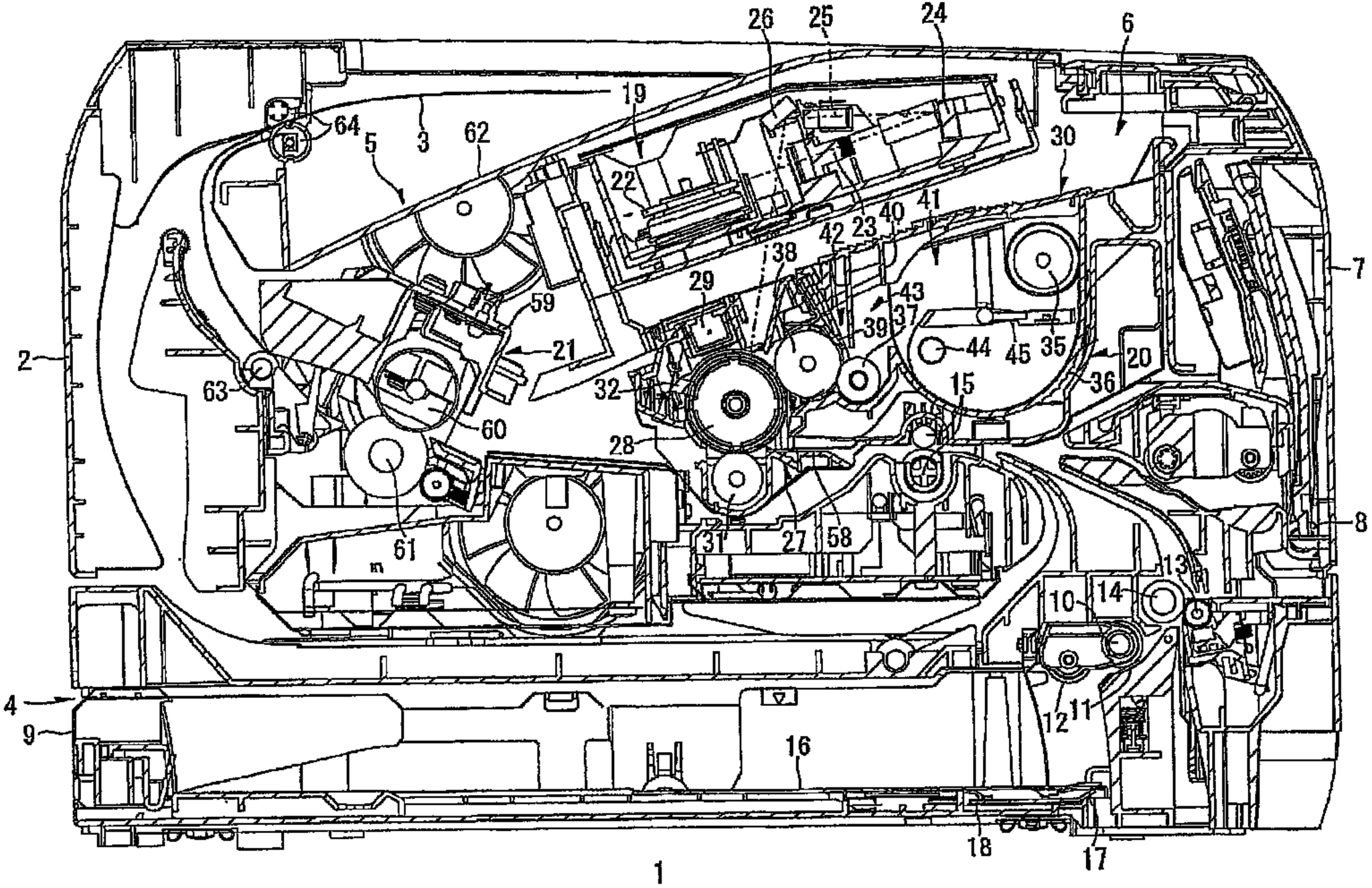

122
119
117
130
130b
123
118
If
201
121
0f
120
125
124
123
79a
202
Ff
79
140
69R
130a
53
38
52

FIG.25


70
117
119
122
79
130a
69R
0f
Ff
If
130b
123
121
124
79a
126
127
120
201
161
50
37
51

REAR


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FRONT