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(54) **RECORDING APPARATUS**

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(57) **ABSTRACT**

There is provided a recording apparatus including: a hopper which is swingably installed on which paper sheets are placed; a feeding roller which is rotatably installed in a downstream side of the hopper in a feeding direction and feeds the recording media; a media guide surface which is opposed to an outer peripheral surface of the feeding roller with a gap therebetween; a separating roller which is installed in a downstream side of the media guide surface in the feeding direction and separates the paper sheets through cooperation with the feeding roller, in which the shortest distance between the outer peripheral surface of the feeding roller and the media guide surface in the gap becomes long along with the rotation of the feeding roller during one rotation of the feeding roller.

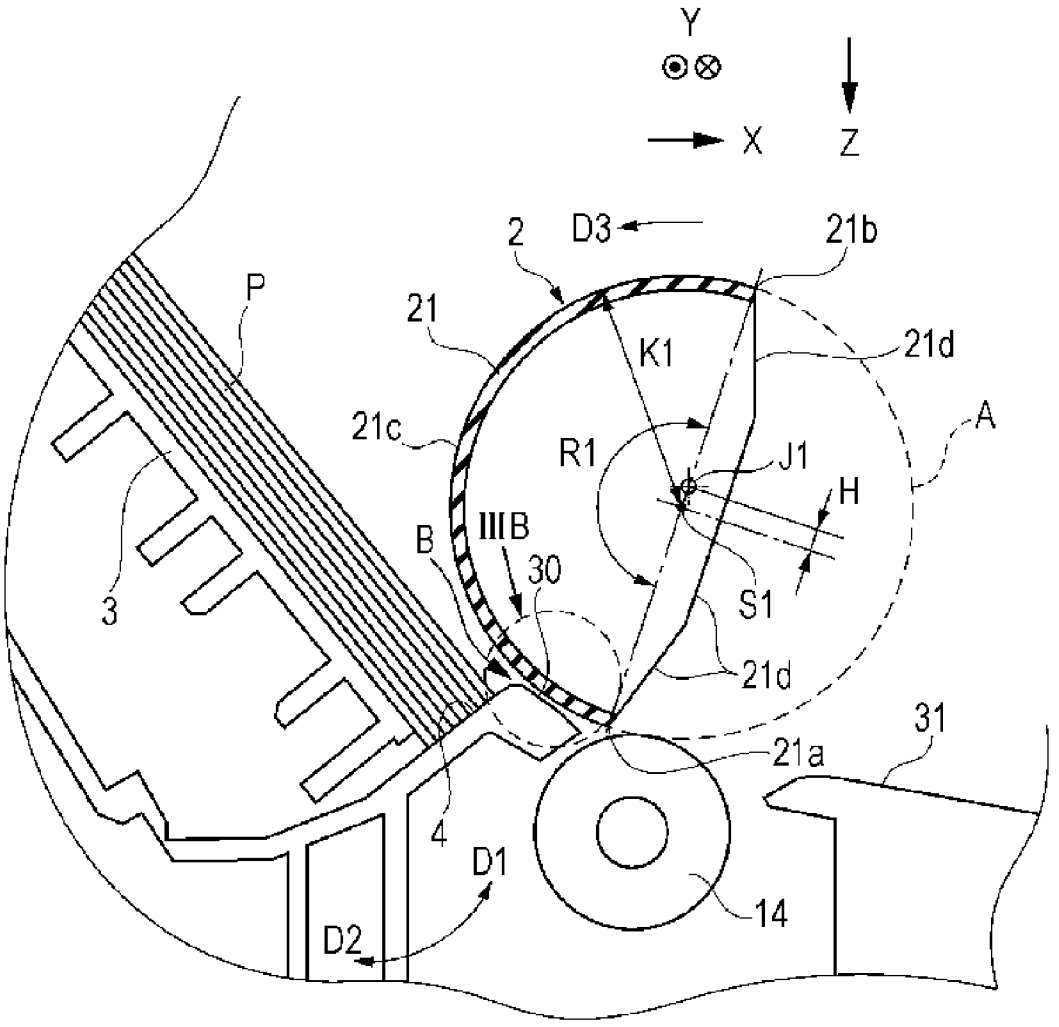


FIG. 1

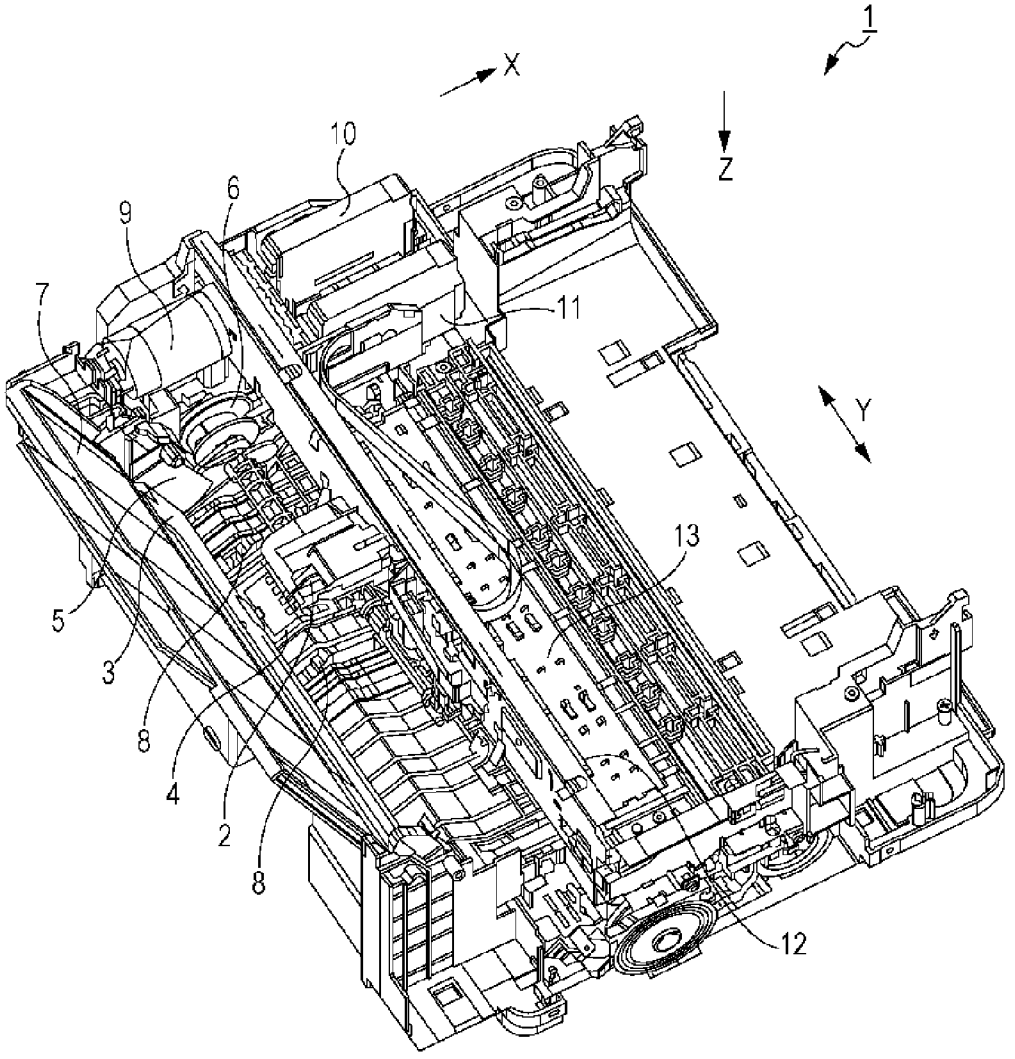


FIG. 2

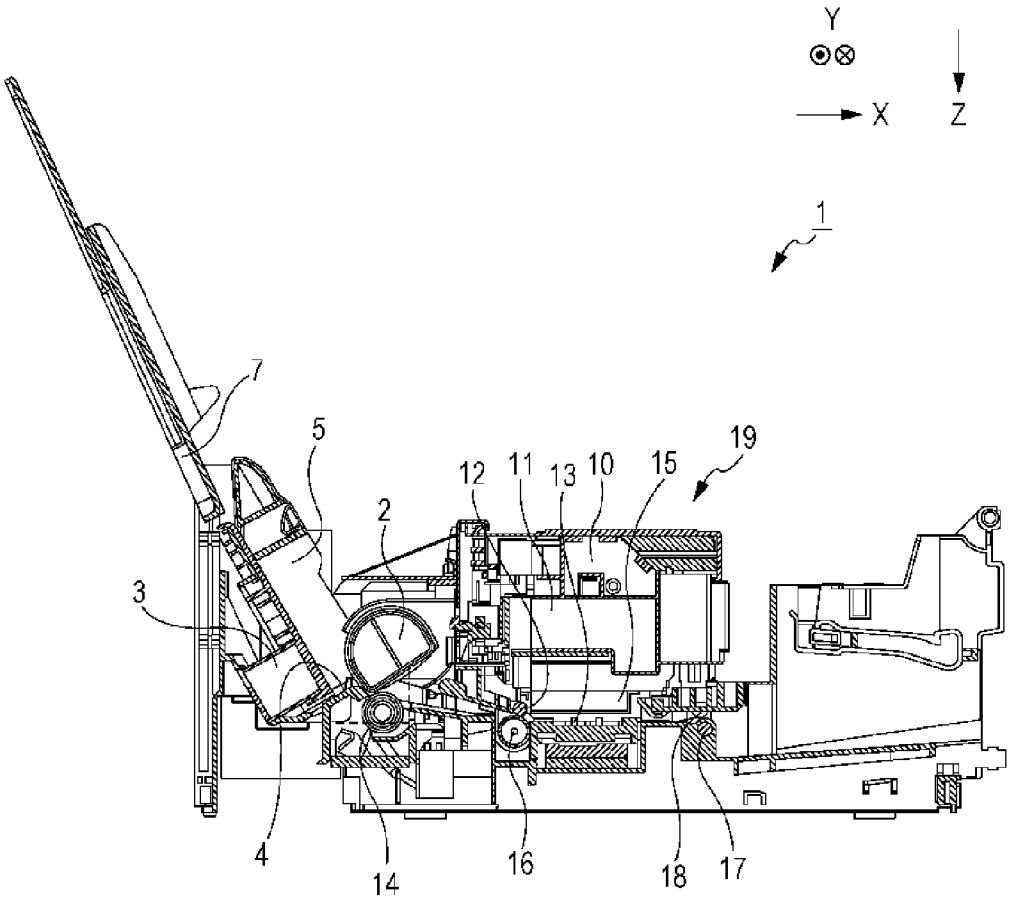


FIG. 3A

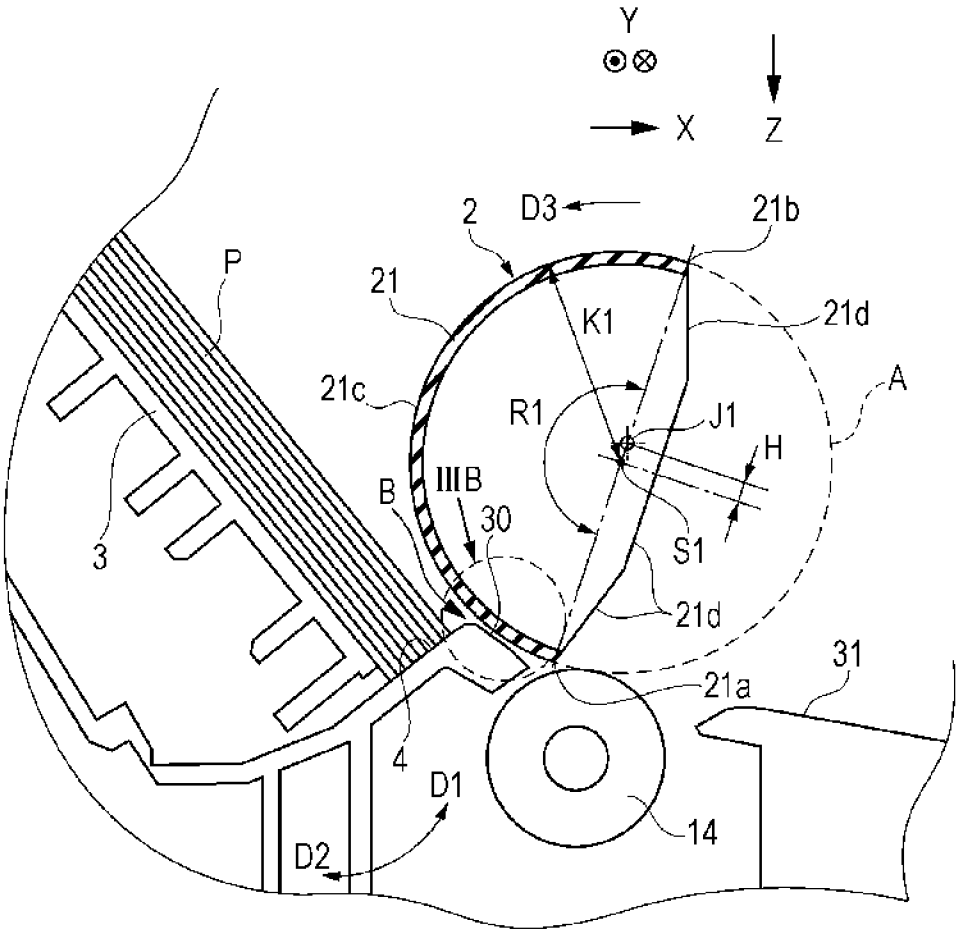

Y
X
Z
2
D3
21b
P
21
K1
21d
21c
R1
J1
A
H
IIIB
B
30
3
S1
21d
31
21a
4
D1
14
D2

FIG. 3B

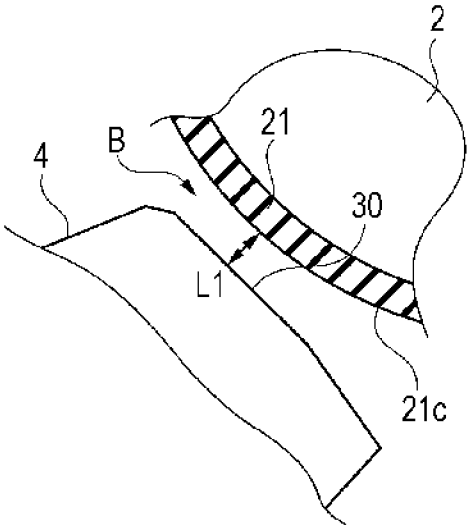

2
B
21
4
30
L1
21c

FIG. 4A

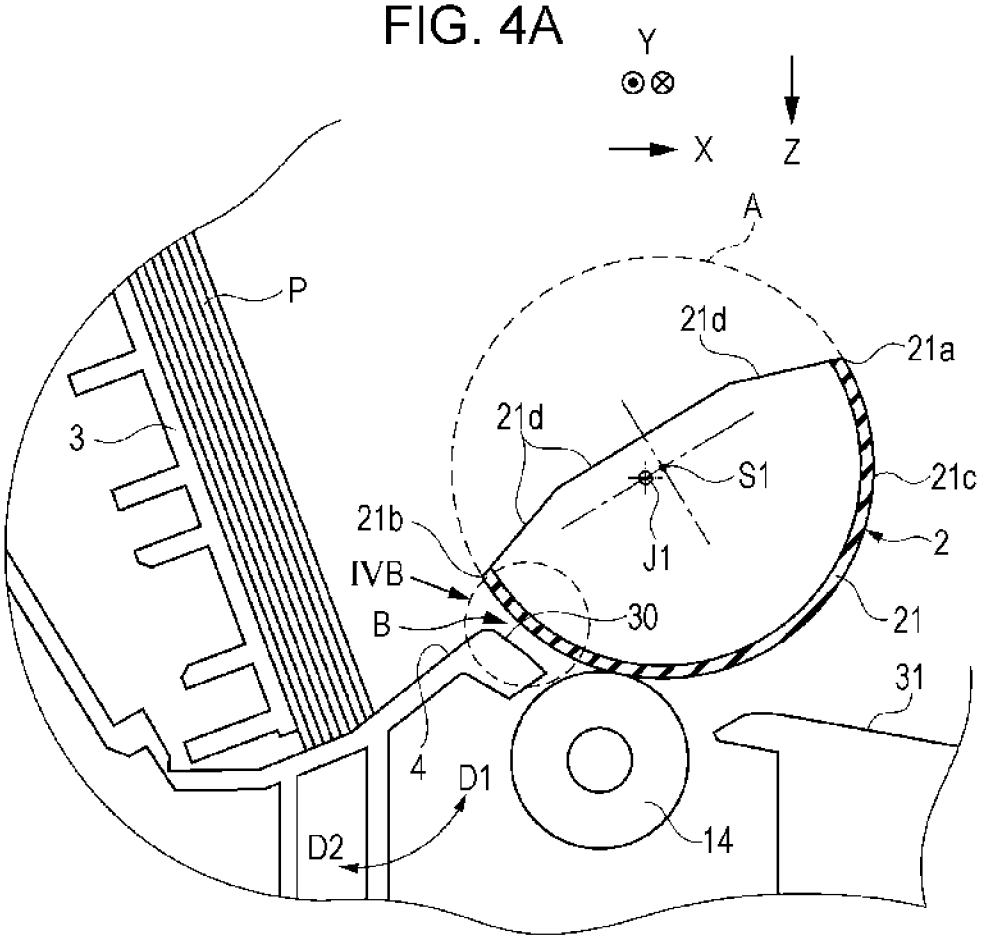

Y
X
Z
A
P
3
21d
21a
21d
S1
21c
21b
IVB
J1
2
B
30
21
31
4
D1
D2
14

FIG. 4B

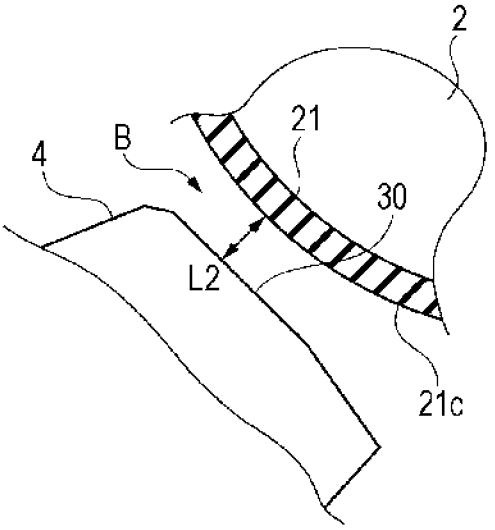

2
21
B
4
30
L2
21c

FIG. 5A

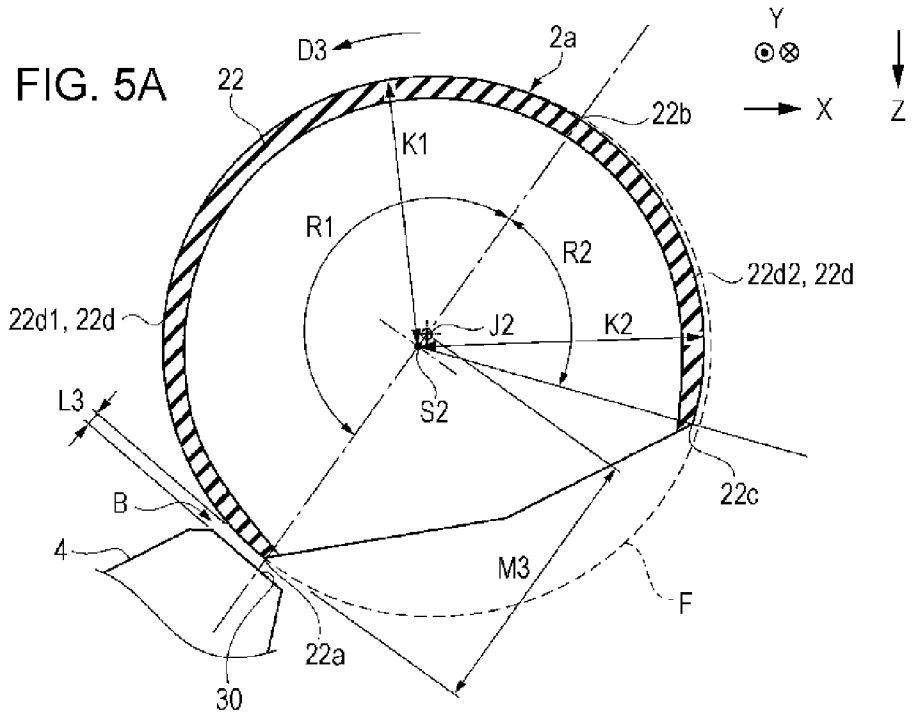

D3
2a
Y
22
22b
X
Z
K1
R1
R2
22d2, 22d
22d1, 22d
J2
K2
S2
L3
B
4
22c
M3
F
22a
30

FIG. 5B

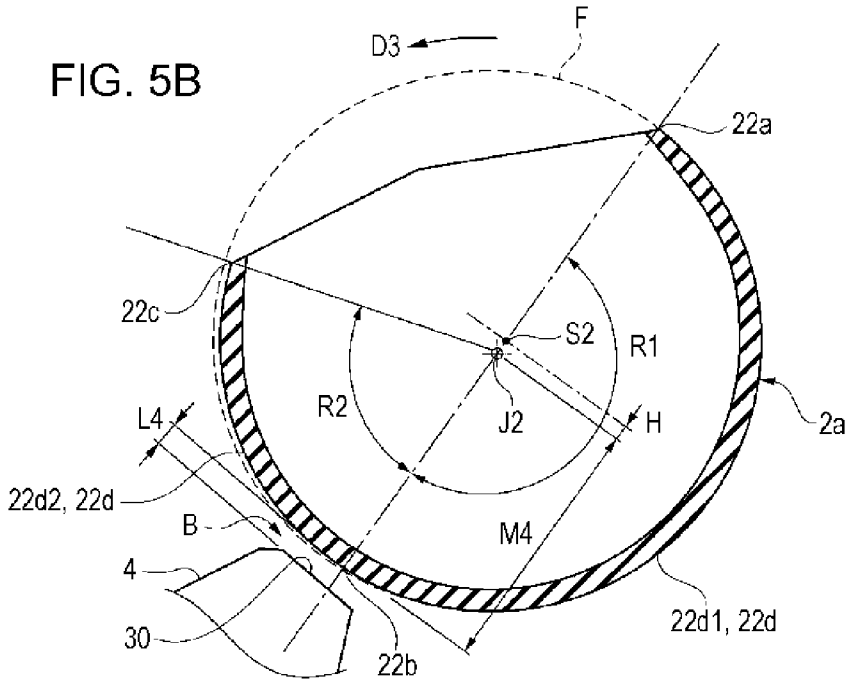

F
D3
22a
22c
S2
R1
R2
J2
H
2a
L4
22d2, 22d
B
M4
4
30
22d1, 22d
22b

FIG. 6

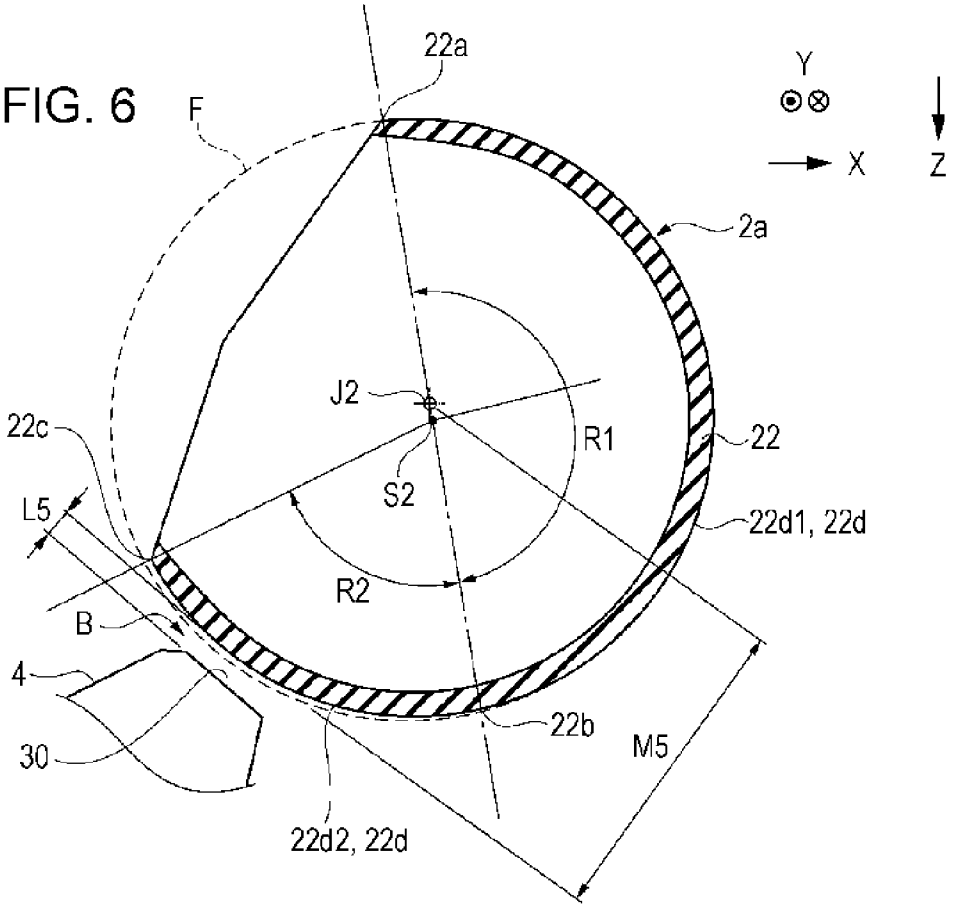

22a
F
Y
X
Z
2a
J2
R1
22
22c
S2
L5
22d1, 22d
R2
B
4
22b
M5
30
22d2, 22d

FIG. 7

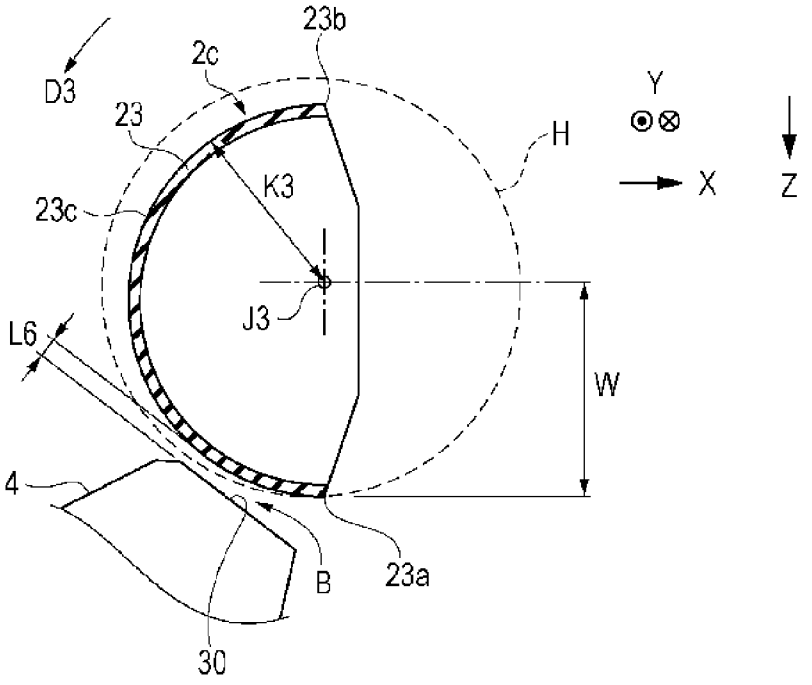

23b
2c
D3
23
Y
H
X
Z
K3
23c
J3
L6
W
4
B
23a
30

FIG. 8A

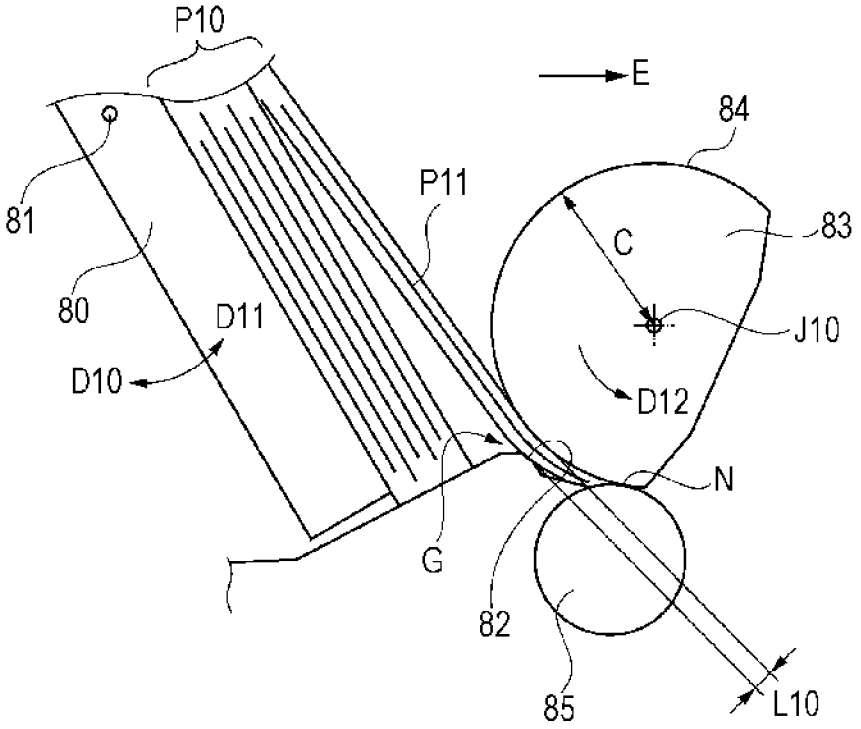
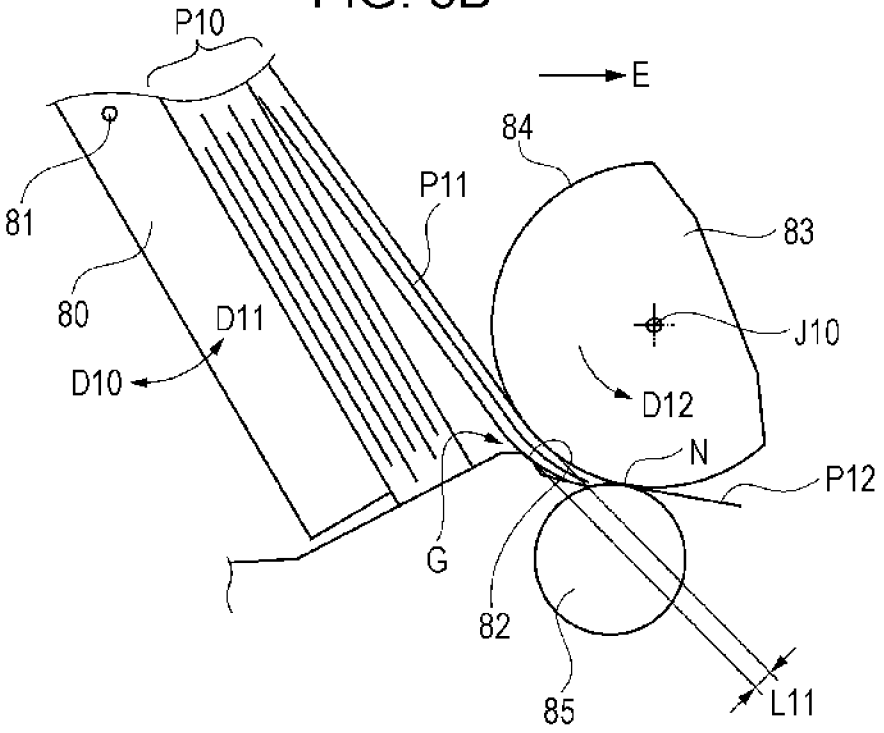

P10
E
84
81
P11
83
C
80
D11
J10
D10
D12
N
G
82
85
L10

FIG. 8B


P10
E
84
81
P11
83
80
D11
J10
D10
D12
N
P12
G
82
85
L11

RECORDING APPARATUS

BACKGROUND

[0001] 1. Technical Field

[0002] The present invention relates to a recording apparatus.

[0003] 2. Related Art

[0004] An ink jet printer as an example of a recording apparatus includes a mechanism feeding a plurality of paper sheets which are placed in a stacked state to a recording unit by separating the paper sheets one by one. For example, JP-A-2005-112496 includes a hopper **80** which is swung with a rocking shaft **81** of FIG. **8**A as a fulcrum in swinging directions D**10** and D**11**; a feeding roller **83** that has an outer peripheral surface **84** where a distance C from a rotational axis J**10** is equal over the outer periphery, rotates in a rotation direction D**12**, and has an approximately D shape from a side view; and a retard roller **85** which is driven in contact with the feeding roller **83**. In addition, a guide surface **82** which is capable of being opposed to the outer peripheral surface **84** of the feeding roller **83** is formed between the hopper **80** and a nip position N of the feeding roller **83** and the retard roller **85**, and a gap G is formed between the outer peripheral surface **84** and the guide surface **82**.

[0005] When the hopper **80** is swung in the swinging direction D**11**, a plurality of paper sheets P**11** on an upper part among the plurality of paper sheets P**10** which are placed in the stacked state enter the gap G. The plurality of paper sheets P**11** which enter the gap G stops further on an upstream side in a feeding direction E than the nip position N between the feeding roller **83** and the retard roller **85**. When the feeding roller **83** of FIG. **8**A further rotates in the rotation direction D**12**, a paper sheet P**12** on an uppermost portion is separated by the feeding roller **83** and the retard roller **85** by being fed in the feeding direction E as shown in FIG. **8**B.

[0006] However, there are cases where the position of the rotational axis J**10** changes along with the rotation of the feeding roller **83** and the distance C between the outer peripheral surface **84** and the rotational axis J**10** is not equally formed over the outer periphery depending on the dimensional accuracy of components processing. Therefore, when the feeding roller **83** of FIG. **8**A is rotated in the rotation direction D**12**, a distance L**11** of the gap G in the rotational position of the feeding roller **83** of FIG. **8**B becomes shorter compared to a distance L**10** of the gap G in the rotational position of the feeding roller **83** of FIG. **8**A. That is, the distance between the outer peripheral surface **84** and the guide surface **82** in the gap G becomes short along with the rotation of the feeding roller **83**.

[0007] Accordingly, a force pressing the plurality of paper sheets P**11** which enter the gap G increases due to the outer peripheral surface **84** and the guide surface **82** along with the rotation of the feeding roller **83**. As a result, there are problems that the plurality of paper sheets which enter the gap G, among the plurality of paper sheets P**11** are transported further on a downstream side in the feeding direction E than the nip position N between the feeding roller **83** and the retard roller **85** to be multi-fed; and the driving rotation of the feeding roller **83** stops.

SUMMARY

[0008] The invention can be realized in the following forms or application examples.

APPLICATION EXAMPLE 1

[0009] According to this application example, there is provided a recording apparatus including: a hopper which is swingably installed on which recording media are placed; a feeding roller which is rotatably installed in a downstream side of the hopper in a feeding direction and feeds the recording media; a medium guide surface which is opposed to an outer peripheral surface of the feeding roller with a gap therebetween; a separating roller which is installed in a downstream side of the media guide surface in the feeding direction and separates the recording media through cooperation with the feeding roller; and a recording unit which makes a record on the recording media separated by the feeding roller and the separating roller, in which the shortest distance between the outer peripheral surface of the feeding roller and the media guide surface in the gap becomes long along with the rotation of the feeding roller during one rotation of the feeding roller.

[0010] In this case, the shortest distance between the outer peripheral surface of the feeding roller and the media guide surface in the gap becomes long along with the rotation of the feeding roller during one rotation of the feeding roller. Accordingly, in the gap where the outer peripheral surface of the feeding roller and the media guide surface are opposed to each other, it is possible to suppress the distance of the gap where the outer peripheral surface of the feeding roller and the media guide surface that are opposed to each other from becoming short along with the rotation of the feeding roller depending on the dimensional accuracy of components processing. For this reason, increase of a force pressing the paper sheets, which enter the gap, caused by the outer peripheral surface of the feeding roller and the media guide surface along with the rotation of the feeding roller can be suppressed. Therefore, it is possible to suppress the recording media from being multi-fed by the feeding roller and the separating roller; the stoppage of the driving rotation of the feeding roller; and the stoppage of the printer.

APPLICATION EXAMPLE 2

[0011] In the recording apparatus, the feeding roller may be configured to have a circular arc portion and a linear portion which make an approximately D shape from a side view, the outer peripheral surface viewed from a rotational axis of the feeding roller in an axis direction forms the circular arc portion, and the rotational axis is installed to be deviated from the center of the circular arc portion toward an opposite side to a starting end in the outer peripheral surface viewed from the feeding roller in the rotation direction.

[0012] In this case, in the gap where the outer peripheral surface of the feeding roller and the media guide surface are opposed to each other, it is possible to suppress the distance of the gap where the outer peripheral surface of the feeding roller and the media guide surface are opposed to each other from becoming short along with the rotation of the feeding roller depending on the dimensional accuracy of components processing. For this reason, increase of a force pressing the paper sheets, which enter the gap, caused by the outer peripheral surface of the feeding roller and the media guide surface along with the rotation of the feeding roller can be suppressed. Therefore, it is possible to suppress the recording media from being multi-fed by the feeding roller and the separating roller; the stoppage of the driving rotation of the feeding roller; and the stoppage of the printer.

APPLICATION EXAMPLE 3

[0013] In the recording apparatus, the outer peripheral surface viewed from the rotational axis of the feeding roller in the axis direction may include a first outer peripheral surface that forms a portion of the circular arc portion; and a second outer peripheral surface that is continuous from the first outer peripheral surface and has a distance between the center of the circular arc portion and the second outer peripheral surface which becomes shorter as the second outer peripheral surface is located further on a finishing end side.

[0014] In this case, it is possible to suppress the distance of the space where the outer peripheral surface of the feeding roller and the media guide surface that are opposed to each other from becoming short. In addition, the distance of rotating the recording medium while being pinched by the feeding roller and the separating roller becomes long. For this reason, increase of a force pressing the paper sheets, which enter the gap, caused by the outer peripheral surface of the feeding roller and the media guide surface along with the rotation of the feeding roller can be suppressed. Therefore, it is possible to suppress the recording media from being multi-fed by the feeding roller and the separating roller; the stoppage of the driving rotation of the feeding roller; and the stoppage of the print.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

[0016] FIG. **1** is an oblique view of a printer.

[0017] FIG. **2** is a cross-sectional view of a printer.

[0018] FIG. **3**A is a view illustrating a portion where paper sheets are separated and FIG. **3**B is a view illustrating a portion where an outer peripheral surface of a feeding roller and a media guide surface are opposed to each other.

[0019] FIG. **4**A is a view illustrating a portion where paper sheets are separated and FIG. **4**B is a view illustrating a portion where an outer peripheral surface of a feeding roller and a media guide surface are opposed to each other.

[0020] FIGS. **5**A and **5**B are views illustrating an outer peripheral surface of a feeding roller and a media guide surface that opposes the outer peripheral surface.

[0021] FIG. **6** is a view illustrating an outer peripheral surface of a feeding roller and a media guide surface that opposes the outer peripheral surface.

[0022] FIG. **7** is a view illustrating a feeding roller when viewed in a main scanning direction.

[0023] FIG. **8**A is a view illustrating a separation mechanism of paper sheets which is provided in a recording apparatus in the related art and FIG. **8**B is a view illustrating a gap formed between a feeding roller and a media guide surface in the separation mechanism of the paper sheets in the related art.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0024] Hereinafter, embodiments of the invention will be described with reference to the drawings.

Embodiment 1

[0025] FIG. **1** is an oblique view of a printer **1** as an example of a recording apparatus. FIG. **2** is a cross-sectional view of a printer **1** viewed from a main scanning direction Y. In a back side (upstream side in a sub scanning direction X) of the printer **1**, there are a hopper **3** and a paper support **7** on which paper sheets (not shown) are placed as recording media. A paper end portion regulation unit **5** which regulates a position of an end portion of the paper sheets is provided in the hopper **3** in a state of being slid in the main scanning direction Y.

[0026] In a downstream side of a feeding direction (sub scanning direction X) of the hopper **3**, a feeding roller **2** is provide in a center portion in the main scanning direction Y. A separating roller **14** provided below the feeding roller **2** of FIG. **2** in a vertical direction Z is biased to the feeding roller **2** side by a spring member, which is not shown, and cooperates with the feeding roller **2** to separate multi-fed paper sheets.

[0027] The separating roller **14** is rotated along with the feeding roller **2** when pinching a paper sheet in a nip position between the separating roller **14** and the feeding roller **2**. However, the separating roller **14** is not rotated along with the feeding roller **2** when two or more paper sheets are multi-fed. For this reason, a paper sheet on an uppermost portion which comes into contact with the feeding roller **2** is fed to a downstream side in the feeding direction, conversely paper sheets other than the paper sheet on the uppermost portion which comes into contact with the feeding roller **2** are not fed to the downstream side in the feeding direction. Accordingly, it is possible to separate the multi-fed paper sheets.

[0028] A paper returning lever **8** is provided on both sides of the feeding roller **2** of FIG. **1** in the main scanning direction Y, and the paper sheets, which are not fed, other than the paper sheet on the uppermost portion that comes into contact with the feeding roller **2**, are pushed back to the upstream side in the feeding direction by a turning operation of the paper returning lever **8**.

[0029] A carriage **11** that reciprocates in the main scanning direction Y in a state of being fixed to an endless belt (not shown) which is rotatively driven by a carriage motor **9** is provided in the downstream side of the feeding roller **2** in the feeding direction. The carriage **11** loads an ink cartridge **10** for accommodating ink and a recording head **15** of FIG. **2** for ejecting the ink is provided in a lower end of the carriage **11** in the vertical direction Z.

[0030] A paper sheet which is fed by the feeding roller **2** and the separating roller **14** is transported in the sub scanning direction X along with a support **13** by a carrier driving roller **16** and a carrier driven roller **12** that is rotated along with the carrier driving roller **16** in a contacted manner.

[0031] Characters or images are recorded on the paper sheet which is transported in the sub scanning direction X by the ink discharged from the recording head **15** that reciprocates in the main scanning direction Y. The recorded paper sheet is discharged to the downstream side in the sub scanning direction X by a discharge driving roller **17** and a discharge driven roller **18** which is driven in contact with the discharge driving roller **17**.

[0032] A recording unit **19** is configured to include the carriage **11**, the recording head **15**, the support **13**, the carrier driving roller **16**, and the carrier driven roller **12**.

[0033] FIG. **3**A is a view illustrating a portion where paper sheets P placed on a hopper **3** are separated when viewed in a main scanning direction Y. The hopper **3** is provided such that a rotational fulcrum (not shown) is installed in an upper left side of FIG. **3**A and the hopper is swingable in directions of

arrow D1 and D2 by a cam **6** of FIG. **1** which rotates on the same axis as the rotational axis J1 of the feeding roller **2**.

[0034] The feeding roller **2** is an approximately D shaped roller from a side view which has a circular arc portion and a linear portion. The feeding roller **2** has a friction layer **21** where an outer peripheral surface **21***c* which is capable of forming the nip portion in contact with the separating roller **14** is formed of rubber or the like; and a flat portion **21***d* where a portion of a circle A which is indicated with a dashed line that extends from the outer peripheral surface **21***c* is cut.

[0035] Central angle R1 is an angle which is opened by setting a center S1 of the circular arc as a center. The friction layer **21** is formed within the range of the central angle R1. Distances K1 from the center S1 of the circular arc to any points of the outer peripheral surface **21***c* are equal over the range of the central angle R1. In this embodiment, the center angle R1 is 180°.

[0036] A media guide surface **30** which is disposed with a gap B is installed in a position opposing the outer peripheral surface **21***c*. When the feeding roller **2** makes one rotation in a rotation direction D3, in the outer peripheral surface **21***c*, a side first opposing the media guide surface **30** is a starting end **21***a* and a side opposing the media guide surface **30** later than the starting end **21***a* is a finishing end **21***b*. FIG. **3**A is a view illustrating an initial state of rotation when the starting end **21***a* in the outer peripheral surface **21***c* of the friction layer **21** opposes the media guide surface **30**.

[0037] When the hopper **3** swings in the direction of arrow D1, a lower end portion of the paper sheets P placed on the hopper **3** in a stacked state is connected to the media guide surface **30** and is pushed up toward an upper side in the vertical direction Z along with an upstream side guide surface **4** (refer to FIG. **1**) which is formed in an upstream side in the feeding direction. For this reason, a part of a plurality of paper sheets P in the upper portion is separated from the paper sheets P placed on the hopper **3** to enter the gap B.

[0038] As described above, a paper sheet P is separated from the plurality of paper sheets P which enters the gap B through the cooperation of the feeding roller **2** and the separating roller **14** to be fed to the downstream side in the feeding direction along with a downstream side guide surface **31**.

[0039] FIG. **4**A is a view illustrating a terminal state of rotation when the finishing end **21***b* in the outer peripheral surface **21***c* of the friction layer **21** opposes the media guide surface **30**. When the feeding roller **2** of FIG. **3**A rotates in the rotation direction D3, as shown in FIG. **4**A, the outer peripheral surface **21***c* in the finishing end **21***b* opposes the media guide surface **30**. The hopper **3** is in a swung state in the direction of arrow D2.

[0040] FIG. **3**B is an enlarged view in which a portion where the starting end **21***a* opposes the media guide surface **30** in the outer peripheral surface **21***c* in the initial state of rotation of FIG. **3**A. FIG. **4**B is an enlarged view in which a portion where the finishing end **21***b* opposes the media guide surface **30** in the outer peripheral surface **21***c* in the terminal state of rotation of FIG. **4**A.

[0041] In this embodiment, the rotational axis J1 of the feeding roller **2** of FIG. **3**A is deviated from the center S1 of the circular arc to an opposite side of the starting end **21***a* by a distance H. Accordingly, the shortest distance L2 in the gap B between the outer peripheral surface **21***c* and the media guide surface **30** in the terminal state of rotation of FIG. **4**A is longer than the shortest distance L1 in the gap B between the outer peripheral surface **21***c* and the media guide surface **30** in the initial state of rotation of FIG. **3**A.

[0042] That is, by the time when the state of the feeding roller **2** becomes the terminal state of rotation of FIG. **4**A by the rotation in the rotation direction D3 from the initial state of rotation of FIG. **3**A, the shortest distance in the gap B between the outer peripheral surface **21***c* and the media guide surface **30** becomes long along with the rotation of the feeding roller **2**.

[0043] Hereinafter, the printer **1** described in this embodiment includes: the hopper **3** which is swingably installed on which the paper sheets P are placed; the feeding roller **2** which is rotatably installed in the downstream side of the hopper **3** in the feeding direction and feeds the paper sheets P to the downstream side of the hopper in the feeding direction; the media guide surface **30** which is opposed to the outer peripheral surface **21***c* of the feeding roller **2** with the gap therebetween; the separating roller **14** which is installed in the downstream side of the media guide surface **30** in the feeding direction and separates the paper sheets P through the cooperation with the feeding roller **2**; and the recording unit **19** which makes a record on the paper sheets P separated by the feeding roller **2** and the separating roller **14**.

[0044] The outer peripheral surface **21***c* viewed from the rotational axis J1 of the feeding roller **2** in the axis direction forms a circular arc and the rotational axis J1 is installed to be deviated from the center S1 of the circular arc toward the opposite side to the starting end **21***a* that first opposes the media guide surface in the outer peripheral surface **21***c*.

[0045] By such a configuration, the shortest distance between the outer peripheral surface **21***c* of the feeding roller **2** and the media guide surface **30** in the gap B becomes long along with the rotation of the feeding roller **2** during one rotation of the feeding roller **2**.

[0046] Accordingly, in the gap B where the outer peripheral surface **21***c* of the feeding roller **2** and the media guide surface **30** are opposed to each other, it is possible to suppress the distance of the gap B where the outer peripheral surface **21***c* of the feeding roller **2** and the media guide surface **30** are opposed to each other from becoming short along with the rotation of the feeding roller **2** in the rotation direction D3 depending on the dimensional accuracy of components processing. For this reason, the increase of the force pressing the paper sheets P, which enter the gap B, caused by the outer peripheral surface **21***c* of the feeding roller **2** and the media guide surface **30** along with the rotation of the feeding roller **2** can be suppressed. Therefore, it is possible to suppress the recording media from being multi-fed by the feeding roller **2** and the separating roller **14**; the stoppage of the driving rotation of the feeding roller **2**; and the stoppage of the printer.

Embodiment 2

[0047] In Embodiment 2, a feeding roller where an outer peripheral surface that is capable of coming in contact with a separating roller is formed in a range of 180° or greater of a central angle will be described. FIGS. **5**A to **6** are views when viewed in a main scanning direction Y, and are views that illustrate the feeding roller **2***a* and a media guide surface **30** in positions at each rotation angle.

[0048] The outer peripheral surface **22***d* in a friction layer **22** of the feeding roller **2***a* is configured to have a first outer peripheral surface **22***d***1** which is formed in a range of a central angle R1; and a second outer peripheral surface **22***d***2** which is continuous from the first outer peripheral surface

22*d***1** and which is formed in a range of a central angle R**2**. A boundary position **22***b* shows a boundary position between the first outer peripheral surface **22***d***1** and the second outer peripheral surface **22***d***2**.

[0049] The first outer peripheral surface **22***d***1** viewed from the rotational axis J**2** in the axis direction forms a circular arc from a starting end **22***a* to the boundary position **22***b*. A distance K**1** from a center S**2** of the circular arc to any points of the first outer peripheral surface **22***d***1** are equal over the range of the central angle R**1**. In this embodiment, the center angle R**1** is 180°.

[0050] In the second outer peripheral surface **22***d***2** viewed from the rotational axis J**2** in the axis direction, a distance K**2** from the center S**2** of the circular arc becomes shorter as the second outer peripheral surface is located further on a finishing end **22***c* side that opposes the media guide surface later than the starting end **22***a* during one rotation of the feeding roller **2***a*.

[0051] FIG. **5**A is a view illustrating an initial state of rotation when the starting end **22***a* in the outer peripheral surface **22***d* of the friction layer **22** opposes the media guide surface **30**. FIG. **5**B is a view illustrating a state when the boundary position **22***b* in the outer peripheral surface **22***d* of the friction layer **22** opposes the media guide surface **30**.

[0052] The rotational axis J**2** of FIG. **5**A is installed to be rotatable and to be deviated from the center S**2** of the circular arc to an opposite side of the starting end **22***a* by a distance H (refer to FIG. **5**B). Accordingly, the shortest distance L**4** in the gap B between the outer peripheral surface **22***d* and the media guide surface **30** when the boundary position **22***b* of FIG. **5**B opposes the media guide surface **30** is longer than the shortest distance L**3** in the gap B between the first outer peripheral surface **22***d***1** and the media guide surface **30** in the initial state of rotation of FIG. **5**A.

[0053] That is, by the time when the feeding roller **2***a* becomes the state that the boundary position **22***b* of FIG. **5**B opposes the media guide surface **30** by the rotation in a rotation direction D**3** from the initial state of rotation of FIG. **5**A, the distance in the gap B between the first outer peripheral surface **22***d***1** and the media guide surface **30** becomes long along with the rotation of the feeding roller **2***a*.

[0054] FIG. **6** is a view illustrating a terminal state of rotation when the second outer peripheral surface **22***d***2** of the friction layer **22** opposes the media guide surface **30** by further rotation of the feeding roller **2***a* of FIG. **5**B in the rotation direction D**3**. A circle F indicated with a dashed line is a portion to which the circular arc of the first outer peripheral surface **22***d***1** is extended. If the outer peripheral surface is formed in the position of the circle F to which the circular arc of the first outer peripheral surface **22***d***1** is extended, the rotational axis J**2** is deviated from the center S**2** of the circular arc to an opposite side of the starting end **22***a*. Therefore, when the feeding roller is further rotated in the rotation direction D**3** from the state where the boundary position **22***b* opposes the media guide surface **30** as in FIG. **5**B, the outer peripheral surface formed in the position of the circle F approaches the media guide surface **30**.

[0055] That is, in the feeding roller where the outer peripheral surface is formed in the position of the circle F to which the circular arc of the first outer peripheral surface **22***d***1** is extended, when the feeding roller is further rotated in the rotation direction D**3** from the state where the boundary position **22***b* opposes the media guide surface **30** as in FIG. **5**B, the distance between the outer peripheral surface formed in the position of the circle F and the media guide surface **30** becomes short.

[0056] As described above, this embodiment includes the second outer peripheral surface **22***d***2** where the distance K**2** (refer to FIG. **5**A) from the center S**2** of the circular arc becomes shorter as the second outer peripheral surface is located further on the finishing end **22***c* side.

[0057] Accordingly, a distance L**5** in the gap B between the second outer peripheral surface **22***d***2** and the media guide surface **30** in the terminal state of rotation of FIG. **6** becomes longer than the shortest distance L**4** in the gap B between the outer peripheral surface **22***d* and the media guide surface **30** when the boundary position **22***b* opposes the media guide surface **30** as in FIG. **5**B. That is, the shortest distance between the second outer peripheral surface **22***d***2** and the media guide surface **30** becomes long even when the state of the feeding roller **2***a* changes from the state of FIG. **5**B to the state of FIG. **6** by the further rotation in the rotation direction D**3**.

[0058] As described above, the outer peripheral surface **22***d* viewed from the rotational axis J**2** of the feeding roller **2***a* in the axis direction in this embodiment is configured to have a first outer peripheral surface **22***d***1** that forms the circular arc and the second outer peripheral surface **22***d***2** that is continuous from the first outer peripheral surface **22***d***1** and has the distance K**2** from the center S**2** of the circular arc which becomes shorter as the outer peripheral surface is located further on the finishing end **22***c* side. Accordingly, it is possible to suppress the distance of the gap where the outer peripheral surface **22***d* of the feeding roller and the media guide surface are opposed to each other from becoming short after the feeding roller **2***a* is rotated at certain times and the length of the outer peripheral surface **22***d* in the rotation direction D**3** from becoming long. Therefore, the distance of rotation while pinching the paper sheets P by the feeding roller **2***a* and the separating roller **14** becomes long.

[0059] For this reason, even in the range in which the second outer peripheral surface **22***d***2** and the media guide surface **30** are opposed to each other by the rotation of the feeding roller **2***a*, it is possible to suppress the distance of the gap B where the second outer peripheral surface **22***d***2** of the feeding roller **2***a* and the media guide surface **30** are opposed to each other from becoming short along with the rotation of the feeding roller **2***a* depending on the dimensional accuracy of components processing. For this reason, the increase of the force pressing the paper sheets P, which enter the gap B, caused by the second outer peripheral surface **22***d***2** of the feeding roller **2***a* and the media guide surface **30** along with the rotation of the feeding roller **2***a* can be suppressed. Therefore, it is possible to suppress the paper sheets from being multi-fed by the feeding roller **2***a* and the separating roller **14**; the stoppage of the driving rotation of the feeding roller **2***a*; and the stoppage of the printer. Furthermore, the other configurations of the printer of this embodiment are the same as the configurations of the printer **1** described in Embodiment 1.

Embodiment 3

[0060] In this embodiment, a feeding roller which is formed such that a distance between a rotational axis and an outer peripheral surface becomes short toward a finishing end from a starting end of the outer peripheral surface will be

described. FIG. **7** is a view illustrating the feeding roller **2***c* viewed in a main scanning direction Y.

[0061] A circle H indicated with a dashed line is a circle having a radius W with a straight line that connects a starting end **23***a* in the outer peripheral surface **23***c* on which a friction layer **23** is formed and a rotational axis J**3**. A distance K**3** between the outer peripheral surface **23***c* and the rotational axis J**3** becomes shorter as the outer peripheral surface is located on a finishing end **23***b* that opposes the media guide surface later than the starting end **23***a* during one rotation of the feeding roller **2***c*.

[0062] Accordingly, the shortest distance L**6** between the outer peripheral surface **23***c* of the feeding roller **2***c* and a media guide surface **30** in a gap B becomes long along with the rotation of the feeding roller **2***c* during one rotation of the feeding roller **2***c*.

[0063] By such a configuration, in the gap B where the outer peripheral surface **23***c* of the feeding roller **2***c* and the media guide surface **30** are opposed to each other, it is possible to suppress the distance of the gap B where the outer peripheral surface **23***c* of the feeding roller **2***c* and the media guide surface **30** are opposed to each other from becoming short along with the rotation of the feeding roller **2***c* in a rotation direction D**3** depending on the dimensional accuracy of components processing. For this reason, increase of a force pressing paper sheets P, which enter the gap B, caused by the outer peripheral surface **23***c* of the feeding roller **2***c* and the media guide surface **30** along with the rotation of the feeding roller **2***c* can be suppressed. Therefore, it is possible to suppress the paper sheets P from being multi-fed by the feeding roller **2***c* and the separating roller **14**; the stoppage of the driving rotation of the feeding roller **2***c*; and the stoppage of the printer.

[0064] The other configurations of the printer of this embodiment are the same as the configurations of the printer **1** described in Embodiment 1. In Embodiments 1 to 3, the printer provided with the recording head **15** that ejects the ink has been explained, but such configurations are also applicable to an electrophotographic-type recording apparatus provided with a photoreceptor.

[0065] The entire disclosure of Japanese Patent Application No. 2012-277755, filed Dec. 20, 2012 is expressly incorporated by reference herein.

What is claimed is:

1. A recording apparatus comprising:

a hopper which is swingably installed on which recording media are placed;

a feeding roller which is rotatably installed in a downstream side of the hopper in a feeding direction and feeds the recording media;

a media guide surface which is opposed to an outer peripheral surface of the feeding roller with a gap therebetween;

a separating roller which is installed in a downstream side of the media guide surface in the feeding direction and separates the recording media through cooperation with the feeding roller; and

a recording unit which make a record on the recording media separated by the feeding roller and the separating roller,

wherein the shortest distance between the outer peripheral surface of the feeding roller and the media guide surface in the gap becomes long along with the rotation of the feeding roller during one rotation of the feeding roller.

2. The recording apparatus according to claim **1**,

wherein the feeding roller is configured to have a circular arc portion and a linear portion which make an approximately D shape from a side view,

wherein the outer peripheral surface viewed from a rotational axis of the feeding roller in an axis direction forms the circular arc portion, and

wherein the rotational axis is installed to be deviated from the center of the circular arc portion toward an opposite side to a starting end of the circular arc portion in the outer peripheral surface viewed from the feeding roller in the rotation direction.

3. The recording apparatus according to claim **2**,

wherein the outer peripheral surface viewed from the rotational axis of the feeding roller in the axis direction includes a first outer peripheral surface that forms a portion of the circular arc portion; and a second outer peripheral surface that is continuous from the first outer peripheral surface and has a distance between the center of the circular arc portion and the second outer peripheral surface which becomes shorter as the second outer peripheral surface is located further on a finishing end side that opposes the media guide surface later than the starting end.

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