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(54) **SHEET FEEDING DEVICE AND IMAGE FORMING APPARATUS**

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(57) **ABSTRACT**

A sheet feeding device includes a feeding member that rotates and feeds a sheet; a resistance member that contacts the feeding member with the sheet interposed therebetween, the resistance member contacting the sheet fed by the feeding member and applying a resistance against the feeding of the sheet; a holding unit that holds the resistance member so that the resistance member is movable to a position where the resistance member does not contact the feeding member; and an urging unit that urges the resistance member held by the holding unit in a direction opposite to a feeding direction of the sheet.

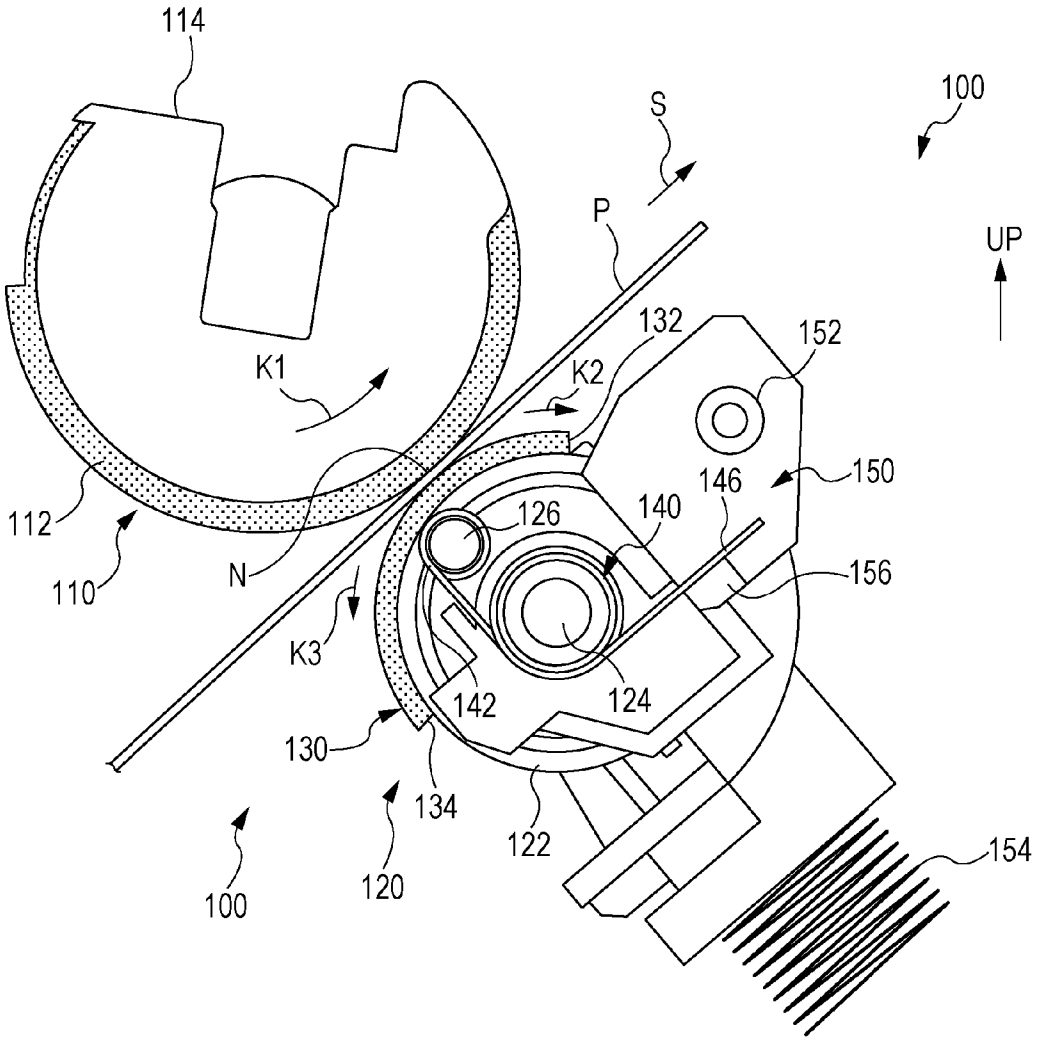


FIG. 1

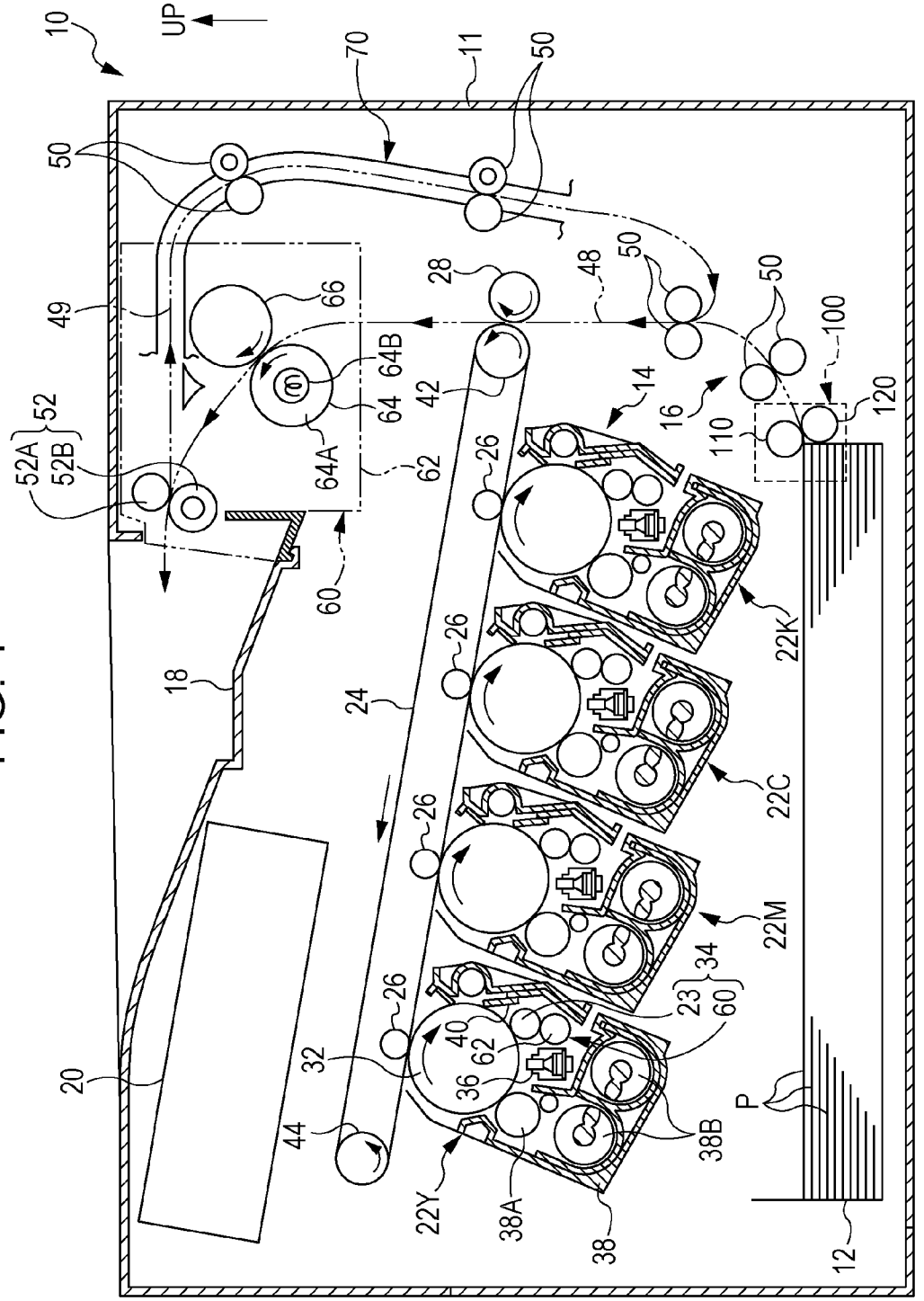

10
UP
70
11
50
49
66
64B
64
64A
28
48
42
14
16
110
120
100
52
52A
52B
62
26
60
18
24
22K
22C
22M
34
23
20
32
40
36
44
22Y
38A
38
38B
P
12

FIG. 2

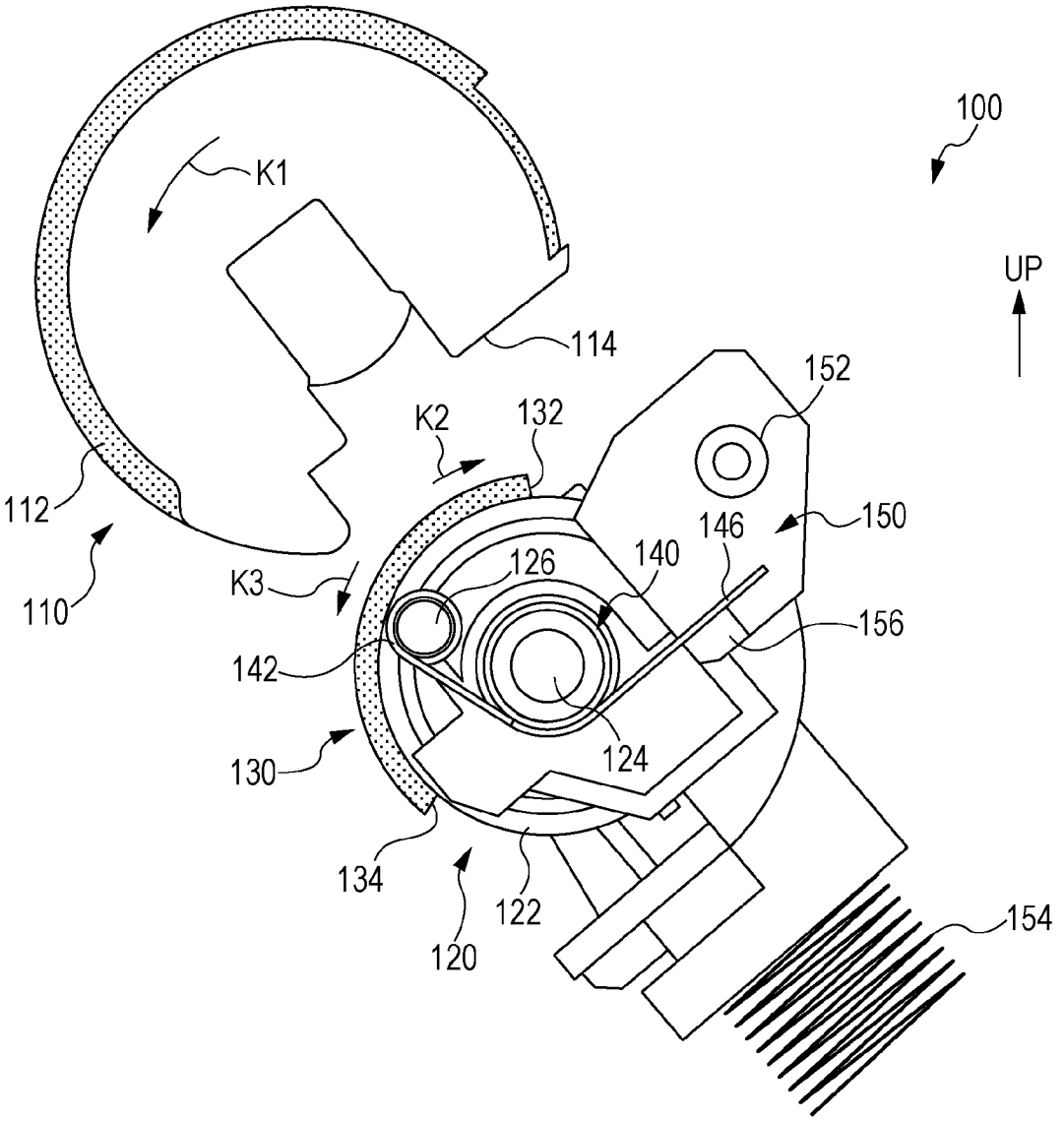

100
UP
K1
114
152
K2
132
112
146
150
126
140
K3
110
156
142
124
130
134
122
120
154

FIG. 3

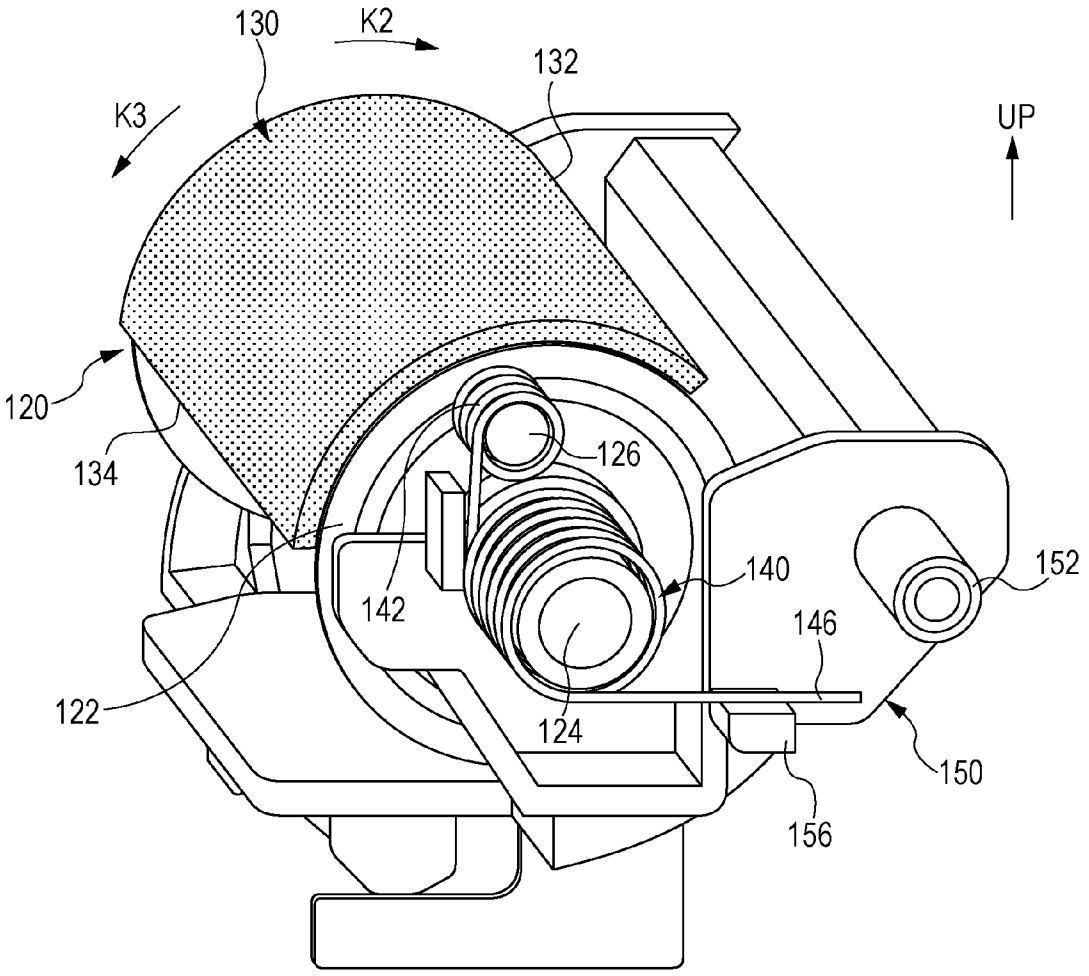


FIG. 4

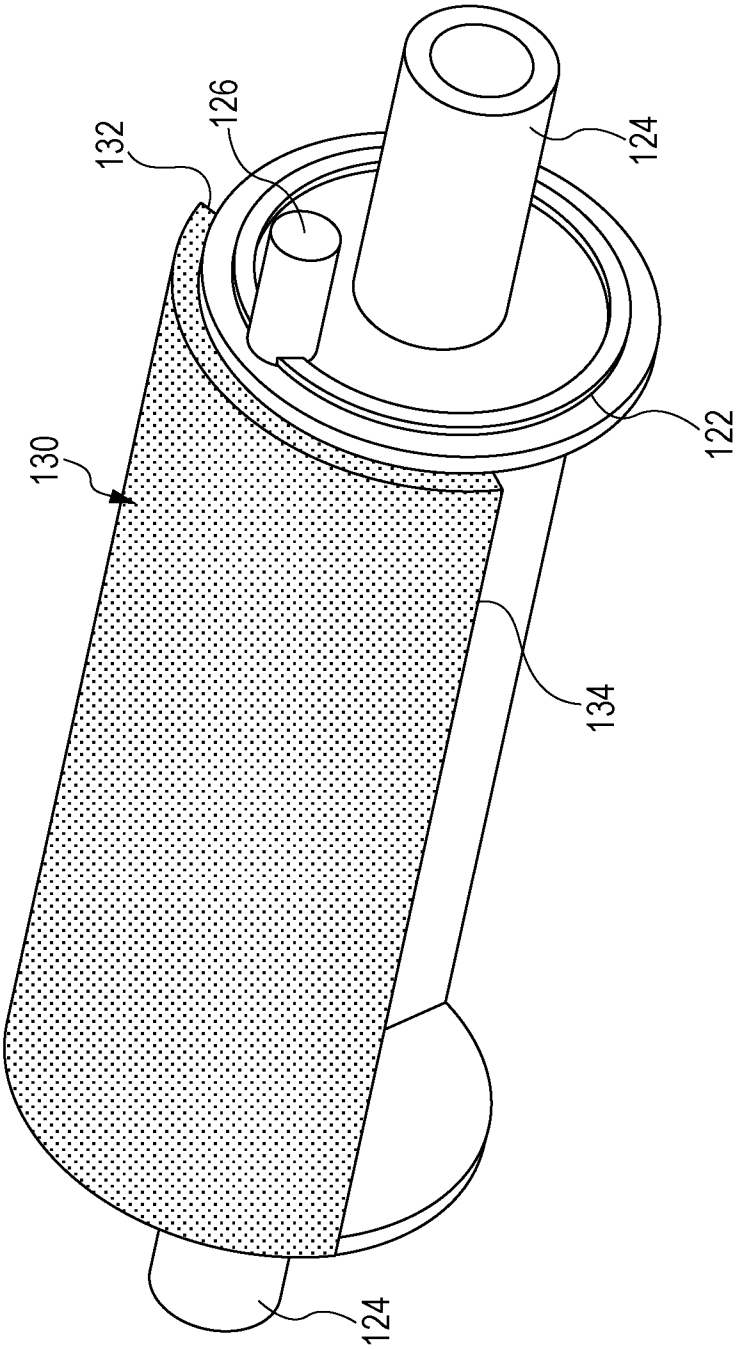


FIG. 5

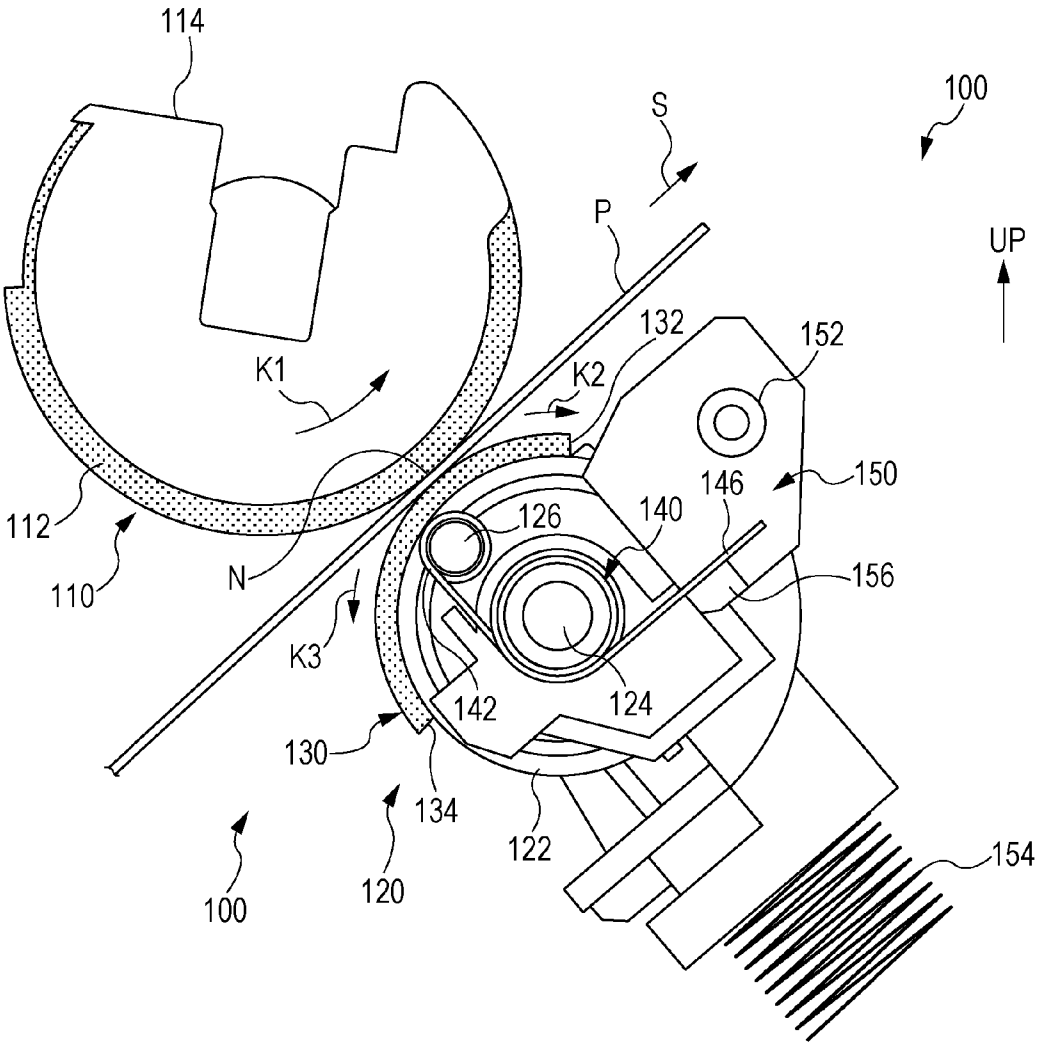

114
100
S
P
UP
K1
132
152
K2
146
150
112
126
140
110
N
156
K3
142
124
130
134
122
154
120
100

FIG. 6

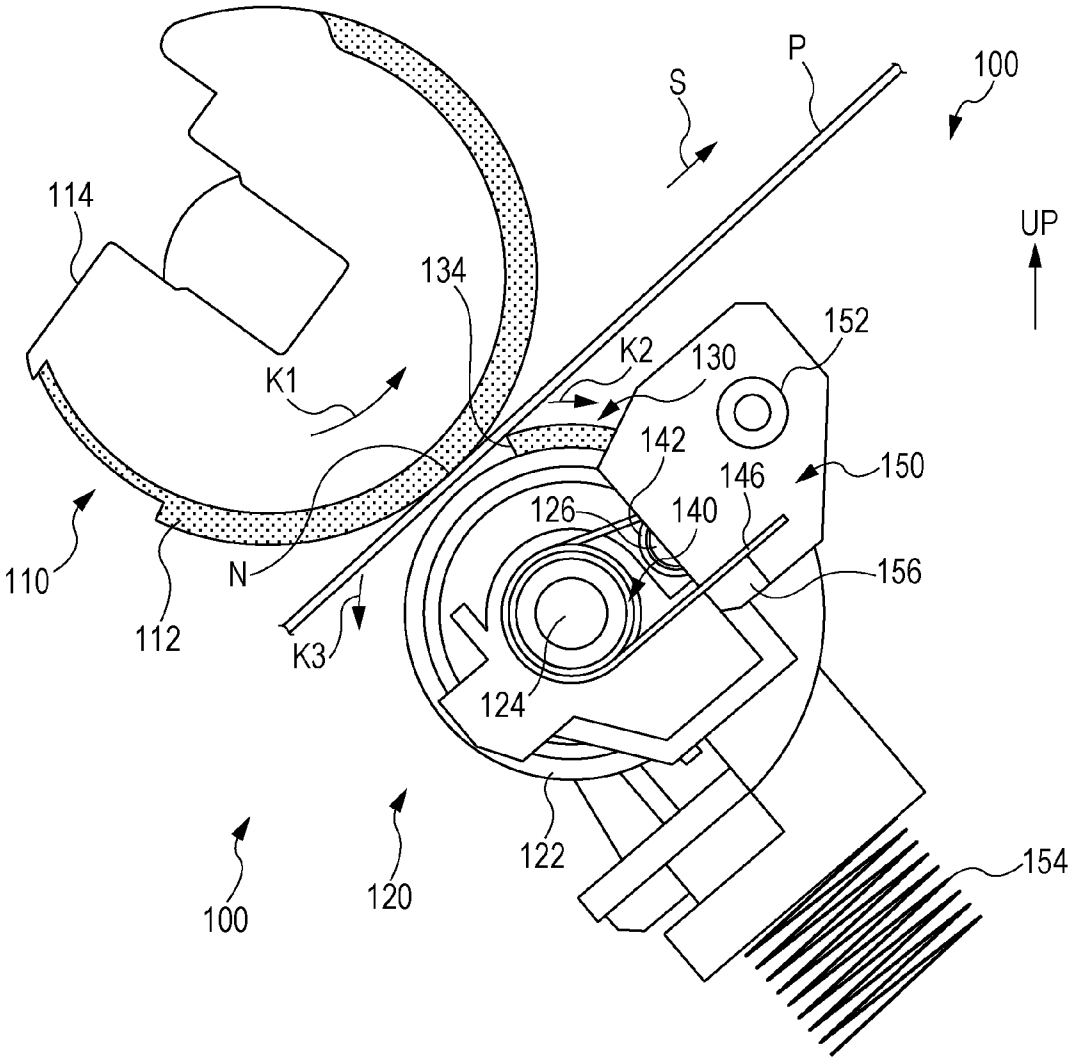

P
100
S
114
UP
134
152
K2
130
K1
142
150
146
126
140
110
156
N
112
K3
124
122
154
100
120

FIG. 7

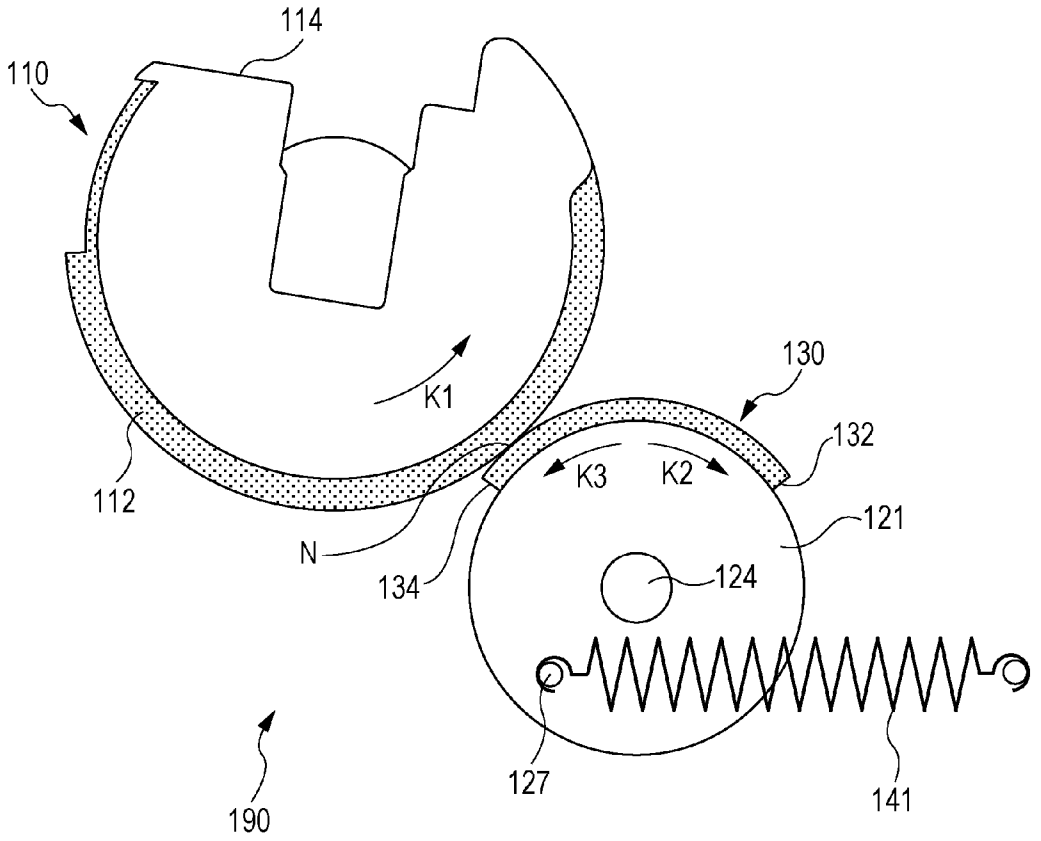


FIG. 8A

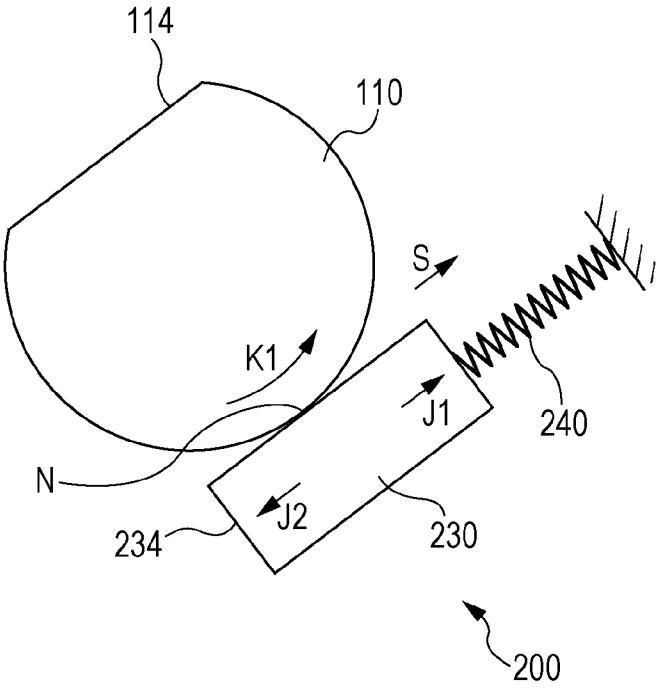

114
110
S
K1
J1
240
N
J2
234
230
200

FIG. 8B

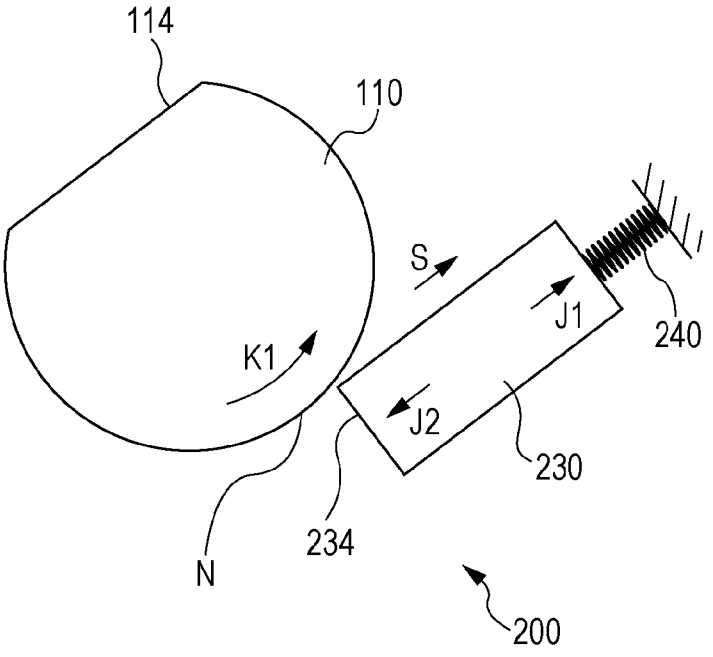
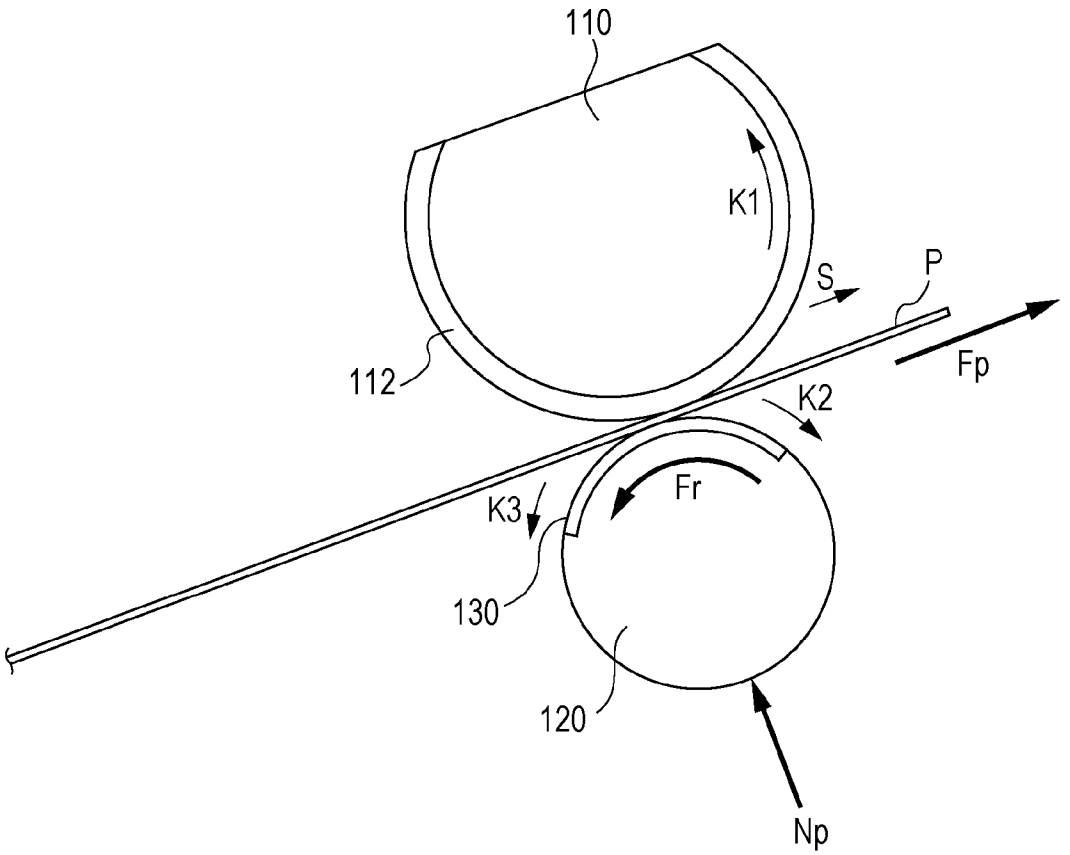

114
110
S
J1
240
K1
J2
230
234
N
200

FIG. 9



SHEET FEEDING DEVICE AND IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2013-085113 filed Apr. 15, 2013.

BACKGROUND

Technical Field

[0002] The present invention relates to a sheet feeding device and an image forming apparatus.

SUMMARY

[0003] According to an aspect of the invention, there is provided a sheet feeding device including a feeding member that rotates and feeds a sheet; a resistance member that contacts the feeding member with the sheet interposed therebetween, the resistance member contacting the sheet fed by the feeding member and applying a resistance against the feeding of the sheet; a holding unit that holds the resistance member so that the resistance member is movable to a position where the resistance member does not contact the feeding member; and an urging unit that urges the resistance member held by the holding unit in a direction opposite to a feeding direction of the sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] An exemplary embodiment of the present invention will be described in detail based on the following figures, wherein:

[0005] FIG. **1** illustrates the structure of an image forming apparatus according to an exemplary embodiment of the present invention;

[0006] FIG. **2** is a side view of a feeding device according to the exemplary embodiment of the present invention;

[0007] FIG. **3** is a perspective view of a part of the feeding device illustrated in FIG. **1**;

[0008] FIG. **4** is a perspective view of a resistance roller included in the feeding device illustrated in FIG. **1**;

[0009] FIG. **5** is a side view of the feeding device illustrated in FIG. **1** in a state immediately after the start of a recording medium feeding process;

[0010] FIG. **6** is a side view of the feeding device in a state in which the recording medium has been transported from the state illustrated in FIG. **5**;

[0011] FIG. **7** is a schematic side view of a feeding device according to a first modification;

[0012] FIG. **8**A is a schematic side view of a feeding device according to a second modification;

[0013] FIG. **8**B is a side view of the feeding device in a state in which a recording medium is being fed; and

[0014] FIG. **9** is a diagram illustrating the relationship between a force that tries to rotate a resistance roller and a force that is applied to the resistance roller by a recording medium in a feeding direction S.

DETAILED DESCRIPTION

[0015] An image forming apparatus according to an exemplary embodiment of the present invention will now be described.

Overall Structure

[0016] First, the structure of an image forming apparatus **10** according to the present exemplary embodiment will be described. FIG. **1** schematically illustrates the structure of the image forming apparatus **10** according to the present exemplary embodiment. The arrow UP in FIG. **1** indicates the upward vertical direction.

[0017] The image forming apparatus **10** according to the present exemplary embodiment illustrated in FIG. **1** includes an image forming apparatus body **11** that houses components therein. The image forming apparatus body **11** houses a container **12** in which sheet-shaped recording media P, such as sheets of recording paper and OHP sheets, are stored; an image forming section **14** that forms an image on a recording medium P; a feeding device **100** that feeds a sheet-shaped recording medium P from the container **12**; a transport unit **16** that transports the recording medium P that has been fed to the image forming section **14**; and a controller **20** that controls the operation of each component of the image forming apparatus **10**. An ejection unit **18**, to which the recording medium P having an image formed thereon by the image forming section **14** is ejected, is provided in an upper section of the image forming apparatus body **11**.

[0018] The image forming section **14** includes image forming units **22**Y, **22**M, **22**C, and **22**K (hereinafter denoted by **22**Y to **22**K) that form toner images of respective colors, which are yellow (Y), magenta (M), cyan (C), and black (K), respectively; an intermediate transfer belt **24** onto which the toner images formed by the image forming units **22**Y to **22**K are transferred; first transfer rollers **26** that transfer the toner images formed by the image forming units **22**Y to **22**K onto the intermediate transfer belt **24**; and a second transfer roller **28** that transfers the toner images, which have been transferred onto the intermediate transfer belt **24** by the first transfer rollers **26**, onto the recording medium P from the intermediate transfer belt **24**. The structure of the image forming section **14** is not limited to the above-described structure as long as an image may be formed on the recording medium P.

[0019] The image forming units **22**Y to **22**K are arranged next to each other in a central region of the image forming apparatus body **11** in the vertical direction while being tilted with respect to the horizontal direction. Each of the image forming units **22**Y to **22**K includes a photoconductor **32** that rotates in a certain direction (for example, clockwise in FIG. **1**). Since the image forming units **22**Y to **22**K have similar structures, components of the image forming units **22**M, **22**C, and **22**K are not denoted by reference numerals in FIG. **1**.

[0020] A charging roller **23**, an exposure device **36**, a developing device **38**, and a removing member **40** are arranged around each photoconductor **32** in that order from an upstream side in a rotation direction of the photoconductor **32**. The charging roller **23** is an example of a charging device that charges the photoconductor **32**. The exposure device **36** performs an exposure process on the photoconductor **32** charged by the charging roller **23** to form an electrostatic latent image on the photoconductor **32**. The developing device **38** develops the electrostatic latent image formed on the photoconductor **32** by the exposure device **36** to form a

toner image. The removing member **40** contacts the photoconductor **32** and removes toner that remains on the photoconductor **32**.

[0021] The exposure device **36** forms the electrostatic latent image on the basis of an image signal transmitted from the controller **20**. The image signal transmitted from the controller **20** may be, for example, an image signal transmitted to the controller **20** from an external device.

[0022] The developing device **38** includes a developer supplying unit **38**A that supplies developer to the photoconductor **32** and plural transport members **38**B that transport the developer to be supplied to the developer supplying unit **38**A while stirring the developer.

[0023] The intermediate transfer belt **24** has an annular shape and is located above the image forming units **22**Y to **22**K. Stretching rollers **42** and **44**, around which the intermediate transfer belt **24** is wrapped, are disposed inside the intermediate transfer belt **24**. When one of the stretching rollers **42** and **44** is rotated, the intermediate transfer belt **24** moves (rotates) in a certain direction (for example, counterclockwise in FIG. **1**) while being in contact with the photoconductors **32**. The stretching roller **42** serves as an opposing roller that opposes the second transfer roller **28**.

[0024] The first transfer rollers **26** oppose the respective photoconductors **32** with the intermediate transfer belt **24** interposed therebetween. The positions between the first transfer rollers **26** and the photoconductors **32** serve as first transfer positions at which the toner images formed on the photoconductors **32** are transferred onto the intermediate transfer belt **24**.

[0025] The second transfer roller **28** opposes the stretching roller **42** with the intermediate transfer belt **24** interposed therebetween. The position between the second transfer roller **28** and the stretching roller **42** serves as a second transfer position at which the toner images that have been transferred onto the intermediate transfer belt **24** are transferred onto the recording medium P.

[0026] The feeding device **100** is configured to separate the sheet-shaped recording media P stored in the container **12** from each other and feed them one by one to the transport unit **16** to avoid simultaneous feeding of two or more recording media P to the transport unit **16**. The feeding device **100** will be described in detail below.

[0027] The transport unit **16** includes a transport path **48** along which each recording medium P is transported and plural transport rollers **50** that are arranged along the transport path **48** to transport the recording medium P to the second transfer position.

[0028] The image forming apparatus body **11** houses a fixing device **60** at a location downstream of the second transfer position in a transport direction. The fixing device **60** fixes the toner images that have been transferred onto the recording medium P by the second transfer roller **28** to the recording medium P. The fixing device **60** may be attached to and detached from the image forming apparatus body **11** in a manufacturing process, but is not detachable by a user. The fixing device **60** includes ejection rollers **52** that eject the recording medium P having the toner images fixed thereto to the ejection unit **18**.

[0029] The fixing device **60** includes a heating roller **64** and a pressing belt **66** as examples of fixing members for fixing the toner images to the recording medium P.

[0030] The heating roller **64** includes a cylindrical member **64**A that is rotatably supported in the fixing device **60** and a heat source **64**B, such as a halogen lamp, disposed in the inner space of the cylindrical member **64**A. The pressing belt **66** has an annular shape and is rotatably supported in the fixing device **60** at a position where the pressing belt **66** opposes the heating roller **64**.

[0031] The heating roller **64** and the pressing belt **66** rotate around a rotation axis direction, which is a width direction of the recording medium P (hereinafter referred to simply as a width direction) that is orthogonal to a transport direction of the recording medium P (hereinafter referred to simply as a transport direction), and extend in the width direction.

[0032] When the heating roller **64** is rotated and the pressing belt **66** is rotated by the rotation of the heating roller **64**, the recording medium P onto which the toner images have been transferred is transported while being nipped between the heating roller **64** and the pressing belt **66**. The toner on the recording medium P that is transported while being nipped between the heating roller **64** and the pressing belt **66** is heated by the heating roller **64** and pressed by the pressing belt **66**, so that the images are fixed to the recording medium P.

[0033] The fixing device **60** is equipped with a pair of ejection rollers **52** for ejecting the recording medium P having the toner images fixed thereon by the heating roller **64** and the pressing belt **66** to the ejection unit **18** from the fixing device **60**. The pair of ejection rollers **52** include a driven roller **52**A and a drive roller **52**B disposed below the driven roller **52**A.

[0034] The image forming apparatus body **11** includes a reverse transport path **70** for returning the recording medium P having images formed on one side thereof to the transfer position (image forming position) with plural transport rollers **50** to allow images to be formed on both sides of the recording medium P.

[0035] The fixing device **60** includes an introduction path **49** that guides the recording medium P having images fixed thereto to the reverse transport path **70**. The introduction path **49** is configured to guide the recording medium P having images fixed thereto that has been transported backward by reverse rotation of the ejection rollers **52** to the reverse transport path **70**. Thus, in the image forming apparatus **10**, the recording medium P having the images formed on one side thereof may be reversed and returned to the transport path **48** by the introduction path **49** and the reverse transport path **70**.

Image Forming Operation

[0036] Next, an image forming operation performed by the image forming apparatus **10** according to the present exemplary embodiment to form an image on the recording medium P will be described.

[0037] In the image forming apparatus **10** according to the present exemplary embodiment, a recording medium P is fed from the container **12** by the feeding device **100**, and is transported to the second transfer position by the transport rollers **50**.

[0038] In each of the image forming units **22**Y to **22**K, the photoconductor **32** is charged by the charging roller **23** and subjected to the exposure process by the exposure device **36**, so that an electrostatic latent image is formed on the photoconductor **32**. The electrostatic latent image is developed by the developing device **38**, so that a toner image is formed on the photoconductor **32**. The toner images of the respective colors formed by the image forming units **22**Y to **22**K are transferred onto the intermediate transfer belt **24** in a superimposed manner at the first transfer positions, so that a color

image is formed. The color image formed on the intermediate transfer belt **24** is transferred onto the recording medium P at the second transfer position.

[0039] The recording medium P onto which the toner images have been transferred is transported to the fixing device **60**, and the toner images are fixed to the recording medium P by the fixing device **60**. In the case where an image is to be formed only on one side of the recording medium P, the recording medium P is ejected to the ejection unit **18** by the ejection rollers **52** after the toner images are fixed.

[0040] In the case where images are to be formed on both sides of the recording medium P, the recording medium P having an image formed on one side thereof is transported from the introduction path **49** to the reverse transport path **70** by the reverse rotation of the ejection rollers **52**. Then, the recording medium P is transported from the reverse transport path **70** to the transport path **48**, and an image is formed on the other side of the recording medium P by a process similar to the above-described process. Thus, images are formed on both sides of the recording medium P. Thus, the image forming operation is performed.

Feeding Device

[0041] The feeding device **100** will now be described. FIG. **2** is a side view illustrating the state before or after the recording medium P is fed, and FIGS. **5** and **6** are side views illustrating the state in which the recording medium P is being fed.

[0042] As illustrated in FIG. **2**, the feeding device **100** includes a feeding roller **110** disposed at an upper location and a resistance roller **120** disposed at a lower location so as to oppose the feeding roller **110**. The direction of rotation axes of these rollers may sometimes be referred to as a width direction. As illustrated in FIG. **5**, for example, the direction in which the recording medium P is fed by the feeding roller **110** is defined as a feeding direction S.

[0043] The feeding roller **110** is substantially D-shaped (half moon shaped) and the outer periphery thereof is chamfered (D-cut) to form a substantially flat portion. The substantially flat portion is called a D-cut portion **114**. A feeding member **112**, which is made of rubber or the like, is provided on the outer periphery of the feeding roller **110** in a region other than the D-cut portion **114**. The feeding roller **110** is rotatable in the direction of arrow K1 by a driving mechanism (not shown).

[0044] Rotating plates (not shown) are provided on both sides of the feeding roller **110**. The rotating plates have a diameter smaller than that of the feeding roller **110**, and are configured to prevent the feeding member **112** and the resistance roller **120** from contacting each other in the state before and after the recording medium P is fed. The rotating plates (not shown) are formed by molding a resin, such as POM.

[0045] As illustrated in FIGS. **2** and **3**, the resistance roller **120** is rotatably supported by the holder member **150**. Shaft portions **152** are provided on both sides of the holder member **150** in the width direction at a downstream position in the feeding direction S. The holder member **150** is rotatably supported on a housing (not shown) or the like by the shaft portions **152**.

[0046] As illustrated in FIG. **2**, a coil spring **154** is disposed below the holder member **150**. The bottom end of the coil spring **154** is fixed to the housing (not shown) or the like. The holder member **150** is urged by an urging force of the coil spring **154** so as to rotate around the shaft portions **152**. Thus, the resistance roller **120** held by the holder member **150** is urged toward the feeding roller **110**. A stopper (not shown) is provided so that the rotation of the holder member **150** is stopped at a predetermined position.

[0047] Referring to FIG. **5**, when the feeding roller **110** is rotated in the direction of arrow K1, a contact pressure is applied to a contact portion (hereinafter referred to as a nip N) between the feeding member **112** of the feeding roller **110** and a resistance member **130** of the resistance roller **120** by the urging force of the coil spring **154**.

[0048] The shaft portions **152** of the holder member **150** are configured such that the urging force applied to the resistance roller **120** held by the holder member **150** is greater when the resistance member **130** is in contact with the feeding member **112** of the feeding roller **110** than when the resistance member **130** is not yet in contact with the feeding member **112** of the feeding roller **110**. In other words, the shaft portions **152** of the holder member **150** are positioned so that the contact force applied between the feeding member **112** and the resistance member **130** increases when the resistance member **130** applies a resistance to the recording medium P.

[0049] As illustrated in FIGS. **2** to **4**, the resistance roller **120** includes a roller body **122** that is rotatably held by the holder member **150** (see FIGS. **2** and **3**) and the resistance member **130** made of rubber that is provided over a part of the outer periphery of the roller body **122** so as to oppose the feeding roller **110**. The resistance member **130** has an arc shape in side view.

[0050] A projection **126** and a rotation shaft **124** that is rotatably supported by the holder member **150** (see FIGS. **2** and **3**) are provided on each end of the resistance roller **120** (roller body **122**) in the width direction. The resistance roller **120** is held by the holder member **150** so as to be rotatable in the direction of arrow K2 and the direction of arrow K3.

The rotational range (movable range) of the resistance member **130** of the resistance roller **120** toward the upstream side in the feeding direction (in the direction of arrow K3) is set so that an end **132** of the resistance member **130** in the feeding direction does not move past the nip N (see FIG. **5**) between the resistance roller **120** and the feeding roller **110**. In other words, the rotation of the resistance roller **120** in the direction of arrow K3 is stopped by a stopper (not shown) at the position shown in FIG. **2**. The feeding roller **110** and the resistance roller **120** do not become separated from each other even when the resistance roller **120** is rotated in the direction of arrow K3.

[0051] The rotational range (movable range) of the resistance member **130** of the resistance roller **120** toward the downstream side in the feeding direction (in the direction of arrow K2) is set so that an end **134** of the resistance member **130** opposite to the end in the feeding direction moves past the nip N (see FIG. **5**) between the resistance roller **120** and the feeding roller **110** (see FIG. **6**). In other words, the resistance roller **120** is held by the holder member **150** so that the resistance roller **120** rotates in the direction of arrow K2 until the upstream end **134** of the resistance member **130** of the resistance roller **120** in the feeding direction (end in the direction of arrow K3) moves past the nip N (see FIG. **5**) between the resistance roller **120** and the feeding roller **110** (see FIG. **6**).

[0052] As illustrated in FIGS. **2** and **3**, a torsion coil spring is fitted to the rotation shaft **124** of the resistance roller **120** (roller body **122**). One end portion **142** of the torsion coil spring **140** is wound around the projection **126**, and the other

end portion **146** of the torsion coil spring **140** is retained by a retaining portion **156** of the holder member **150**. Thus, the resistance roller **120** is urged so as to rotate in the direction of arrow K3, that is, in a direction opposite to the feeding direction S. The resistance roller **120** receives a torque in the direction of arrow K3 (direction opposite to the feeding direction S) from the torsion coil spring **140**.

[0053] Although only one side in the width direction (axial direction) is illustrated in FIGS. **2** and **3**, the structure at the other side is similar to that at the illustrated side, and the rotation shaft **124**, the projection **126**, the torsion coil spring **140**, and the retaining portion **156** are provided. More specifically, the torsion coil spring **140** is provided at each end of the resistance roller **120** (resistance member **130**) in the width direction (axial direction).

Operation

[0054] The operation of the present exemplary embodiment will now be described.

[0055] As illustrated in FIG. **5**, the topmost one of the recording media P in a stacked state is fed when the substantially D-shaped (half moon shaped) feeding roller **110** is rotated.

[0056] As described above, a nip pressure is applied to the nip N between the feeding member **112** of the feeding roller **110** and the resistance member **130** of the resistance roller **120** by the urging force of the coil spring **154**. In addition, the resistance roller **120** (the resistance member **130**) receives a torque in the direction of arrow K3 (direction opposite to the feeding direction) owing to the urging force of the torsion coil spring **140**.

[0057] When a single recording medium P is fed by the feeding roller **110**, the resistance roller **120** (resistance member **130**) receives a rotational force in the direction of arrow K2 through the recording medium P, and rotates in the direction of arrow K2 (feeding direction) against the urging force of the torsion coil spring **140**.

[0058] Referring to FIG. **9**, when Np is the nip pressure applied by the resistance member **130** of the resistance roller **120** that presses the feeding member **112** of the feeding roller **110**, μ is the coefficient of friction of the resistance member **130** of the resistance roller **120**, r is the radius of the resistance roller **120**, and T is the torque of the torsion coil spring **140**, a force Fr that tries to rotate the resistance roller **120** in the direction of arrow K3 is calculated as $Fr=T/r$.

[0059] A force Fp applied to the resistance roller **120** (resistance member **130**) by the recording medium P in the feeding direction S is calculated as $Fp=Np\times\mu$.

[0060] In order for the recording medium P to be transported, that is, in order for the resistance roller **120** to be rotated in the direction of arrow K2, $Fp>Fr$ needs to be satisfied.

[0061] The image forming apparatus **10** is designed so that $Fp>Fr$ is satisfied as long as the recording medium P is of a type that is capable of being subjected to a printing process performed by the image forming apparatus **10**.

[0062] As illustrated in FIG. **6**, when the end portion **134** of the resistance member **130** of the resistance roller **120** in the direction of arrow K3 (direction opposite to the feeding direction) moves past the nip N, the resistance roller **120** is rotated in the direction of arrow K3 by the urging force of the torsion coil spring **140**, so that the end portion **134** returns to the nip N. However, the resistance roller **120** soon rotates in the direction of arrow K2 (feeding direction) again owing to the frictional force between the recording medium P and the resistance member **130**, so that the end portion **134** of the resistance member **130** of the resistance roller **120** is moved past the nip N. In other words, the end portion **134** of the resistance member **130** repeatedly moves past and returns to the nip N (small motion).

[0063] In the case where plural recording media P are fed together by the feeding roller **110** (in case of double feeding), the topmost recording medium P that is in contact with the feeding member **112** of the feeding roller **110** is further transported by the feeding roller **110**. Since the frictional resistance between the recording media P is small, one or more recording media P below the topmost recording medium P are stopped owing to a transport load (transport resistance) of the resistance member **130** of the resistance roller **120** that tries to rotate in the direction of arrow K3 (direction opposite to the feeding direction), and are pushed backward in the direction of arrow K3. The recording media P below the topmost recording medium P are pushed back past the nip N toward the downstream side in the feeding direction. Thus, the recording media P are separated from each other and only the topmost recording medium P is fed to the transport unit **16** (see FIG. **1**). As described above, the image forming apparatus **10** is designed so that $Fp>Fr$ is satisfied. Therefore, as long as the recording medium P is of a type that is capable of being subjected to the printing process performed by the image forming apparatus **10**, the end portion **134** of the resistance member **130** of the resistance roller **120** moves past the nip N.

[0064] As described above, in the feeding device **100** according to the present exemplary embodiment, the urging force (spring force) of the torsion coil spring **140** serves as the transport load (transport resistance) applied to the recording medium P. Therefore, the transport load (transport resistance) may be defined by the urging force (spring force) of the torsion coil spring **140**. Accordingly, even when the surface of the resistance member **130** has dust or the like attached thereto, the transport load (transport resistance) changes by a smaller amount than in the case where the resistance member is fixed (in the case where the transport load (transport resistance) is defined by the frictional resistance and the nip pressure). In other words, feeding failure, double feeding, etc., of the recording media P may be prevented or suppressed.

[0065] The torsion coil spring **140** is provided at each end of the resistance roller **120** (resistance member **130**) in the width direction (axial direction). Therefore, compared to the case in which the torsion coil spring **140** is provided only at one end in the width direction, variation in transport load along the width direction (axial direction) is reduced (the transport load is made uniform).

[0066] The torsion coil spring may be disposed inside the resistance roller. Also in such a case, the spring (urging unit) is disposed on each side of a central region in the width direction (axial direction) to reduce variation in the transport load along the axial direction. Alternatively, the spring (urging unit) may be disposed only in the central region in the width direction (axial direction). In the case where plural resistance rollers are arranged in the axial direction, spring (urging units) may be disposed between the resistance rollers.

[0067] When the feeding process performed by the feeding roller **110** is finished, that is, when the D-cut portion **114** of the feeding roller **110** is positioned so as to face the resistance roller **120**, the resistance roller **120** is rotated in the direction of arrow K3 by the urging force of the torsion coil spring **140**, and returns to the original position, as illustrated in FIG. **2**. As

a result, the recording media P that have been separated from the topmost recording medium P and that remain at a position near the downstream end of the nip N in the feeding direction are pushed back in the direction of arrow K3. Thus, displacements of the recording media P from the predetermined position (regular position) may be suppressed.

[0068] A comparative example will now be considered in which the movable range (rotatable range) of the end portion **134** of the resistance member **130** of the resistance roller **120** is such that the end portion **134** does not move past the nip N.

[0069] When the feeding roller **110** is rotated, the recording medium P is fed and the resistance roller **120** is also rotated. When the end portion **134** of the resistance member **130** in the direction of arrow K3 stops before it moves past the nip N, the frictional force and nip pressure of the resistance member **130**, instead of the urging force of the torsion coil spring **140**, serve as the transport load (transport resistance). This is the same as the case where the resistance member is fixed (case where the transport load (transport resistance) is defined by the frictional resistance and nip pressure), and the urging force (spring force) of the torsion coil spring **140** does not serve as the transport load (transport resistance) applied to the recording medium P.

[0070] In the present exemplary embodiment, as described above, the rotational range of the resistance member **130** of the resistance roller **120** toward upstream side in the feeding direction (in the direction of arrow K2) is set such that the end portion **134** at the end opposite to the end in the feeding direction moves past the nip N (see FIG. **2**) between the resistance roller **120** and the feeding roller **110**. Therefore, the urging force (spring force) of the torsion coil spring **140** serves as the transport load (transport resistance) applied to the recording medium P.

Modifications

[0071] Modifications of the present exemplary embodiment will now be described.

First Modification

[0072] In the above-described exemplary embodiment, the urging unit that urges the resistance roller **120** held by the holder member **150** in a direction opposite to the feeding direction is the torsion coil spring **140**. However, the urging unit is not limited to this.

[0073] For example, in a feeding device **190** according to a first modification illustrated in FIG. **7**, an extension coil spring **141** having an end hooked on a projection **127** may be provided to rotate a resistance roller **121** in the direction of arrow K3. Alternatively, a compression coil or a leaf spring may be used as the urging unit. Alternatively, an elastic member other than a spring, such as rubber, may be used.

Second Modification

[0074] In the above-described exemplary embodiment, the transport load (transport resistance) is applied by the arc-shaped resistance member **130** provided on a part of the outer periphery of the roller body **122** that is rotatably held by the holder member **150**.

[0075] The present invention may also be applied to, for example, a case where a pad-shaped resistance member is used. In a feeding device **200** according to a second modification illustrated in FIGS. **8**A and **8**B, a plate-shaped resistance member **230** having a flat surface that applies a resistance to the recording medium P is configured to slide along a straight line. The resistance member **230** is urged in the direction of arrow J2 by a compression coil spring **240**. As illustrated in FIG. **8**B, the movable range of the resistance member **230** in the direction of arrow J1 (feeding direction) is set so that an end portion **234** of the resistance member **230** in the direction of arrow J2 moves past the nip N. When the recording medium P reaches the nip N and is transported, the end portion **234** of the resistance member **230** repeatedly moves past and returns to the nip N (small motion).

Others

[0076] The present invention is not limited to the above-described exemplary embodiment.

[0077] For example, the structure of the image forming apparatus is not limited to the structure of the above-described exemplary embodiment, and the image forming apparatus may have various structures.

[0078] In addition, although the image forming section **14** forms an image on the recording medium P by an electrophotographic method in the above-described exemplary embodiment, the image forming method is not limited to this. An image may be formed on the recording medium P by other methods, such as an inkjet method or a heat transfer method.

[0079] Furthermore, although the present invention is applied to the image forming apparatus that forms an image on the recording medium P in the above-described exemplary embodiment, the present invention is not limited to this. The present invention may also be applied to apparatuses other than image forming apparatuses, such as image reading apparatuses, automatic teller machines, and cash registers. The present invention may be applied to any type of feeding device that separates sheets from each other and feeds them one by one.

[0080] Furthermore, various embodiments are, of course, possible within the scope of the present invention.

[0081] The foregoing description of the exemplary embodiment of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiment was chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. A sheet feeding device comprising:

a feeding member that rotates and feeds a sheet;

a resistance member that contacts the feeding member with the sheet interposed therebetween, the resistance member contacting the sheet fed by the feeding member and applying a resistance against the feeding of the sheet;

a holding unit that holds the resistance member so that the resistance member is movable to a position where the resistance member does not contact the feeding member; and

an urging unit that urges the resistance member held by the holding unit in a direction opposite to a feeding direction of the sheet.

2. The sheet feeding device according to claim 1,
wherein a surface of the resistance member that faces the feeding member is arc shaped in cross section,
wherein the resistance member is rotatably held by the holding unit, and
wherein the urging unit is a spring that applies a rotational force to the resistance member.

3. The sheet feeding device according to claim 1,
wherein the resistance member includes a flat surface that applies the resistance against the feeding of the sheet.

4. The sheet feeding device according to claim 2,
wherein the holder member includes a rotation fulcrum, and
wherein the rotation fulcrum is located so that a contact force between the feeding member and the resistance member increases when the resistance member applies the resistance to the sheet.

5. The sheet feeding device according to claim 1,
wherein the feeding member and the resistance member are not in contact with each other before the feeding member is rotated.

6. The sheet feeding device according to claim 1,
wherein the urging unit is disposed in a central region of the resistance member in a width direction that crosses a movement direction of the resistance member or on each side of the central region in the width direction.

7. The sheet feeding device according to claim 1,
wherein, when a single sheet is nipped between the feeding member and the resistance member, the resistance member is moved against an urging force applied by the urging unit to the position where the resistance member does not contact the feeding member.

8. The sheet feeding device according to claim 1,
wherein, in the case where a single sheet is nipped between the feeding member and the resistance member, when Np is a pressing force with which the resistance member presses the sheet against the feeding member and μ is a coefficient of friction of the resistance member, a force Fp applied to the resistance member in the feeding direction through the single sheet is $Fp=Np\times\mu$, and
wherein, when Fr is an urging force applied to the resistance member by the urging unit in the direction opposite to the feeding direction of the sheet, $Fp>Fr$ is satisfied.

9. An image forming apparatus comprising:
the sheet feeding device according to claim 1; and
an image forming unit which forms an image on the sheet fed by the sheet feeding device.

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