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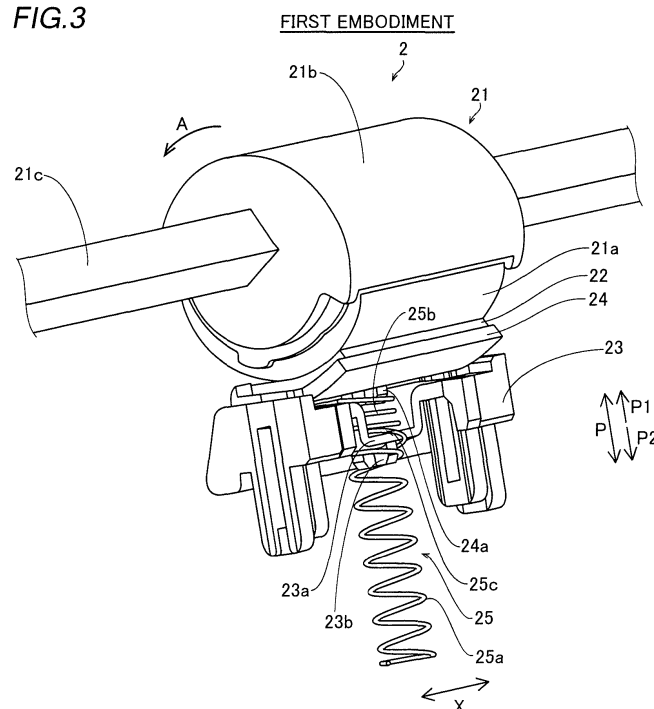
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(54) **PAPER FEEDING APPARATUS AND IMAGE FORMING APPARATUS**

(57) This paper feeding apparatus (100) includes a pickup roller (21) including a first portion (21a) that picks up paper (150) in a first state where the paper is to be picked up and a second portion (21b) that transports, in a second state where the paper is to be transported, the paper picked up in the first state and a friction pad (22)

that suppresses transport of paper subsequent to the picked up paper, and the pickup roller is in surface contact such that a contact area between the first portion and the friction pad and a contact area between the second portion and the friction pad are substantially equal to each other.

FIG.3



Description

Technical Field

[0001] The present invention relates to a paper feeding apparatus and an image forming apparatus, and more particularly, it relates to a paper feeding apparatus and an image forming apparatus each including a pickup roller.

Background Art

[0002] A paper feeding apparatus including a pickup roller is known in general (refer to Patent Document 1, for example).

[0003] In the aforementioned Patent Document 1, there is disclosed a paper feeding apparatus including a rotatable pickup roller including a paper feed portion that picks up stacked paper while contacting with a surface of the stacked paper in a first state where the paper is to be picked up and a hub that contacts with the surface of the paper picked up in the first state in a second state where the paper is to be transported. This paper feeding apparatus includes a separation pad (friction pad) that is arranged to face the pickup roller and suppresses transport of subsequent paper by contacting with the paper subsequent to the paper picked up in the first state. The pickup roller is configured such that the paper feed portion is urged (pushed) to the separation pad in the first state and the hub is urged (pushed) to the separation pad in the second state. In this pickup roller, a portion of the hub that faces the separation pad has an area smaller than the area of a portion of the paper feed portion that faces the separation pad.

Prior Art

Patent Document

[0004] Patent Document 1: Japanese Patent No. 4385929

Summary of the Invention

Problem to be Solved by the Invention

[0005] In the paper feeding apparatus according to the aforementioned Patent Document 1, however, the portion of the hub of the pickup roller that faces the separation pad has the area smaller than the area of the portion of the paper feed portion that faces the separation pad, and hence in the second state, the hub is urged (pushed) to the separation pad in a state where a contact area between the separation pad and the hub is small. Thus, the contact area between the separation pad and the hub is small in the second state, and hence pressure applied to the separation pad is large. Consequently, the separation pad easily becomes worn or damaged.

[0006] The present invention has been proposed in order to solve the aforementioned problem, and one object of the present invention is to provide a paper feeding apparatus and an image forming apparatus each capable of suppressing tendency to wear and damage a friction pad.

Means for Solving the Problem

[0007] A paper feeding apparatus according to a first aspect of the present invention includes a rotatable pickup roller including a first portion that picks up stacked paper while contacting with a surface of the paper in a first state where the paper is to be picked up and a second portion that transports the paper picked up in the first state while contacting with the surface of the paper in a second state where the paper is to be transported and a friction pad that is arranged to face the pickup roller and suppresses transport of paper subsequent to the paper picked up in the first state by contacting with the paper that is subsequent, and the pickup roller is in surface contact such that a contact area between the first portion and the friction pad in the first state and a contact area between the second portion and the friction pad in the second state are substantially equal to each other.

[0008] In the paper feeding apparatus according to the first aspect of the present invention, as hereinabove described, the pickup roller is configured to be in surface contact such that the contact area between the first portion of the pickup roller and the friction pad in the first state and the contact area between the second portion of the pickup roller and the friction pad in the second state are substantially equal to each other. Thus, even when the friction pad is urged toward the pickup roller, the second portion is urged to the friction pad in a state where the contact area between the friction pad and the second portion in the second state is substantially equal to the contact area between the friction pad and the first portion in the first state, unlike the case where the second portion is urged (pushed) to the friction pad in a state where the contact area between the friction pad and the second portion is smaller in the second state. Thus, an increase in pressure applied to the friction pad can be suppressed in the second state, and hence tendency to wear and damage the friction pad can be suppressed.

[0009] Preferably in the aforementioned paper feeding apparatus according to the first aspect, the first portion of the pickup roller has a first curvature on a cross-sectional surface orthogonal to the rotation axis of the pickup roller, the second portion of the pickup roller has a second curvature on the cross-sectional surface orthogonal to the rotation axis of the pickup roller, and the first curvature and the second curvature are set so as to bring the pickup roller into surface contact such that the contact area between the first portion and the friction pad in the first state and the contact area between the second portion and the friction pad in the second state are substantially equal to each other. According to this structure, the first curva-

ture of the first portion and the second curvature of the second portion are adjusted, whereby surface contact between the friction pad and the first portion and surface contact between the friction pad and the second portion can be easily kept substantially the same as each other in the first state and the second state.

[0010] Preferably, the aforementioned paper feeding apparatus according to the first aspect further includes a single urging member including a first urging portion and a second urging portion having urging force weaker than the urging force of the first urging portion, and the urging member urges the friction pad toward the pickup roller by the first urging portion in the first state and urges the friction pad toward the pickup roller by the second urging portion in the second state. According to this structure, the friction pad can be urged by the second urging portion having the urging force weaker than the urging force of the first urging portion in the second state, and hence the pressure applied to the friction pad can be further reduced in the second state than in the first state. Thus, tendency to wear the friction pad can be easily suppressed. Furthermore, the single (one) urging member can serve as both the first urging portion and the second urging portion having the urging force weaker than the urging force of the first urging portion, and hence the structure of the paper feeding apparatus can be simplified while an increase in the number of components can be suppressed, unlike the case where the first urging portion and the second urging portion are provided separately from each other.

[0011] Preferably in the aforementioned structure in which the first portion has the first curvature, in the pickup roller, the center of curvature of the first portion and the center of curvature of the second portion are arranged in different positions, as viewed along the axis. According to this structure, the first curvature of the first portion and the second curvature of the second portion can be adjusted individually. Consequently, the surface contact between the friction pad and the first portion and the surface contact between the friction pad and the second portion can be more easily kept substantially the same as each other in the first state and the second state.

[0012] Preferably in the aforementioned structure in which the center of curvature of the first portion and the center of curvature of the second portion are arranged in the different positions, the amount of protrusion of the pickup roller toward the friction pad is larger in the first state than in the second state. According to this structure, the position of the first portion in the first state can be further moved in a direction toward the friction pad than the position in the second state, and the position of the first portion in the second state can be further moved in a direction away from the friction pad than the position in the first state. Consequently, the paper can be easily picked up in the first state, and the paper can be transported while an increase in the pressure applied to the friction pad is suppressed in the second state.

[0013] Preferably in the aforementioned structure in

which the amount of protrusion of the pickup roller toward the friction pad is larger in the first state than in the second state, in the pickup roller, the center of curvature of the second portion is arranged closer to the second portion than the center of the pickup roller, and the center of curvature of the first portion is arranged closer to the first portion than the center of the pickup roller, as viewed along the axis, and in the pickup roller, the center of curvature of the second portion coincides with the rotation axis of the pickup roller. According to this structure, by the simple structure, the position of the first portion in the first state can be further moved in the direction toward the friction pad than the position in the second state, and the position of the first portion in the second state can be further moved in the direction away from the friction pad than the position in the first state.

[0014] Preferably in the aforementioned structure in which the first portion has the first curvature, in the pickup roller, a surface of the first portion having the first curvature and a surface of the second portion having the second curvature are flush with each other. According to this structure, the pickup roller can be smoothly rotated when the paper is picked up and then transported.

[0015] Preferably in this case, the paper feeding apparatus further includes a first friction pad holding member and a second friction pad holding member that hold the friction pad, the first friction pad holding member is arranged to partition a boundary region between the first urging portion and the second urging portion of the urging member, and the second friction pad holding member is arranged to hold the second urging portion between the first friction pad holding member and the second friction pad holding member. According to this structure, the second friction pad holding member (friction pad) can be urged by the second urging portion in a state where application of the urging force of the first urging portion is suppressed in the second state even when the common urging member including the first urging portion and the second urging portion is provided.

[0016] Preferably in the aforementioned structure including the first friction pad holding member and the second friction pad holding member, the first friction pad holding member includes a plate-like partition portion, and the partition portion is held between the first urging portion and the second urging portion. According to this structure, the second friction pad holding member (friction pad) can be urged by the second urging portion while the application of the urging force of the first urging portion is stably suppressed by the partition portion in the second state even when the common urging member including the first urging portion and the second urging portion is provided.

[0017] Preferably in the aforementioned structure including the partition portion, the partition portion includes an engaging portion that engages with the urging member. According to this structure, misalignment of the partition portion and the urging member can be suppressed.

[0018] Preferably in the aforementioned structure in-

cluding the first friction pad holding member and the second friction pad holding member, movement of the first friction pad holding member toward the pickup roller is restricted in the second state, and the second friction pad holding member is urged toward the pickup roller by urging of the second urging portion in a state where the movement of the first friction pad holding member is restricted in the second state. According to this structure, the movement of the first friction pad holding member toward the pickup roller is restricted in the second state so that the application of the urging force of the first urging portion can be suppressed, and hence the second friction pad holding member (friction pad) can be more easily urged by the second urging portion.

[0019] Preferably in the aforementioned case where the movement of the first friction pad holding member toward the pickup roller is restricted in the second state, the first urging portion of the urging member is a first spring portion, the second urging portion of the urging member is a coil spring member that is a second spring portion, the first spring portion has a first pitch, and the second spring portion has a second pitch larger than the first pitch. According to this structure, the urging force can be easily changed by the single spring member, and hence by the simple structure, the movement of the first friction pad holding member toward the pickup roller is restricted in the second state so that the application of the urging force of the first urging portion can be suppressed.

[0020] Preferably in the aforementioned structure including the first spring portion and the second spring portion, the second friction pad holding member is urged toward the pickup roller by urging of the second spring portion in a state where the first spring portion has a natural length such that the movement of the first friction pad holding member toward the pickup roller is restricted in the second state. According to this structure, generation of the urging force of the first spring portion to the first friction pad holding member can be prevented in the second state. Consequently, the movement of the first friction pad holding member toward the pickup roller is restricted so that the application of the urging force of the first urging portion can be easily suppressed.

[0021] Preferably in the aforementioned case where the movement of the first friction pad holding member toward the pickup roller is restricted in the second state, the second friction pad holding member is movable relative to the first friction pad holding member. According to this structure, the second friction pad holding member can be easily moved independently of the first friction pad holding member in the second state. Thus, the movement of the first friction pad holding member toward the pickup roller is restricted in the second state so that the application of the urging force of the first urging portion can be further suppressed.

[0022] Preferably in the aforementioned structure further including the first friction pad holding member and the second friction pad holding member, the first portion

of the pickup roller has a first curvature, the second portion of the pickup roller has a second curvature, both the first friction pad holding member and the second friction pad holding member linearly move in a direction in which the urging member expands and contracts, and in the pickup roller, the first curvature of the first portion and the second curvature of the second portion are substantially equal to each other. According to this structure, the friction pad can be easily urged by the linear movement of the first friction pad holding member and the second friction pad holding member in the direction in which the urging member expands and contracts.

[0023] Preferably in the aforementioned structure further including the first friction pad holding member and the second friction pad holding member, the first portion of the pickup roller has a first curvature, the second portion of the pickup roller has a second curvature, the second friction pad holding member rotates with respect to the first friction pad holding member, and in the pickup roller, the first curvature of the first portion and the second curvature of the second portion are different from each other. According to this structure, the friction pad can be urged while a space for moving the second friction pad holding member with respect to the first friction pad holding member is further reduced, as compared with the case where the second friction pad holding member is linearly moved with respect to the first friction pad holding member in the direction in which the urging member expands and contracts, and hence a space where the second friction pad holding member is arranged can be reduced (can be compact).

[0024] Preferably in the aforementioned structure in which the first portion has the first curvature, the pickup roller has a shape formed by connecting a curve having the first curvature and a curve having the second curvature, as viewed along the axis. According to this structure, the contact area between the friction pad and the first portion in the first state and the contact area between the friction pad and the second portion in the second state can be easily made substantially equal to each other.

[0025] Preferably in the aforementioned paper feeding apparatus according to the first aspect, the first portion of the pickup roller is detachable. According to this structure, only the first portion not the entire pickup roller can be replaced when it is necessary to replace the first portion.

[0026] An image forming apparatus according to a second aspect of the present invention includes a printing portion that prints on paper, a rotatable pickup roller including a first portion that picks up the paper that is stacked while contacting with a surface of the paper in a first state where the paper is to be picked up and a second portion that transports the paper picked up in the first state while contacting with the surface of the paper in a second state where the paper is to be transported, and a friction pad that is arranged to face the pickup roller and suppresses transport of paper subsequent to the paper picked up in the first state by contacting with the paper

that is subsequent, and the pickup roller is in surface contact such that a contact area between the first portion and the friction pad in the first state and a contact area between the second portion and the friction pad in the second state are substantially equal to each other.

[0027] In the image forming apparatus according to the second aspect of the present invention, as hereinabove described, the pickup roller is configured to be in surface contact such that the contact area between the first portion of the pickup roller and the friction pad in the first state and the contact area between the second portion of the pickup roller and the friction pad in the second state are substantially equal to each other. Thus, even in the second state, the second portion is urged to the friction pad in a state where the contact area between the friction pad and the second portion is substantially equal to the contact area between the friction pad and the first portion in the first state, unlike the case where the second portion is urged (pushed) to the friction pad in a state where the contact area between the friction pad and the second portion is smaller in the second state. Thus, an increase in pressure applied to the friction pad can be suppressed in the second state, and hence tendency to wear and damage the friction pad can be suppressed.

[0028] Preferably in the aforementioned paper feeding apparatus according to the first aspect, the first portion of the pickup roller has a first curvature on a cross-sectional surface orthogonal to the rotation axis of the pickup roller, the second portion of the pickup roller has a second curvature on the cross-sectional surface orthogonal to the rotation axis of the pickup roller, and the first curvature and the second curvature are set so as to bring the pickup roller into surface contact such that the contact area between the first portion and the friction pad in the first state and the contact area between the second portion and the friction pad in the second state are substantially equal to each other. According to this structure, the first curvature of the first portion and the second curvature of the second portion are adjusted, whereby surface contact between the friction pad and the first portion and surface contact between the friction pad and the second portion can be easily kept substantially the same as each other in the first state and the second state.

Effect of the Invention

[0029] According to the present invention, as hereinabove described, tendency to wear and damage the friction pad can be suppressed.

Brief Description of the Drawings

[0030]

[Fig. 1] A schematic view showing the overall structure of a laser printer according to a first embodiment of the present invention.

[Fig. 2] A perspective view showing a paper separation

portion of the laser printer according to the first embodiment of the present invention.

[Fig. 3] An enlarged view showing the paper separation portion of the laser printer according to the first embodiment of the present invention.

[Fig. 4] A diagram of the paper separation portion of the laser printer according to the first embodiment of the present invention, as viewed from a side where a spring member is arranged.

[Fig. 5] A diagram of a pickup roller of the laser printer according to the first embodiment of the present invention, as viewed along an axis.

[Fig. 6] A diagram showing a first friction pad holding member and a second friction pad holding member in a first state of the laser printer according to the first embodiment of the present invention.

[Fig. 7] A diagram showing the spring member in the first state of the laser printer according to the first embodiment of the present invention.

[Fig. 8] A diagram showing the first friction pad holding member and the second friction pad holding member in a second state of the laser printer according to the first embodiment of the present invention.

[Fig. 9] A diagram showing the spring member in the second state of the laser printer according to the first embodiment of the present invention.

[Fig. 10] An enlarged view of a paper separation portion of a laser printer according to a second embodiment of the present invention.

[Fig. 11] A diagram of a pickup roller of the laser printer according to the second embodiment of the present invention, as viewed along an axis.

[Fig. 12] A diagram showing a first friction pad holding member and a second friction pad holding member in a first state of the laser printer according to the second embodiment of the present invention.

Modes for Carrying Out the Invention

[0031] Embodiments of the present invention are hereinafter described on the basis of the drawings.

(First Embodiment)

[0032] The structure of a laser printer 100 according to a first embodiment of the present invention is described with reference to Figs. 1 to 9. The laser printer 100 is an example of the "paper feeding apparatus" or the "image forming apparatus" in the present invention.

[0033] The laser printer 100 includes a paper feed tray 1 into which paper 150 is loaded, a paper separation portion 2 configured to separate the stacked paper 150 from the paper feed tray 1 and transport the same, transport roller members 3 and 4 configured to transport the paper 150 to a printing position, and paper discharge roller members 5a to 5c configured to discharge the printed paper 150 to a paper discharge tray 6, as shown in Fig. 1. The transport roller members 3 and 4 are respec-

tively provided in pairs. The paper discharge roller members 5a to 5c are respectively provided in pairs. The laser printer 100 includes a developing device 7 that prints on transported paper 151 and a laser emitting portion 8 configured to apply laser light to a photoreceptor drum 70 of the developing device 7. The laser printer 100 includes a heating roller member 9 and a pressurizing roller member 10 configured to fix toner adhering to the transported paper 151. The paper feed tray 1 is provided with a push-up plate 11 configured to place the paper 150 to a prescribed height with respect to the paper separation portion 2. The paper separation portion 2 is configured to separate and pick up the stacked paper 150 from the paper feed tray 1 in a first state (see Fig. 6) described later, as shown in Fig. 2. Furthermore, the paper separation portion 2 is configured to transport, in a second state (see Fig. 8) described later, the paper 151 picked up from the paper feed tray 1 in the first state.

[0034] According to the first embodiment, the paper separation portion 2 includes a pickup roller 21, a friction pad 22, a first friction pad holding member 23, a second friction pad holding member 24, and a spring member 25, as shown in Figs. 3 and 4. The paper separation portion 2 is set on a set portion 26 (see Fig. 1).

[0035] The pickup roller 21 is configured to pick up (extract) the stacked paper 150 from the paper feed tray 1 and transport the same toward the developing device 7 (transport roller 4). The pickup roller 21 includes a first portion 21a that picks up the paper 150 while contacting with a surface of the stacked paper 150 in the first state (see Fig. 6) where the paper 150 is to be picked up and a second portion 21b that transports the paper picked up in the first state while contacting with a surface of the paper 151 in the second state (see Fig. 8) where the picked up paper 151 is to be transported, as shown in Fig. 3. The pickup roller 21 includes a shaft portion 21c and is set in a housing 100a (see Fig. 1) to be rotatable. The shaft portion 21c is arranged in the second portion 21b in a state where the shaft portion 21c is eccentric from the center C of the pickup roller 21 when the pickup roller 21 is taken as a whole, as shown in Fig. 5. The first portion 21a and the second portion 21b are made of rubber (EPDM (ethylene-propylene rubber), for example) having a non-slip function. The second portion 21b forms a main body portion of the pickup roller 21. The first portion 21a is configured to be detachably (replaceably) fixed to the second portion 21b. The pickup roller 21 is configured to operate and pick up the paper 150 from the paper feed tray 1 when the developing device 7 performs printing.

[0036] The first portion 21a of the pickup roller 21 has a first curvature $1/R$ on a cross-sectional surface orthogonal to the rotation axis (shaft portion 21c) of the pickup roller 21, as shown in Fig. 5. The second portion 21b of the pickup roller 21 has a second curvature $1/R$ on a cross-sectional surface orthogonal to the rotation axis of the pickup roller 21. More specifically, the pickup roller 21 is configured such that the first curvature $1/R$ of the

first portion 21a and the second curvature $1/R$ of the second portion 21b are substantially equal to each other. The pickup roller 21 is formed asymmetrically, as viewed along the rotation axis (shaft portion 21c). The pickup roller 21 has a substantially circular shape (a near-circular shape) as a whole, as viewed along the axis. The first portion 21a and the second portion 21b are configured such that the center C1 of curvature of the first portion 21a and the center C2 of curvature of the second portion 21b are located in different positions. The rotation center of the shaft portion 21c is arranged to coincide with the center C2 of the second portion 21b. The pickup roller 21 is configured such that a surface of the first portion 21a having the first curvature $1/R$ and a surface of the second portion 21b having the second curvature $1/R$ are flush with each other. The pickup roller 21 is configured such that the center C2 of curvature of the second portion 21b is arranged closer to the second portion 21b than the center C (geometric center C) of the pickup roller 21 and the center C1 of curvature of the first portion 21a is arranged closer to the first portion 21a than the center C of the pickup roller 21, as viewed along the axis. Furthermore, the pickup roller 21 is configured such that the center C2 of curvature of the second portion 21b is eccentric from the center C of the pickup roller 21 and coincides with the rotation axis of the pickup roller 21. Moreover, the pickup roller 21 is configured such that the amount of protrusion toward the friction pad 22 is larger in the first state than in the second state. More specifically, a distance from the rotation axis (the center C2 of curvature) of the pickup roller 21 to the friction pad 22 is D2 in the second state, as shown in Fig. 8. As shown in Fig. 7, a distance from the rotation axis of the pickup roller 21 to the friction pad 22 is D1 larger than D2 in the first state.

[0037] The friction pad 22 is arranged to face the pickup roller 21 and is configured to suppress transport of paper 152 subsequent to the paper 151 picked up in the first state by contacting with the subsequent paper 152, as shown in Fig. 8. The friction pad 22 is made of rubber (EPDM (ethylene-propylene rubber), for example) having a non-slip function. The pickup roller 21 is configured such that a contact area between the first portion 21a and the friction pad 22 in the first state and a contact area between the second portion 21b and the friction pad 22 in the second state are substantially equal to each other, as shown in Figs. 6 to 9. Specifically, in the pickup roller 21, the first curvature $1/R$ and the second curvature $1/R$ (see Fig. 5) are set such that the contact area between the first portion 21a and the friction pad 22 in the first state and the contact area between the second portion 21b and the friction pad 22 in the second state are substantially equal to each other. The friction pad 22 is in a substantially arcuate shape corresponding to the shape of each of the first portion 21a and the second portion 21b of the pickup roller 21, as viewed along the rotation axis (shaft portion 21c). The friction pad 22 and the first portion 21a or the second portion 21b of the pickup roller

21 are configured to be in surface contact with each other. The friction pad 22 has substantially the same width W as the first portion 21a of the pickup roller 21 in a direction (direction X) in which the shaft portion 21c extends, as shown in Fig. 4.

[0038] As shown in Fig. 8, the pickup roller 21 is configured such that the contact area between the first portion 21a and the friction pad 22 in the first state and the contact area between the second portion 21b and the friction pad 22 in the second state are substantially equal to each other in a state where the friction pad 22 and the first portion 21a or the second portion 21b of the pickup roller 21 are arranged through the transported paper 151. In other words, the pickup roller 21 is configured such that the contact area between the first portion 21a and the friction pad 22 in the first state and the contact area between the second portion 21b and the friction pad 22 in the second state are substantially equal to each other in a state where the transported paper 151 is held between the friction pad 22 and the first portion 21a or the second portion 21b of the pickup roller 21.

[0039] According to the first embodiment, the first friction pad holding member 23 and the second friction pad holding member 24 are configured to hold the friction pad 22, as shown in Fig. 3. Specifically, the first friction pad holding member 23 is configured to hold the second friction pad holding member 24 to which the friction pad 22 is fixed. The friction pad 22 is configured to be detachably fixed to the second friction pad holding member 24.

[0040] Both the first friction pad holding member 23 and the second friction pad holding member 24 are configured to linearly move (move parallel) in a direction (direction P) in which the spring member 25 expands and contracts, as shown in Fig. 3. The second friction pad holding member 24 is configured to be movable relative to the first friction pad holding member 23. The first friction pad holding member 23 is arranged to partition a boundary region 25c between a first spring portion 25a and a second spring portion 25b of the spring member 25, as shown in Figs. 3 and 4. Specifically, a partition portion 23a provided in the first friction pad holding member 23 that extends in a direction (direction X) substantially orthogonal to the direction (direction P) in which the spring member 25 expands and contracts is arranged in the boundary region 25c between the first spring portion 25a and the second spring portion 25b of the spring member 25. The partition portion 23a is plate-like. The partition portion 23a has a thickness smaller than a pitch in the vicinity of the boundary region 25c of the spring member 25. The partition portion 23a is configured to be held between the first spring portion 25a and the second spring portion 25b. The first friction pad holding member 23 (partition portion 23a) includes a fixing portion 23b that suppresses disengagement of the first spring portion 25a (spring member 25). The fixing portion 23b is configured to protrude in a direction (direction P2) in which the first spring portion 25a expands or contracts. The fixing portion 23b is configured to suppress disengagement of the

first spring portion 25a (spring member 25) from the first friction pad holding member 23 by being fitted into an inner diameter portion of the first spring portion 25a (spring member 25). More specifically, the fixing portion 23b serves as an engaging portion that engages with the first spring portion 25a (spring member 25).

[0041] The second friction pad holding member 24 is arranged to hold the second spring portion 25b between the second friction pad holding member 24 and the first friction pad holding member 23, as shown in Figs. 3 and 4. The second friction pad holding member 24 includes a fixing portion 24a that suppresses disengagement of the second spring portion 25b (spring member 25). The fixing portion 24a is configured to protrude in the direction (direction P2) in which the first spring portion 25a expands or contracts. The fixing portion 24a is configured to suppress disengagement of the second spring portion 25b (spring member 25) from the second friction pad holding member 24 by being fitted into an inner diameter portion of the second spring portion 25b (spring member 25).

[0042] According to the first embodiment, the first friction pad holding member 23 is configured such that movement of the first friction pad holding member 23 toward the pickup roller 21 (in a direction P1) is restricted in the second state, as shown in Figs. 8 and 9. Specifically, the first friction pad holding member 23 is configured to be movable in the direction in which the spring member 25 expands and contracts in the first state (a state where the paper 151 is arranged between the first portion 21a and the friction pad 22). Furthermore, the first friction pad holding member 23 is configured such that the set portion 26 (see Fig. 2) restricts the movement of the first friction pad holding member 23 in the direction (toward the pickup roller 21 (in the direction P1)) in which the spring member 25 expands or contracts in the second state (a state where the paper 151 picked up in the first state is to be transported and the paper 152 subsequent to the picked up paper 151 is to be not transported). The second friction pad holding member 24 is configured to be urged toward the pickup roller 21 by urging of the second spring portion 25b (spring member 25) in a state where the movement of the first friction pad holding member 23 is restricted in the second state. The first friction pad holding member 23 and the second friction pad holding member 24 are made of resin.

[0043] According to the first embodiment, the spring member 25 includes a coil spring, for example. The spring member 25 includes a single spring member including the first spring portion 25a and the second spring portion 25b having urging force weaker than the urging force of the first spring portion 25a, as shown in Fig. 3. The spring member 25 includes the second spring portion 25b closer to the pickup roller 21 (in the direction P1) and the first spring portion 25a opposite to the pickup roller 21 (in the direction P2). The first spring portion 25a having a natural length has a first pitch smaller than a second pitch of the second spring portion 25b having a natural length. The

spring member 25 is configured to urge the friction pad 22 toward the pickup roller 21 by the first spring portion 25a in the first state and to urge the friction pad 22 toward the pickup roller 21 by the second spring portion 25b in the second state. The spring member 25 is configured such that the first spring portion 25a has a natural length in the second state. More specifically, the friction pad 22 is urged toward the pickup roller 21 by the urging force of the second spring portion 25b in the second state. In other words, the second friction pad holding member 24 is configured to be urged toward the pickup roller 21 by urging of the second spring portion 25b in a state where the first spring portion 25a has a natural length such that the movement of the first friction pad holding member 23 toward the pickup roller 21 is restricted in the second state. The spring member 25 is an example of the "urging member" in the present invention. The first spring portion 25a is an example of the "first urging portion" in the present invention. The second spring portion 25b is an example of the "second urging portion" in the present invention.

[0044] The developing device 7 includes the photoreceptor drum 70 configured to perform printing by causing toner to adhere to the transported paper 151, a developing roller 71 configured to supply the toner to the photoreceptor drum 70, a supply roller 72 configured to supply the toner to the developing roller 71, and a restricting roller 73, as shown in Fig. 1. All of the developing roller 71, the supply roller 72, and the restricting roller 73 are arranged in a toner carrying region 74. The developing device 7 is an example of the "printing portion" in the present invention.

[0045] The developing device 7 also includes a toner supply passage 75 that supplies the toner to the toner carrying region 74, a toner cartridge 76 that stores new toner, and an old toner recovery portion 77 configured to recover old toner adhering to the developing roller 71 or old toner around the developing roller 71. The developing device 7 further includes a transfer roller 78 arranged in a position that faces the photoreceptor drum 70, configured to transfer the toner adhering to the photoreceptor drum 70 to the transported paper 151, and a cleaning portion 79 configured to recover toner remaining on the photoreceptor drum 70.

[0046] The photoreceptor drum 70 is configured such that a surface thereof is negatively charged. In the photoreceptor drum 70 during printing, the laser emitting portion 8 first applies laser light to a prescribed surface of the photoreceptor drum 70 along the rotational direction of the photoreceptor drum 70, and negative charge is removed from a surface of a position subjected to the application of the laser light. Thus, an electrostatic latent image is formed on a region of the surface of the photoreceptor drum 70 from which the negative charge is removed. Thereafter, the toner supplied by the developing roller 71 adheres to the electrostatic latent image formed on the photoreceptor drum 70. Then, the positively charged transfer roller 78 moves the negatively

charged toner from the photoreceptor drum 70 toward the transfer roller 78, whereby the toner is adsorbed (transferred) to the paper 151 transported between the transfer roller 78 and the photoreceptor drum 70. Consequently, an image is printed on the transported paper 151 on the basis of the electrostatic latent image formed on the photoreceptor drum 70.

[0047] After the negative charge is removed from the surface of the photoreceptor drum 70, the cleaning portion 79 recovers toner remaining on the surface of the photoreceptor drum 70. Finally, an unshown electrode negatively charges the surface of the photoreceptor drum 70 again, so that a printing operation is performed again.

[0048] The operation of the paper separation portion 2 for separating the stacked paper 150 from the paper feed tray 1 and transporting the same is now described with reference to Figs. 6 to 9. Figs. 6 and 8 omit the set portion 26 for the convenience of illustration and show the paper separation portion 2 viewed along the rotation axis (shaft portion 21c). Figs. 7 and 9 omit the set portion 26 and the first friction pad holding member 23 for the convenience of illustration and show the paper separation portion 2 viewed along the rotation axis (shaft portion 21c).

[0049] A state where the paper 150 stacked on the paper feed tray 1 is picked up (extracted) in the first state is described with reference to Figs. 6 and 7. First, the pickup roller 21 is rotated in a direction A, whereby the paper 150 stacked on the paper feed tray 1 is held between the first portion 21a and the friction pad 22. Thereafter, the spring member 25 (the first spring portion 25a and the second spring portion 25b) is urged opposite to the pickup roller 21 (in the direction P2) until an end 21e of the pickup roller 21 is rotated to a position corresponding to the spring member 25. The first spring portion 25a and the second spring portion 25b urge the friction pad 22 toward the pickup roller 21, whereby the pickup roller 21 is rotated in the direction A in a state where the paper is held between the first portion 21a and the friction pad 22. Then, the pickup roller 21 is further rotated in the direction A, whereby a state where the end 21e of the pickup roller 21 is arranged in the position corresponding to the spring member 25 is shifted to the second state.

[0050] A state where the paper 151 picked up (extracted) in the first state is transported toward the developing device 7 in the second state is described with reference to Figs. 8 and 9. From the state where the end 21e of the pickup roller 21 is arranged in the position corresponding to the spring member 25, the pickup roller 21 is rotated in the direction A, whereby the paper 151 between the first portion 21a and the friction pad 22 is transported. At this time, the pickup roller 21 is arranged in a position above (in the direction P1) the position in the first state by the eccentric shaft portion 21c. In the second state, the movement of the first friction pad holding member 23 toward the pickup roller 21 (in the direction P1) is restricted, so that the friction pad 22 is urged toward the pickup roller 21 by the second spring portion 25b of the spring

member 25. Thus, in the second state, the friction pad 22 is urged toward the pickup roller 21 by urging force weaker than urging force (force of holding the paper 150) in the first state, and hence the paper 151 can be transported toward the developing device 7 (transport roller member 4) while the transport of the paper 152 other than the transported paper 151 (simultaneous transport (multi feed) of the paper 151 and the paper 152) is suppressed.

[0051] According to the first embodiment, as hereinabove described, the pickup roller 21 is configured to be in surface contact such that the contact area between the first portion 21a of the pickup roller 21 and the friction pad 22 in the first state and the contact area between the second portion 21b of the pickup roller 21 and the friction pad 22 in the second state are substantially equal to each other. Thus, even when the friction pad 22 is urged toward the pickup roller 21, the second portion 21b is urged to the friction pad 22 in a state where the contact area between the friction pad 22 and the second portion 21b in the second state is substantially equal to the contact area between the friction pad 22 and the first portion 21a in the first state, unlike the case where the second portion 21b is urged (pushed) to the friction pad 22 in a state where the contact area between the friction pad 22 and the second portion 21b is smaller in the second state. Thus, an increase in pressure applied to the friction pad 22 can be suppressed in the second state, and hence tendency to wear and damage the friction pad 22 can be suppressed.

[0052] According to the first embodiment, as hereinabove described, the first portion 21a of the pickup roller 21 is configured to have the first curvature on the cross-sectional surface orthogonal to the rotation axis of the pickup roller 21, the second portion 21b of the pickup roller 21 is configured to have the second curvature on the cross-sectional surface orthogonal to the rotation axis of the pickup roller 21, and the first curvature and the second curvature are set so as to bring the pickup roller 21 into surface contact such that the contact area between the first portion 21a and the friction pad 22 in the first state and the contact area between the second portion 21b and the friction pad 22 in the second state are substantially equal to each other. Thus, surface contact between the friction pad 22 and the first portion 21a and surface contact between the friction pad 22 and the second portion 21b can be easily kept substantially the same as each other in the first state and the second state.

[0053] According to the first embodiment, as hereinabove described, the single spring member 25 including the first spring portion 25a and the second spring portion 25b having the urging force weaker than the urging force of the first spring portion 25a is provided, and the spring member 25 is configured to urge the friction pad 22 toward the pickup roller 21 by the first spring portion 25a in the first state and to urge the friction pad 22 toward the pickup roller 21 by the second spring portion 25b in the second state. Thus, the friction pad 22 can be urged

by the second spring portion 25b having the urging force weaker than the urging force of the first spring portion 25a in the second state, and hence the pressure applied to the friction pad 22 can be further reduced in the second state than in the first state. Thus, tendency to wear the friction pad 22 can be easily suppressed. Furthermore, the single (one) spring member 25 can serve as both the first spring portion 25a and the second spring portion 25b having the urging force weaker than the urging force of the first spring portion 25a, and hence the structure of the laser printer 100 can be simplified while an increase in the number of components can be suppressed, unlike the case where the first spring portion 25a and the second spring portion 25b are provided separately from each other.

[0054] According to the first embodiment, as hereinabove described, the pickup roller 21 is configured such that the center C1 of curvature of the first portion 21a and the center C2 of curvature of the second portion 21b are located in the different positions. Thus, the first curvature 1/R of the first portion 21a and the second curvature 1/R of the second portion 21b can be adjusted individually. Consequently, the surface contact between the friction pad 22 and the first portion 21a and the surface contact between the friction pad 22 and the second portion 21b can be more easily kept substantially the same as each other in the first state and the second state.

[0055] According to the first embodiment, as hereinabove described, the pickup roller 21 is configured such that the amount of protrusion toward the friction pad 22 is larger in the first state than in the second state. Thus, the position of the first portion 21a in the first state can be further moved in a direction toward the friction pad 22 than the position in the second state, and the position of the first portion 21a in the second state can be further moved in a direction away from the friction pad 22 than the position in the first state. Consequently, the paper 150 can be easily picked up in the first state, and the paper 22 can be transported while an increase in the pressure applied to the friction pad 22 is suppressed in the second state.

[0056] According to the first embodiment, as hereinabove described, the pickup roller 21 is configured such that the center C2 of curvature of the second portion 21b is arranged closer to the second portion 21b than the center C of the pickup roller 21 and the center C1 of curvature of the first portion 21a is arranged closer to the first portion 21a than the center C of the pickup roller 21. Furthermore, the pickup roller 21 is configured such that the center C2 of curvature of the second portion 21b coincides with the rotation axis of the pickup roller 21. Thus, by the simple structure, the position of the first portion 21a in the first state can be further moved in the direction toward the friction pad 22 than the position in the second state, and the position of the first portion 21a in the second state can be further moved in the direction away from the friction pad 22 than the position in the first state.

[0057] According to the first embodiment, as herein-

above described, the pickup roller 21 is configured such that the surface of the first portion 21a having the first curvature $1/R$ and the surface of the second portion 21b having the second curvature $1/R$ are flush with each other. Thus, the pickup roller 21 can be smoothly rotated when the paper 150 is picked up and then transported.

[0058] According to the first embodiment, as herein-above described, the first friction pad holding member 23 and the second friction pad holding member 24 that hold the friction pad 22 are provided, the first friction pad holding member 23 is arranged to partition the boundary region between the first spring portion 25a and the second spring portion 25b of the spring member 25, and the second friction pad holding member 24 is arranged to hold the second spring portion 25b between the first friction pad 22 holding member and the second friction pad holding member 24. Thus, the second friction pad holding member 24 (friction pad 22) can be urged by the second spring portion 25b in a state where application of the urging force of the first spring portion 25a is suppressed in the second state even when the common spring member 25 including the first spring portion 25a and the second spring portion 25b is provided.

[0059] According to the first embodiment, as herein-above described, the plate-like partition portion 23a is configured to be held between the first spring portion 25a and the second spring portion 25b. Thus, the second friction pad holding member 24 can be urged by the second spring portion 25b while the application of the urging force of the first spring portion 25a is stably suppressed by the partition portion 23a in the second state.

[0060] According to the first embodiment, as herein-above described, the partition portion 23a is configured to include the fixing portion 23b serving as the engaging portion that engages with the first spring portion 25a. Thus, misalignment of the partition portion 23a and the first spring portion 25a can be suppressed.

[0061] According to the first embodiment, as herein-above described, the first friction pad holding member 23 is configured such that the movement of the first friction pad holding member 23 toward the pickup roller 21 is restricted in the second state, and the second friction pad holding member 24 is configured to be urged toward the pickup roller 21 by the urging of the second spring portion 25b in the state where the movement of the first friction pad holding member 23 is restricted in the second state. Thus, the movement of the first friction pad holding member 23 toward the pickup roller 21 is restricted in the second state so that the application of the urging force of the first spring portion 25a can be suppressed, and hence the second friction pad holding member 24 (friction pad 22) can be more easily urged by the second spring portion 25b.

[0062] According to the first embodiment, as herein-above described, the second spring portion 25b is configured to have the second pitch larger than the first pitch of the first spring portion 25a. Thus, the urging force can be easily changed by the single spring member 25, and

hence by the simple structure, the movement of the first friction pad holding member 23 toward the pickup roller 21 is restricted in the second state so that the application of the urging force of the first spring portion 25a can be suppressed.

[0063] According to the first embodiment, as herein-above described, the second friction pad holding member 24 is configured to be urged toward the pickup roller 21 by the urging of the second spring portion 25b in the state where the first spring portion 25a has a natural length such that the movement of the first friction pad holding member 23 toward the pickup roller 21 is restricted in the second state. Thus, generation of the urging force of the first spring portion 25a to the first friction pad holding member 23 can be prevented in the second state. Consequently, the movement of the first friction pad holding member 23 toward the pickup roller 21 is restricted so that the application of the urging force of the first spring portion 25a can be easily suppressed.

[0064] According to the first embodiment, as herein-above described, the second friction pad holding member 24 is configured to be movable relative to the first friction pad holding member 23. Thus, the second friction pad holding member 24 can be easily moved independently of the first friction pad holding member 23 in the second state.

[0065] According to the first embodiment, as herein-above described, the first friction pad holding member 23 and the second friction pad holding member 24 are configured to linearly move in the direction in which the spring member 25 expands and contracts, and the pickup roller 21 is configured such that the first curvature of the first portion 21a and the second curvature of the second portion 21b are substantially equal to each other. Thus, the friction pad 22 can be easily urged by the linear movement of the first friction pad holding member 23 and the second friction pad holding member 24 in the direction in which the spring member 25 expands and contracts.

[0066] According to the first embodiment, as herein-above described, the pickup roller 21 is configured to have a shape formed by connecting a curve having the first curvature $1/R$ and a curve having the second curvature $1/R$. Thus, the contact area between the friction pad 22 and the first portion 21a in the first state and the contact area between the friction pad 22 and the second portion 21b in the second state can be easily made substantially equal to each other.

[0067] According to the first embodiment, as herein-above described, the pickup roller 21 is configured such that the first portion 21a is detachable. Thus, only the first portion 21a not the entire pickup roller 21 can be replaced when it is necessary to replace the first portion 21a.

(Second Embodiment)

[0068] The structure of a laser printer 200 according to a second embodiment of the present invention is now

described with reference to Figs. 10 to 12. The laser printer 200 is an example of the "paper feeding apparatus" or the "image forming apparatus" in the present invention.

[0069] In this second embodiment, the laser printer 200 is configured such that a second friction pad holding member 124 rotates with respect to a first friction pad holding member 123 as described, unlike the first embodiment in which both the first friction pad holding member 23 and the second friction pad holding member 24 are configured to linearly move in the direction (direction P) in which the spring member 25 expands and contracts.

[0070] As shown in Fig. 10, a paper separation portion 102 of the laser printer 200 according to the second embodiment includes a pickup roller 121, a friction pad 22, the first friction pad holding member 123, the second friction pad holding member 124, and a spring member 25.

[0071] According to the second embodiment, the pickup roller 121 includes a first portion 121a that picks up stacked paper 150 while contacting with a surface of the paper 150 in a first state where the paper 150 is to be picked up by the first portion 121a and a second portion 121b that transports paper 151 picked up in the first state while contacting with a surface of the paper 151 in a second state where the picked up paper 151 is to be transported.

[0072] The first portion 121a of the pickup roller 121 is configured to have a first curvature $1/R1$ on a cross-sectional surface orthogonal to the rotation axis (shaft portion 121c) of the pickup roller 121, as shown in Fig. 11. More specifically, the second portion 121b of the pickup roller 121 is configured to have a second curvature $1/R2$ on a cross-sectional surface orthogonal to the rotation axis of the pickup roller 121. More specifically, the pickup roller 121 is configured such that the first curvature $1/R1$ of the first portion 121a and the second curvature $1/R2$ of the second portion 121b are different from each other. The pickup roller 121 is configured such that a contact area between the first portion 121a and the friction pad 22 in the first state and a contact area between the second portion 121b and the friction pad 22 in the second state are substantially equal to each other. Specifically, in the pickup roller 121, the first curvature $1/R1$ and the second curvature $1/R2$ are set such that the contact area between the first portion 121a and the friction pad 22 in the first state and the contact area between the second portion 121b and the friction pad 22 in the second state are substantially equal to each other.

[0073] The first friction pad holding member 123 includes a partition portion 123a arranged in a boundary area 25c between a first spring portion 25a and a second spring portion 25b of the spring member 25 and a fixing portion 123b that suppresses disengagement of the first spring portion 25a (spring member 25), as shown in Fig. 10. The second friction pad holding member 124 includes a fixing portion 124a that suppresses disengagement of the second spring portion 25b (spring member 25).

[0074] According to the second embodiment, the second friction pad holding member 124 is configured to rotate with respect to the first friction pad holding member 123, as shown in Fig. 12. Specifically, the second friction pad holding member 124 is provided with a pair of convex portions 124b on both ends in a direction (direction X) in which the shaft portion 121c extends, as shown in Fig. 10. The pair of convex portions 124b are formed to protrude in the direction in which the shaft portion 121c extends. The first friction pad holding member 123 is formed with hole portions 123c in positions corresponding to the convex portions 124b of the second friction pad holding member 124. The second friction pad holding member 124 is configured to be rotatable using the convex portions 124b as the center of rotation by fitting of the convex portions 124b into the hole portions 123c of the first friction pad holding member 123. Furthermore, the second friction pad holding member 124 is configured to be rotated toward the pickup roller 121 (in a direction P1) by the urging force of the second spring portion 25b (spring member 25) in a state where movement of the first friction pad holding member 123 is suppressed in the second state.

[0075] The remaining structure of the second embodiment is similar to that of the aforementioned first embodiment.

[0076] According to the second embodiment, as hereinabove described, the pickup roller 121 is configured to be in surface contact such that the contact area between the first portion 121a of the pickup roller 121 and the friction pad 22 in the first state and the contact area between the second portion 121b of the pickup roller 121 and the friction pad 22 in the second state are substantially equal to each other. Thus, even when the friction pad 22 is urged toward the pickup roller 121, the second portion 121b is urged to the friction pad 22 in a state where the contact area between the friction pad 22 and the second portion 121b in the second state is substantially equal to the contact area between the friction pad 22 and the first portion 121a in the first state, unlike the case where the second portion 121b is urged (pushed) to the friction pad 22 in a state where the contact area between the friction pad 22 and the second portion 121b is smaller in the second state. Thus, an increase in pressure applied to the friction pad 22 can be suppressed in the second state, and hence tendency to wear and damage the friction pad 22 can be suppressed.

[0077] According to the second embodiment, as hereinabove described, the second friction pad holding member 124 is configured to rotate with respect to the first friction pad holding member 123, and the pickup roller 121 is configured such that the first curvature of the first portion 121a and the second curvature of the second portion 121b are different from each other. Thus, the friction pad 22 can be urged while a space for moving the second friction pad holding member 124 with respect to the first friction pad holding member 123 is further reduced, as compared with the case where the second friction pad holding member 124 is linearly moved with respect to the first friction pad holding member 123 in the

direction in which the spring member 25 expands and contracts, and hence a space where the second friction pad holding member 124 is arranged can be reduced (can be compact).

[0078] The remaining effects of the second embodiment are similar to those of the aforementioned first embodiment.

[0079] The embodiments disclosed this time must be considered as illustrative in all points and not restrictive. The range of the present invention is shown not by the above description of the embodiments but by the scope of claims for patent, and all modifications within the meaning and range equivalent to the scope of claims for patent are further included.

[0080] For example, while the example of applying the present invention to the laser printer as the example of the image forming apparatus has been shown in each of the aforementioned first and second embodiments, the present invention is not restricted to this. For example, the present invention is also applicable to an ink-jet printer or the like other than the laser printer or another image forming apparatus such as a facsimile.

[0081] While the example of providing the single spring member 25 (urging member) including the first spring portion 25a (first urging portion) and the second spring portion 25b (second urging portion) having the urging force weaker than the urging force of the first spring portion 25a has been shown in each of the aforementioned first and second embodiments, the present invention is not restricted to this. According to the present invention, two urging members in which the first urging portion and the second urging portion are provided separately from each other may be provided.

[0082] While the example of providing the spring member including the coil spring as the urging member according to the present invention has been shown in each of the aforementioned first and second embodiments, the present invention is not restricted to this. According to the present invention, an urging member other than the coil spring, such as a leaf spring, or an urging member other than a spring may be used.

[0083] While the example of providing the shaft portion 21c that is eccentric as viewed along the rotation axis (shaft portion 21c) in the pickup roller has been shown in each of the aforementioned first and second embodiments, the present invention is not restricted to this. According to the present invention, the shaft portion 21c that is not eccentric as viewed along the rotation axis (shaft portion 21c) in the pickup roller may be provided in the pickup roller.

[0084] While the example of forming the first friction pad holding member and the second friction pad holding member separately from each other has been shown in each of the aforementioned first and second embodiments, the present invention is not restricted to this. According to the present invention, the first friction pad holding member and the second friction pad holding member may be integrally provided.

Description of Reference Numerals

[0085]

- | | |
|----|---|
| 5 | 7 developing device (printing portion) |
| | 21, 121 pickup roller |
| | 21a, 121a first portion |
| | 21b, 121b second portion |
| | 22 friction pad |
| 10 | 23, 123 first friction pad holding member |
| | 23a partition portion |
| | 24, 124 second friction pad holding member |
| | 25 spring member (urging member) |
| | 25a first spring portion (first urging portion) |
| 15 | 25b second spring portion (second urging portion) |
| | 25c boundary region |
| | 100, 200 laser printer (paper feeding apparatus, image forming apparatus) |

20

Claims

1. A paper feeding apparatus (100, 200) comprising:

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a rotatable pickup roller (21, 121) including a first portion (21a, 121a) that picks up stacked paper (150) while contacting with a surface of the paper in a first state where the paper is to be picked up and a second portion (21b, 121b) that transports the paper picked up in the first state while contacting with the surface of the paper in a second state where the paper is to be transported; and

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a friction pad (22) that is arranged to face the pickup roller and suppresses transport of paper subsequent to the paper picked up in the first state by contacting with the paper that is subsequent, wherein

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the pickup roller is in surface contact such that a contact area between the first portion and the friction pad in the first state and a contact area between the second portion and the friction pad in the second state are substantially equal to each other.

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2. The paper feeding apparatus according to claim 1, wherein

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the first portion of the pickup roller has a first curvature on a cross-sectional surface orthogonal to a rotation axis of the pickup roller,

the second portion of the pickup roller has a second curvature on the cross-sectional surface orthogonal to the rotation axis of the pickup roller, and

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the first curvature and the second curvature are set so as to bring the pickup roller into surface contact such that the contact area between the first portion and the friction pad in the first state and the contact area between the second portion and the friction pad

- in the second state are substantially equal to each other.
3. The paper feeding apparatus according to claim 1, further comprising a single urging member (25) including a first urging portion (25a) and a second urging portion (25b) having urging force weaker than urging force of the first urging portion, wherein the urging member urges the friction pad toward the pickup roller by the first urging portion in the first state and urges the friction pad toward the pickup roller by the second urging portion in the second state.
 4. The paper feeding apparatus according to claim 2, wherein in the pickup roller, a center of curvature of the first portion and a center of curvature of the second portion are arranged in different positions, as viewed along the axis.
 5. The paper feeding apparatus according to claim 4, wherein an amount of protrusion of the pickup roller toward the friction pad is larger in the first state than in the second state.
 6. The paper feeding apparatus according to claim 5, wherein in the pickup roller, the center of curvature of the second portion is arranged closer to the second portion than a center of the pickup roller, and the center of curvature of the first portion is arranged closer to the first portion than the center of the pickup roller, as viewed along the axis, and in the pickup roller, the center of curvature of the second portion coincides with the rotation axis of the pickup roller.
 7. The paper feeding apparatus according to claim 2, wherein in the pickup roller, a surface of the first portion having the first curvature and a surface of the second portion having the second curvature are flush with each other.
 8. The paper feeding apparatus according to claim 3, further comprising a first friction pad holding member (23, 123) and a second friction pad holding member (24, 124) that hold the friction pad, wherein the first friction pad holding member is arranged to partition a boundary region between the first urging portion and the second urging portion of the urging member, and the second friction pad holding member is arranged to hold the second urging portion between the first friction pad holding member and the second friction pad holding member.
 9. The paper feeding apparatus according to claim 8, wherein the first friction pad holding member includes a plate-like partition portion (23a), and the partition portion is held between the first urging portion and the second urging portion.
 10. The paper feeding apparatus according to claim 9, wherein the partition portion includes an engaging portion that engages with the urging member.
 11. The paper feeding apparatus according to claim 8, wherein movement of the first friction pad holding member toward the pickup roller is restricted in the second state, and the second friction pad holding member is urged toward the pickup roller by urging of the second urging portion in a state where the movement of the first friction pad holding member is restricted in the second state.
 12. The paper feeding apparatus according to claim 11, wherein the first urging portion of the urging member is a first spring portion (25a), and the second urging portion of the urging member is a coil spring member (25) that is a second spring portion (25b), the first spring portion has a first pitch, and the second spring portion has a second pitch larger than the first pitch.
 13. The paper feeding apparatus according to claim 12, wherein the second friction pad holding member is urged toward the pickup roller by urging of the second spring portion in a state where the first spring portion has a natural length such that the movement of the first friction pad holding member toward the pickup roller is restricted in the second state.
 14. The paper feeding apparatus according to claim 11, wherein the second friction pad holding member is movable relative to the first friction pad holding member.
 15. The paper feeding apparatus according to claim 14, wherein the first portion of the pickup roller has a first curvature, the second portion of the pickup roller has a second curvature, both the first friction pad holding member and the second friction pad holding member linearly move in a direction in which the urging member expands and contracts, and in the pickup roller, the first curvature of the first por-

tion and the second curvature of the second portion are substantially equal to each other.

16. The paper feeding apparatus according to claim 14, wherein
the first portion of the pickup roller has a first curvature,
the second portion of the pickup roller has a second curvature,
the second friction pad holding member rotates with respect to the first friction pad holding member, and in the pickup roller, the first curvature of the first portion and the second curvature of the second portion are different from each other. 5 10 15
17. The paper feeding apparatus according to claim 2, wherein
the pickup roller has a shape formed by connecting a curve having the first curvature and a curve having the second curvature, as viewed along the axis. 20
18. The paper feeding apparatus according to claim 1, wherein
the first portion of the pickup roller is detachable. 25
19. An image forming apparatus (100, 200) comprising:
a printing portion (7) that prints on paper;
a rotatable pickup roller including a first portion that picks up the paper that is stacked while contacting with a surface of the paper in a first state where the paper is to be picked up and a second portion that transports the paper picked up in the first state while contacting with the surface of the paper in a second state where the paper is to be transported; and
a friction pad that is arranged to face the pickup roller and suppresses transport of paper subsequent to the paper picked up in the first state by contacting with the paper that is subsequent, wherein
the pickup roller is in surface contact such that a contact area between the first portion and the friction pad in the first state and a contact area between the second portion and the friction pad in the second state are substantially equal to each other. 30 35 40 45
20. The image forming apparatus according to claim 19, wherein
the first portion of the pickup roller has a first curvature on a cross-sectional surface orthogonal to a rotation axis of the pickup roller,
the second portion of the pickup roller has a second curvature on the cross-sectional surface orthogonal to the rotation axis of the pickup roller, and
the first curvature and the second curvature are set so as to bring the pickup roller into surface contact 50 55

such that the contact area between the first portion and the friction pad in the first state and the contact area between the second portion and the friction pad in the second state are substantially equal to each other.

FIG. 1

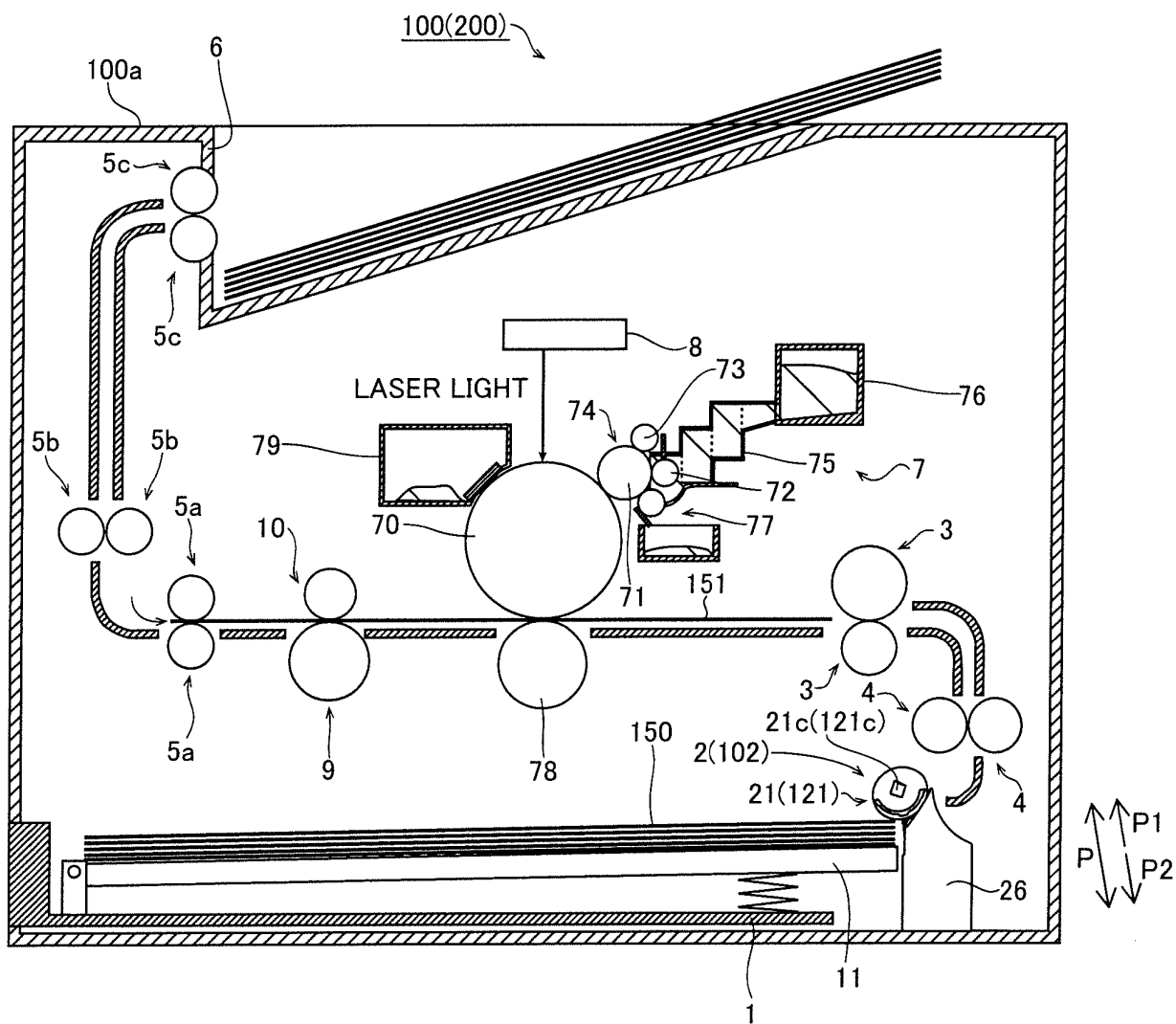


FIG.2

FIRST EMBODIMENT

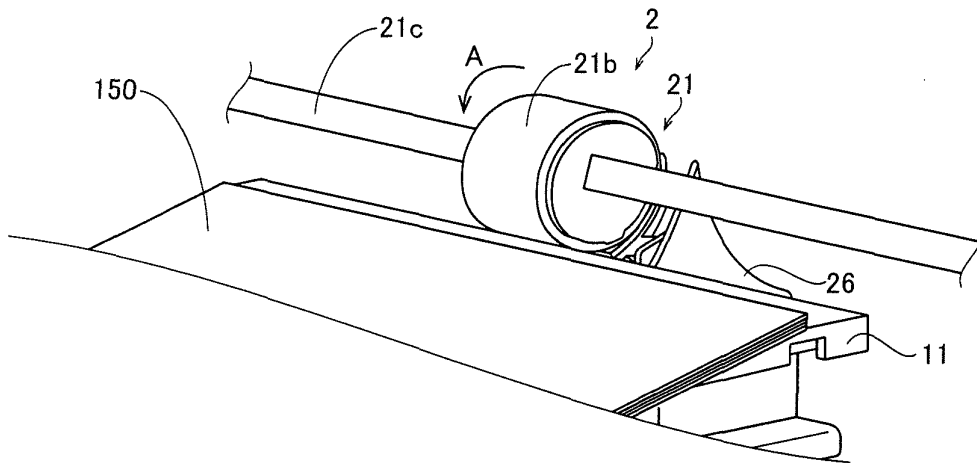


FIG.3

FIRST EMBODIMENT

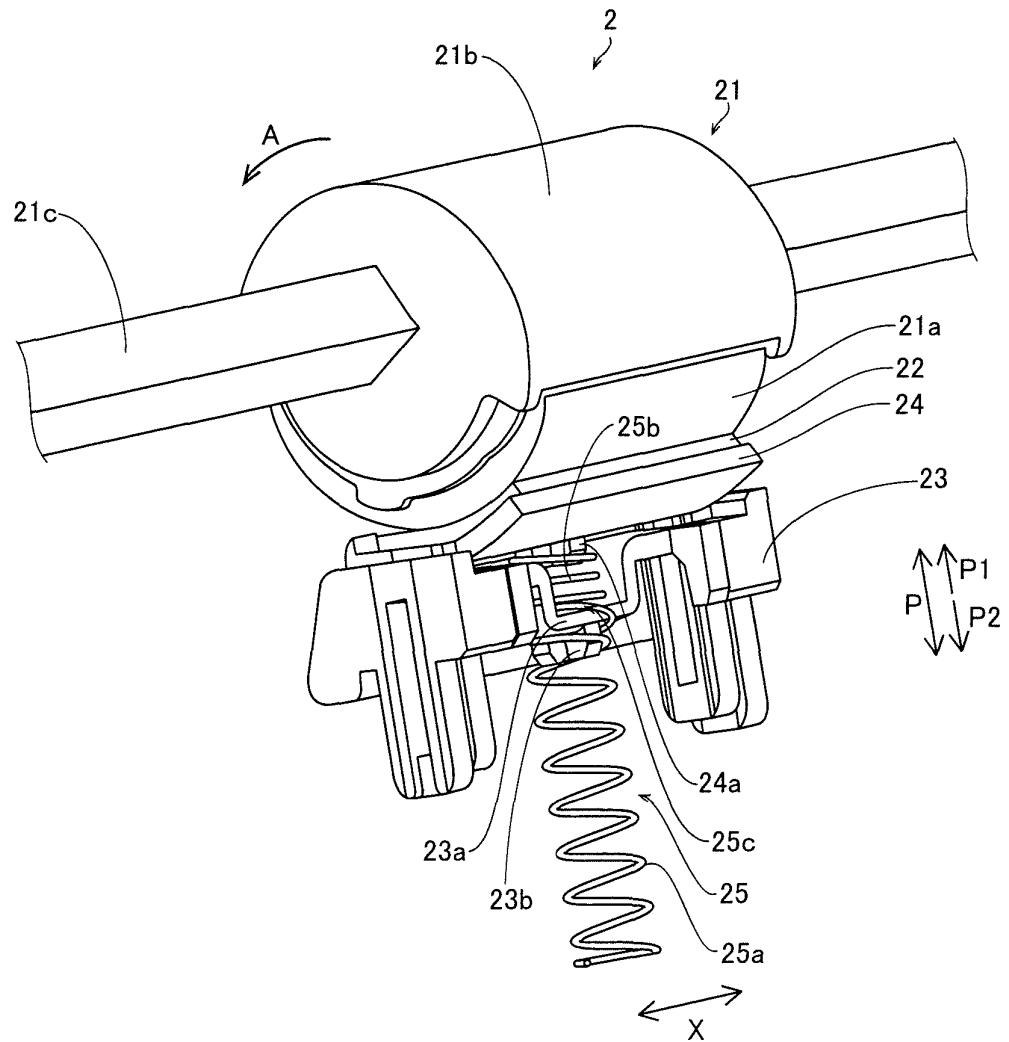


FIG.4

FIRST EMBODIMENT

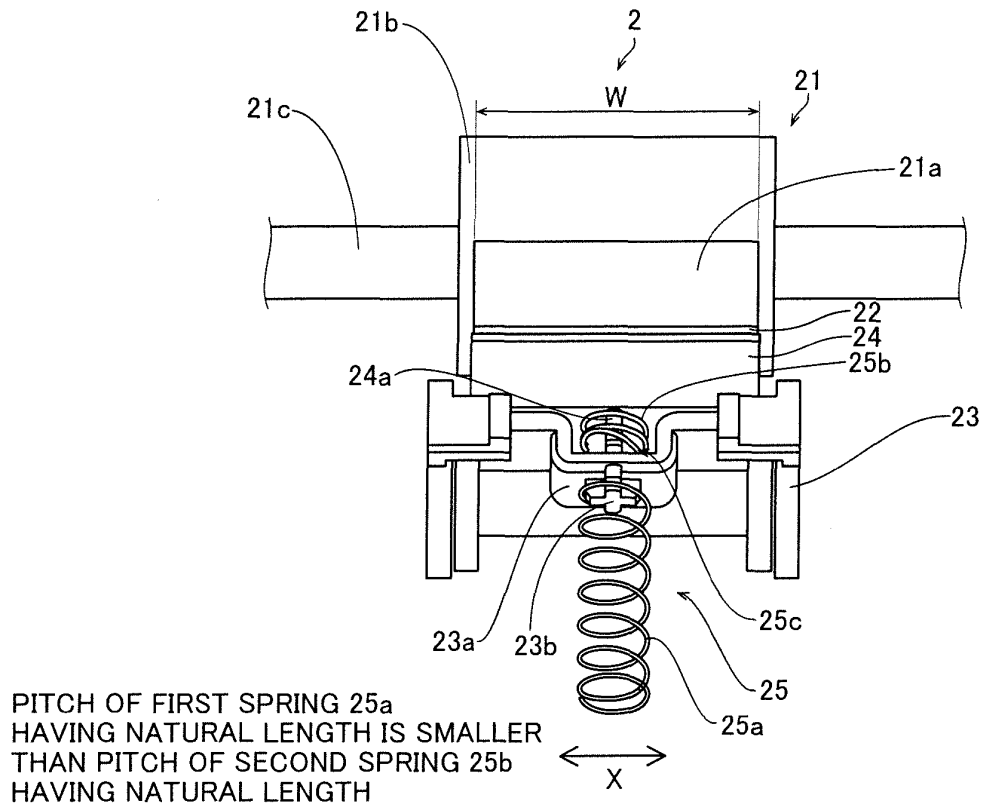


FIG.5

FIRST EMBODIMENT

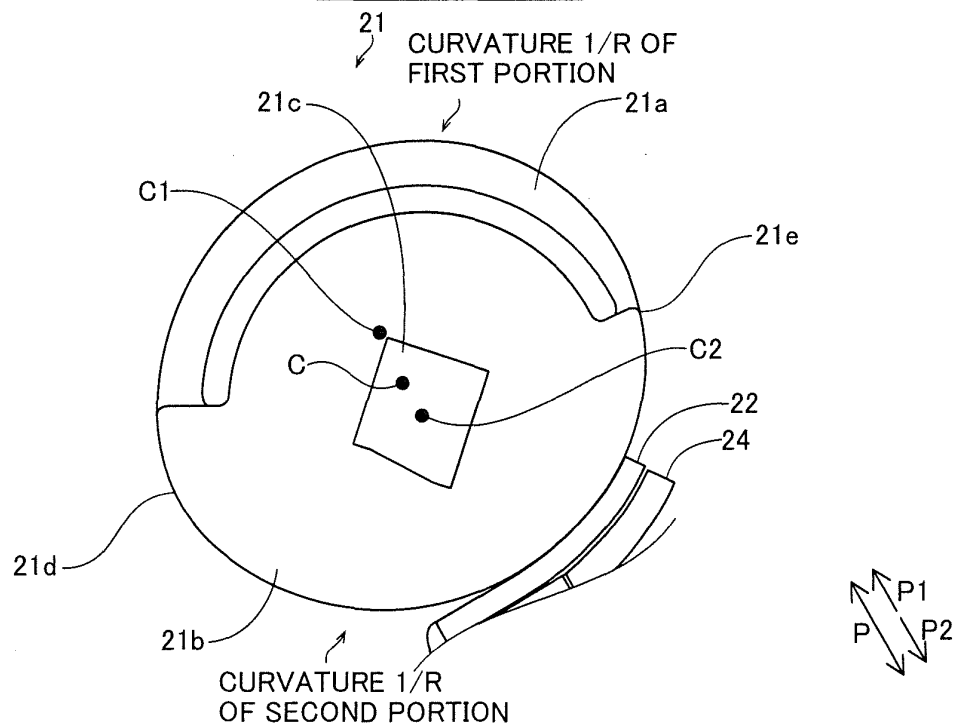


FIG.6

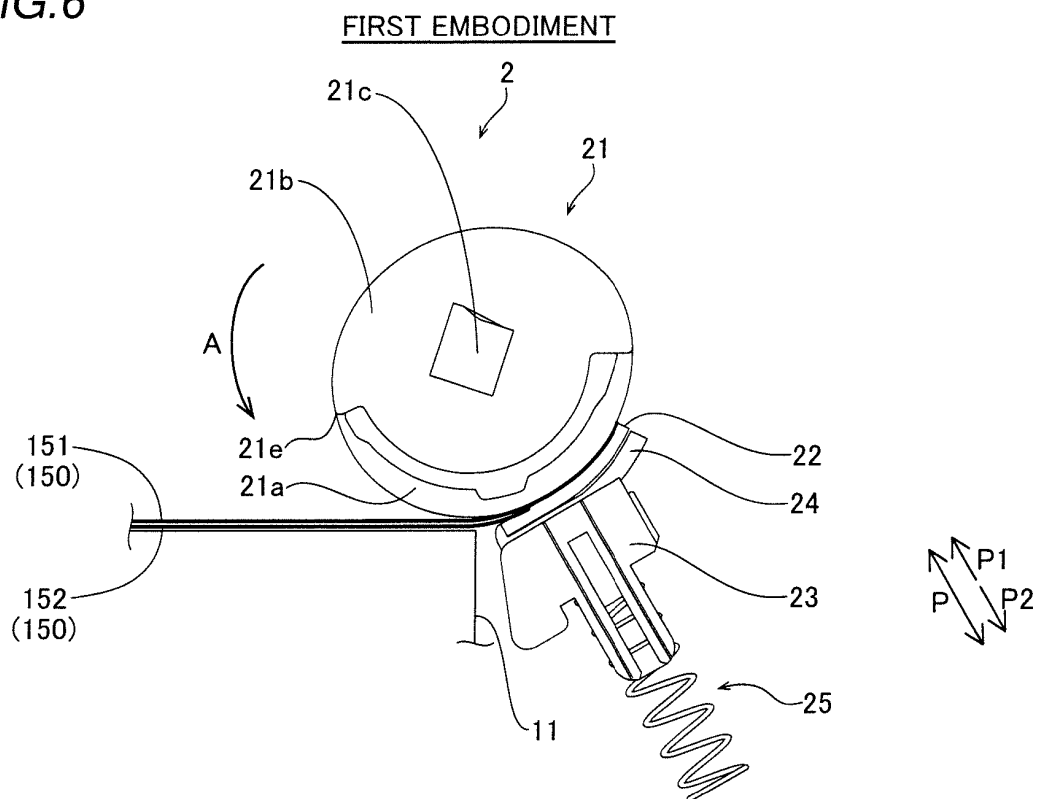


FIG.7

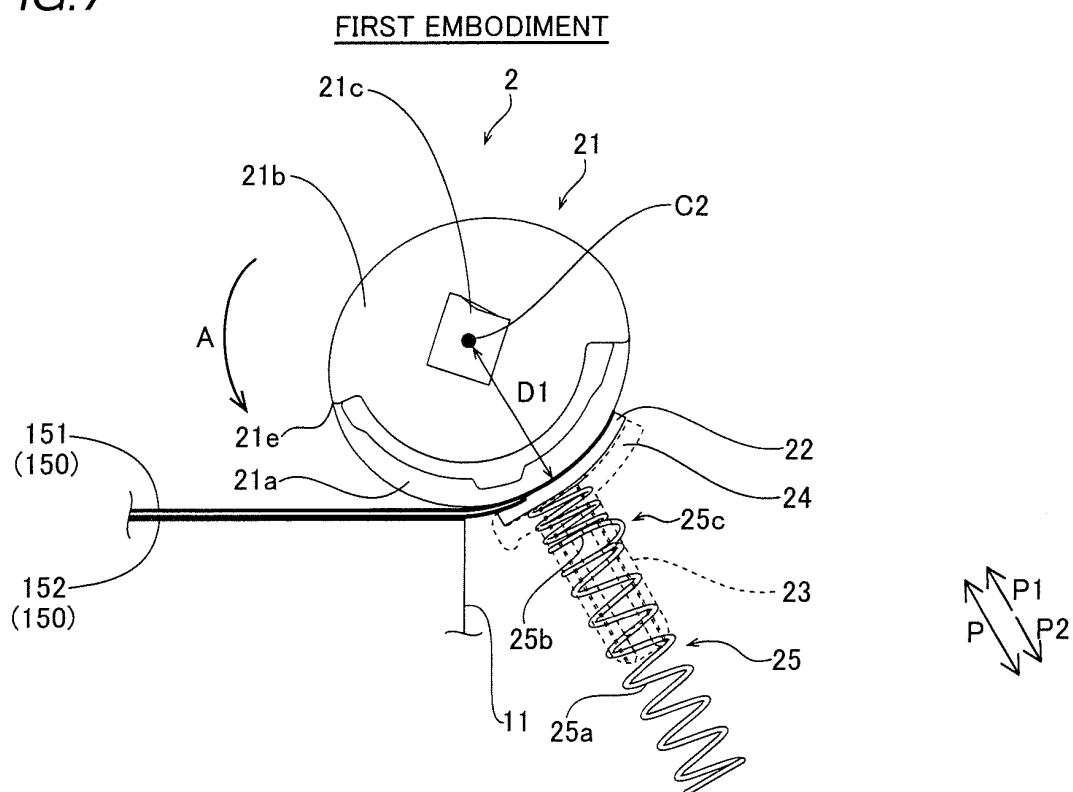


FIG.8

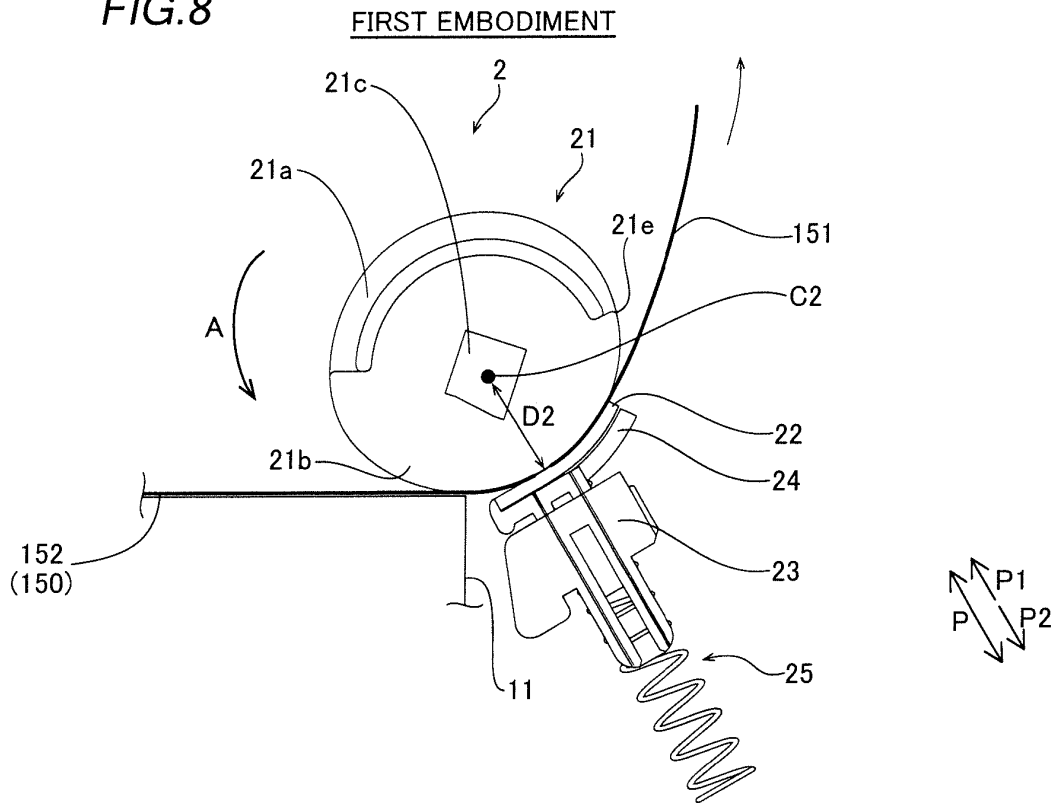


FIG.9

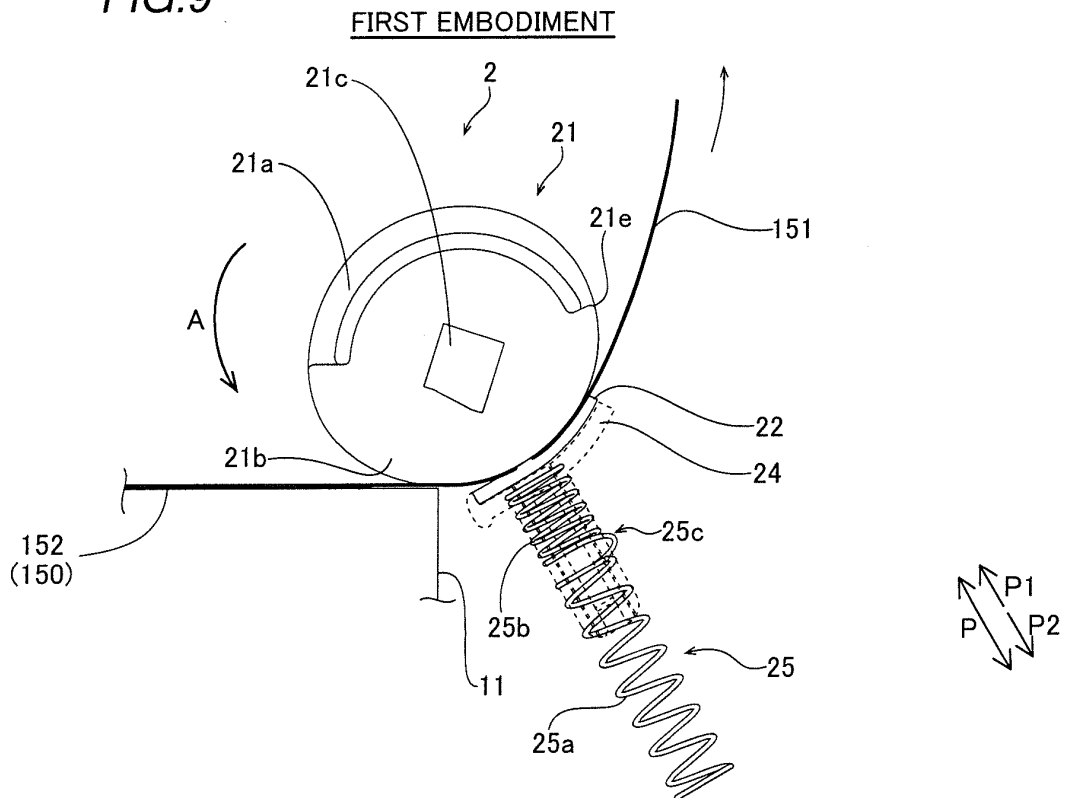


FIG. 10

SECOND EMBODIMENT

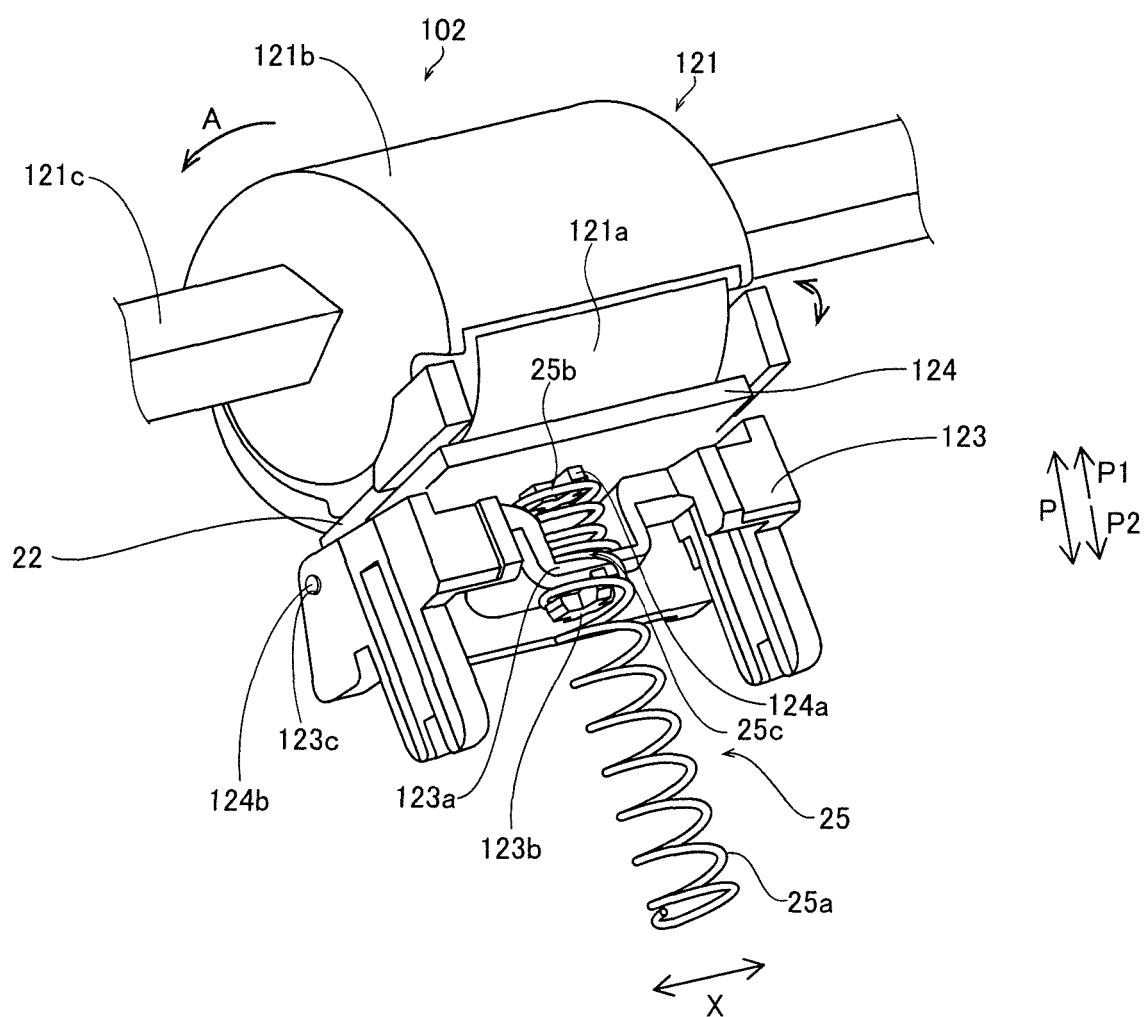


FIG. 11

SECOND EMBODIMENT

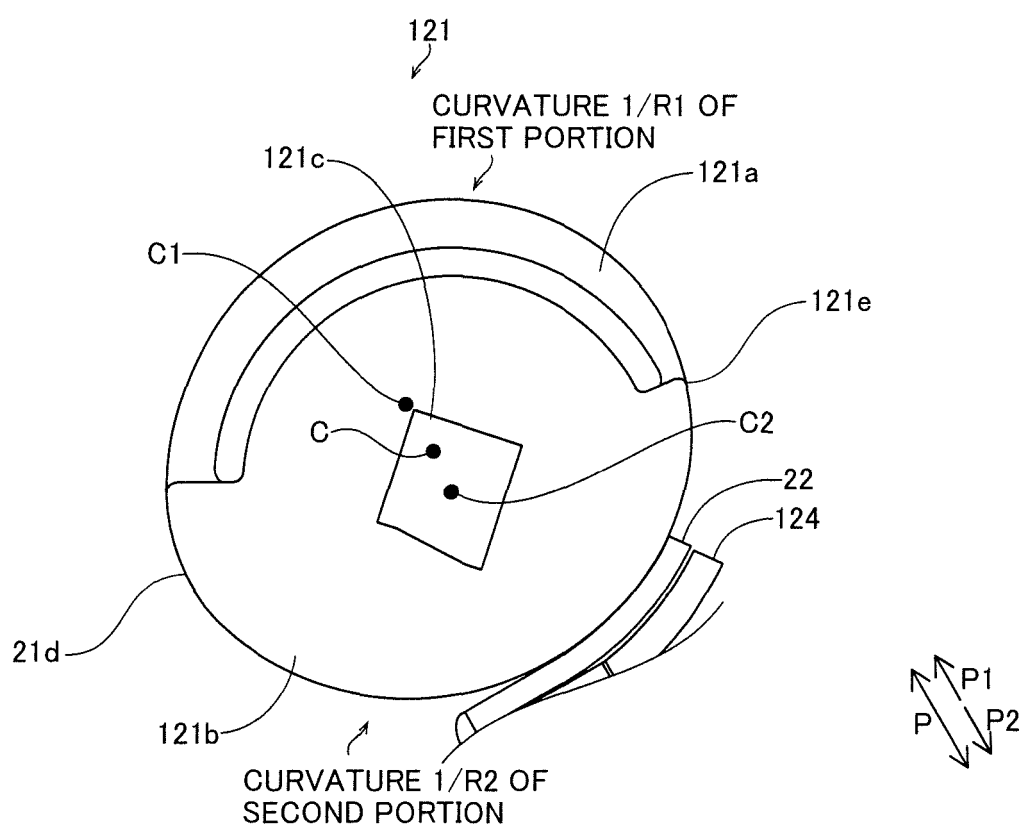
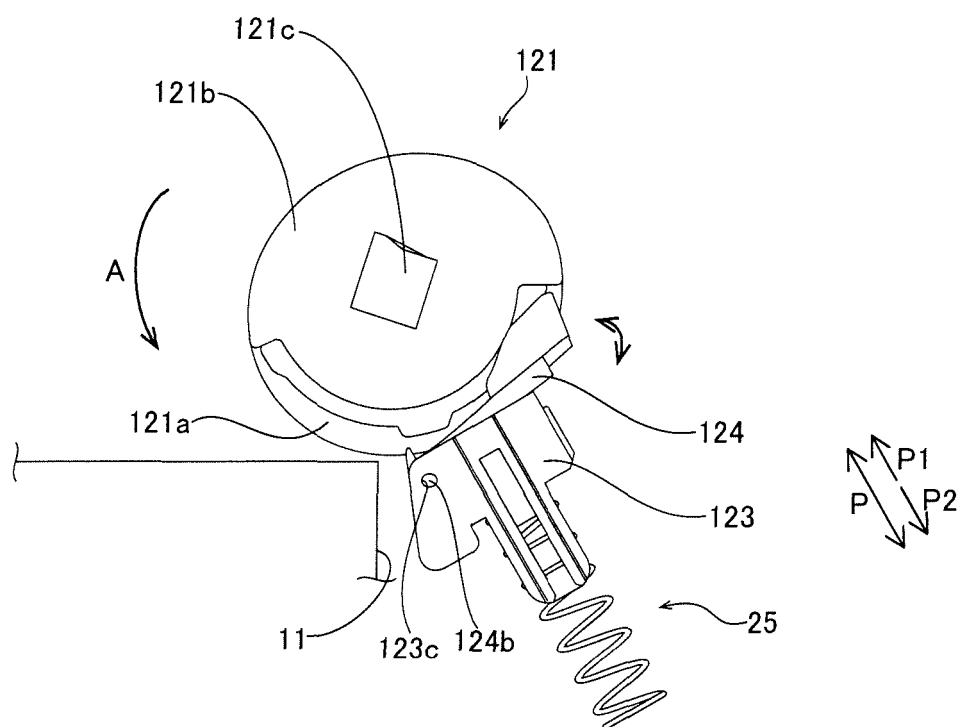


FIG. 12

SECOND EMBODIMENT



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/062243

A. CLASSIFICATION OF SUBJECT MATTER

B65H3/06(2006.01)i, B65H3/52(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65H1/00-3/68

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 083620/1990(Laid-open No. 042127/1992)	1,2,7,17,19,20
A	(Riso Kagaku Corp.), 09 April 1992 (09.04.1992), specification, page 7, line 7 to page 9, line 15; page 10, line 19 to page 13, line 13; fig. 1 to 3 (Family: none)	3-6,8-16,18
A	JP 4385929 B2 (Funai Electric Co., Ltd.), 16 December 2009 (16.12.2009), paragraphs [0018] to [0039]; fig. 1 to 8 & JP 2006-131395 A	1-20

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

14 July, 2014 (14.07.14)

Date of mailing of the international search report

22 July, 2014 (22.07.14)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/062243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-133078 A (Kyocera Mita Corp.), 12 June 2008 (12.06.2008), paragraph [0035]; fig. 2 to 4 (Family: none)	1-20
A	JP 8-002723 A (Canon Inc.), 09 January 1996 (09.01.1996), paragraph [0031]; fig. 1 (Family: none)	1-20
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 007474/1988 (Laid-open No. 111637/1989) (Murata Machinery Ltd.), 27 July 1989 (27.07.1989), specification, page 5, line 3 to page 6, line 9; fig. 1 to 2 (Family: none)	1-20

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4385929 B [0004]