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TRANSPORT DEVICE AND IMAGE FORMING APPARATUS

Abstract

A transport device includes a shaft body provided with a transport member configured to transport a medium, the shaft body extending in a first direction intersecting a transport direction in which the medium is to be transported, the shaft body being rotatably supported; an urging part configured to apply a nipping pressure to the transport member by urging the shaft body from an outer peripheral side of the shaft body; and a movable part supported independently of the shaft body and configured to move the urging part away from the shaft body by moving in the first direction in such a manner as to go into a gap between the shaft body and the urging part.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS
[0001] This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2024-022384 filed Feb. 16, 2024.
BACKGROUND
(i) Technical Field
[0002] The present disclosure relates to a transport device and an image forming apparatus.
(ii) Related Art
[0003] A sheet transport device disclosed in Japanese Unexamined Patent Application Publication No. 2011-136808 includes a transport-roller pair, a pressure arm, first and second urging-force-applying members, and an adjusting drive unit. The transport-roller pair includes a driving roller to which a driving force is transmitted, and a driven roller that is pressed against the driving roller. The pressure arm includes first and second arms provided across a pivot from each other. The pressure arm rotatably supports the driven roller at the distal end of the first arm thereof. The second arm has first and second acting points that are defined at different distances from the pivot. The first and second urging-force-applying members are configured to apply respective urging forces to the first and second acting points defined on the pressure arm. The adjusting drive unit is configured to selectively change the operating lengths of the first and second urging-force-applying members to adjust the pressing force with which the driven roller is pressed against the driving roller. In the adjustment, the adjusting drive unit increases the urging force exerted by one of the first and second urging-force-applying members and decreases the urging force exerted by the other of the first and second urging-force-applying members.
SUMMARY
[0004] Aspects of non-limiting embodiments of the present disclosure relate to a configuration in which a nipping pressure is applied to a transport member by causing an urging part to urge a shaft body and that has a smaller overall size than a configuration in which the nipping pressure is adjusted by moving, in the radial direction of the shaft body, a supporting member that supports the urging part in the radial direction of the shaft body.
[0005] Aspects of certain non-limiting embodiments of the present disclosure address the above advantages and/or other advantages not described above. However, aspects of the non-limiting embodiments are not required to address the advantages described above, and aspects of the non-limiting embodiments of the present disclosure may not address advantages described above.
[0006] According to an aspect of the present disclosure, there is provided a transport device including a shaft body provided with a transport member configured to transport a medium, the shaft body extending in a first direction intersecting a transport direction in which the medium is to be transported, the shaft body being rotatably supported; an urging part configured to apply a nipping pressure to the transport member by urging the shaft body from an outer peripheral side of the shaft body; and a movable part supported independently of the shaft body and configured to move the urging part away from the shaft body by moving in the first direction in such a manner as to go into a gap between the shaft body and the urging part.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0007] Exemplary embodiments of the present disclosure will be described in detail based on the following figures, wherein:
[0008] FIG. **1** is a schematic diagram of an image forming apparatus according to an exemplary

embodiment;
[0009] FIG. **2**A is a plan view of a transport device included in the image forming apparatus according to the exemplary embodiment;
[0010] FIG. **2**B is a side view of the transport device;
[0011] FIG. **3** is a sectional view of the transport device illustrated in FIG. **2**B, taken along line III-III;
[0012] FIG. **4**A is a plan view of a part of the transport device according to the exemplary embodiment, with a handle being in contact with a front wall of an intermediate bracket;
[0013] FIG. **4**B is a side view of the part illustrated in FIG. **4**A;
[0014] FIG. **5** is a plan view of the part illustrated in FIG. **4**A, with an intermediate spring removed;
[0015] FIG. **6** is a sectional side view of a part of the transport device according to the exemplary embodiment, illustrating a bearing and relevant elements therearound;
[0016] FIG. **7**A is a plan view of a part of the transport device according to the exemplary embodiment, with an assist member being in contact with a rear wall of the intermediate bracket;
[0017] FIG. **7**B is a side view of the part illustrated in FIG. **7**A; and
[0018] FIG. **8**A is a plan view of a part of a transport device according to a modification of the exemplary embodiment; and
[0019] FIG. **8**B is a side view of the part illustrated in FIG. **8**A.

DETAILED DESCRIPTION

Exemplary Embodiment

[0020] A transport device and an image forming apparatus according to an exemplary embodiment of the present disclosure will be now described with reference to the drawings. In the drawings, arrow H represents the top-bottom direction of the image forming apparatus, arrow W represents the widthwise direction of the image forming apparatus, arrow DR represents the rear side of the image forming apparatus in the front-rear direction, and arrow DF represents the front side of the image forming apparatus in the front-rear direction. The top-bottom direction of the image forming apparatus, the widthwise direction of the image forming apparatus, and the front-rear direction of the image forming apparatus are orthogonal to each other. These directions are defined for convenience of description and do not limit the configuration of the image forming apparatus. In describing these directions of the image forming apparatus, the phrase “of the image forming apparatus” may be omitted. The front-rear direction is an exemplary first direction.

Image Forming Apparatus

[0021] An image forming apparatus **10** is configured to form an image on a sheet member P. The sheet member P is an exemplary medium. As illustrated in FIG. **1**, the image forming apparatus **10** includes relevant elements provided inside an apparatus body **10***a*. The image forming apparatus **10** basically includes a sheet container section **12**, a main operation section **14**, and a transport section **18**. The image forming apparatus **10** further includes a display part **40**, which serves as an interface through which the user exchanges information with the image forming apparatus **10**.

Sheet Container Section

[0022] As illustrated in FIG. **1**, the sheet container section **12** is configured to contain sheet members P. The sheet container section **12** includes a first container **22**, a second container **24**, a third container **26**, and a fourth container **28**. The first container **22**, the second container **24**, the third container **26**, and the fourth container **28** contain sheet members P of different sizes as appropriate. The first container **22**, the second container **24**, the third container **26**, and the fourth container **28** are each provided with a feed roll **32** and a double-feed-preventing roll **34**. The feed roll **32** is configured to feed the sheet members P, contained as above, one by one in response to an instruction issued by a managing unit **20**, which is configured to manage the operations of relevant elements. The double-feed-preventing roll **34** is configured to transport the sheet member P fed from the feed roll **32** to a transport path **30**, which runs inside the image forming apparatus **10**.

Main Operation Section

[0023] As illustrated in FIG. **1**, the main operation section **14** is configured to visualize, on the sheet member P transported from the sheet container section **12**, image data generated from an original by an image reading section **16** or image data received from an external device. The main operation section **14** includes an image forming unit **60**, a transfer unit **68**, and a fixing device **58**.

[0024] The image forming unit **60** is configured to form a toner image. The image forming unit **60** includes image forming subunits **64**K, **64**C, **64**M, and **64**Y, which are configured to form toner images in respective colors of black (K), cyan (C), magenta (M), and yellow (Y). In the following description, suffixes K, C, M, or Y added to a corresponding one of the reference signs may be omitted unless otherwise distinguished.

[0025] The image forming subunits **64** include respective photoconductor drums **62**, respective charging devices **42**, respective developing devices **44**, respective cleaning members **46**, and respective exposure devices **66** (**66**K, **66**C, **66**M, and **66**Y). The charging devices **42** are configured to charge the respective photoconductor drums **62** while the photoconductor drums **62** are rotating. The exposure devices **66** are configured to emit exposure light to the respective charged photoconductor drums **62**, thereby forming respective electrostatic latent images on the photoconductor drums **62**. The developing devices **44** are configured to develop the respective electrostatic latent images into toner images. That is, the image forming apparatus **10** according to the present exemplary embodiment is an electrophotographic apparatus.

[0026] The transfer unit **68** is configured to transfer the toner images onto the sheet member P. As illustrated in FIG. **1**, the transfer unit **68** is located below the image forming unit **60**. The transfer unit **68** includes a transfer belt **48**, first transfer rolls **50**, a second transfer roll **52**, an assist roll **54**, and rolls **56**.

[0027] The transfer belt **48** has an endless shape and is positioned to form a triangular shape with the top thereof pointing downward as viewed from the front in the front-rear direction. The transfer belt **48** is in contact with the image forming unit **60** from below in the top-bottom direction.

[0028] The first transfer rolls **50** (**50**K, **50**C, **50**M, and **50**Y) each have a cylindrical shape extending in the front-rear direction. The first transfer rolls **50** are arranged in correspondence with the photoconductor drums **62** and nip the transfer belt **48** in cooperation with the respective photoconductor drums **62**, so that the toner images are to be transferred from the photoconductor drums **62** collectively onto the transfer belt **48**.

[0029] The second transfer roll **52** has a cylindrical shape extending in the front-rear direction and is located below the first transfer rolls **50**. The second transfer roll **52** is configured to transfer the set of toner images from the transfer belt **48** to the sheet member P at a second transfer position T.

[0030] The assist roll **54** has a cylindrical shape extending in the front-rear direction and is located on the inner side of the transfer belt **48**, at a position across the transfer belt **48** from the second transfer roll **52**.

[0031] The rolls **56** are located on the inner side of the transfer belt **48**. The transfer belt **48** is wound around the rolls **56**. One of the rolls **56** serves as a driving roll configured to cause the transfer belt **48** to rotate in a direction represented by arrow C in FIG. **1**.

[0032] The fixing device **58** has a cylindrical shape extending in the front-rear direction and is located downstream of the second transfer position T. The fixing device **58** is configured to fix the set of toner images transferred onto the sheet member P to the sheet member P.

Transport Section

[0033] As illustrated in FIG. **1**, the transport section **18** is configured to receive the sheet member P transported from the double-feed-preventing roll **34** or fed from the outside of the apparatus body **10***a*, and to transport the sheet member P. The transport section **18** includes the transport path **30**, transport rolls **36**, and a transport device **38**.

[0034] The transport path **30** defines the direction in which the sheet member P is to be transported (hereinafter simply referred to as “transport direction CV”). The transport direction CV intersects

the front-rear direction but does not necessarily coincide with the widthwise direction.
[0035] An upstream portion of the transport path **30** extends upward from a lower position on one side in the widthwise direction. A manual feed path **33** is connected to the upper end of the upstream portion of the transport path **30**.
[0036] A downstream portion of the transport path **30** extends in the widthwise direction from the one side to the other side and is connected to an output part **80**, where the sheet member P is to be outputted to the outside of the apparatus body **10***a*. The downstream end of the transport path **30** is connected to a duplex transport path **31**, in which the sheet member P is transported to be turned over for the formation of another image on the back side of the sheet member P. The duplex transport path **31** includes a switchback path **31***a*. In the duplex transport path **31**, the sheet member P fed from the switchback path **31***a* is turned upside down and is fed to the upper end of the upstream portion, in the transport direction CV, of the transport path **30**.
[0037] The transport rolls **36** each have a cylindrical shape extending in the front-rear direction and are arranged along the transport path **30**. The transport rolls **36** each include a pair of rolls that are located across the transport path **30** from each other in the apparatus body **10***a*.
[0038] The transport device **38** is located upstream of the second transfer position T in the transport direction CV. The transport device **38** is configured to temporarily stop the sheet member P and to feed the sheet member P to the second transfer position T at a determined timing. The transport device **38** has three functions: a basic function, a nipping-pressure-applying function, and a nipping-pressure-adjusting function. The functions of the transport device **38** will now be described.

Basic Function

[0039] As illustrated in FIGS. **2**A and **2**B, the transport device **38** includes a guide **110**, a shaft **120**, and transport-roll pairs **130**, all of which are configured to exert the basic function.
[0040] As illustrated in FIGS. **2**A, **2**B, and **3**, the guide **110** is an elongated plate member extending in the front-rear direction and includes a bottom part **113** and an upright part **114**. The bottom part **113** extends in the widthwise direction, and the upright part **114** extends upward in the top-bottom direction from the bottom part **113**. Hence, the guide **110** has an L shape in sectional view. The guide **110** is supported by a frame (not illustrated) included in the apparatus body **10***a*. As illustrated in FIG. **2**A, the guide **110** has holes **112**, which are provided in the bottom part **113** and are at intervals from each other in the front-rear direction. In the present exemplary embodiment, the guide **110** has four holes **112**. The guide **110** is configured to guide the sheet member P by the bottom part **113** in such a manner as to orient the sheet member P in the transport direction CV.
[0041] As illustrated in FIG. **2**A, the shaft **120** extends in the front-rear direction with a center axis C1, and is rotatably supported by the guide **110**. The shaft **120** is an exemplary shaft body. As illustrated in FIG. **2**B, the shaft **120** is located above the guide **110**.
[0042] As illustrated in FIGS. **2**A and **2**B, the transport-roll pairs **130** are pairs of cylindrical rolls each extending in the front-rear direction. The rolls in each pair are arranged one above the other. The transport-roll pairs **130** are each an exemplary transport member. In each of the transport-roll pairs **130**, the upper one of the rolls that is located on the upper side in the top-bottom direction is supported by the shaft **120**, and the lower one (see FIG. **1**) of the rolls that is located on the lower side in the top-bottom direction is supported by the guide **110**. The transport-roll pairs **130** are located in correspondence with the holes **112**. The transport-roll pairs **130** are configured to transport the sheet member P in the transport direction CV, with a portion of the peripheral surface of each of the upper rolls being exposed in a corresponding one of the holes **112** and projecting downward relative to the lower surface, **110**A, of the guide **110** in such a manner as to be pressed against a corresponding one of the lower rolls under the nipping-pressure-applying function. In the present exemplary embodiment, four transport-roll pairs **130** are provided in correspondence with the four holes **112**.

Application of Nipping Pressure

[0043] The transport device **38** includes a bearing **180**, end-side springs **190**, an intermediate spring **140**, end-side brackets **192**, and an intermediate bracket **150**, all of which are configured to exert the nipping-pressure-applying function. The end-side springs **190** and the intermediate spring **140** are to apply nipping pressure to the transport-roll pairs **130** through the shaft **120**.
[0044] As illustrated in FIG. **5**, the bearing **180** is located on the outer peripheral side of the shaft **120** and has a circular shape when viewed from the front in the front-rear direction. The bearing **180** is an exemplary receiving part. In the present exemplary embodiment, the bearing **180** is an antifriction bearing. The bearing **180** is to reduce the rotational resistance in an area where a relatively high nipping pressure is to be applied. The length (thickness) of the bearing **180** in the front-rear direction is denoted by TB (see FIG. **6**).
[0045] As illustrated in FIGS. **2**A and **2**B, the end-side springs **190** are provided near the two respective ends of the shaft **120** in the front-rear direction. In the present exemplary embodiment, the end-side springs **190** are each a helical extension spring. As illustrated in FIG. **2**B, the end-side springs **190** each include a central portion **190**C, and one end **190**A and an other end **190**B. The central portion **190**C is bent in a U shape in such a manner as to cover an upper portion of the shaft **120** in the top-bottom direction. The ends **190**A and **190**B are positioned on the two respective sides of the shaft **120** in the transport direction CV. The end-side springs **190** urge the shaft **120** from the outer peripheral side while being supported by the respective end-side brackets **192** as to be described below.
[0046] As illustrated in FIG. **3**, the intermediate spring **140** includes a central portion **140**C, and one end **140**A and an other end **140**B. The central portion **140**C is bent in a U shape in such a manner as to cover an upper portion of the shaft **120** in the top-bottom direction. The ends **140**A and **140**B are positioned on the two respective sides of the shaft **120**. Thus, the intermediate spring **140** urges the shaft **120** from the outer peripheral side.
[0047] As illustrated in FIGS. **2**A and **2**B, the intermediate spring **140** is provided at an intermediate position that is between the two end-side springs **190** in the front-rear direction and where none of the holes **112** are provided. In the present exemplary embodiment, the intermediate spring **140** is a helical extension spring. The intermediate spring **140** is an exemplary urging part.
[0048] Referring to FIG. **6**, in a section taken along the center axis C1 of the shaft **120**, the central portion **140**C of the intermediate spring **140** has a circular shape having a center CS and a radius RS to the outer periphery. Twice the radius RS of the intermediate spring **140** (i.e., the diameter of the intermediate spring **140**) is longer than the length TB of the bearing **180** in the front-rear direction.
[0049] The intermediate spring **140** has a greater elastic modulus than the end-side springs **190**. The intermediate spring **140** urges the shaft **120** more strongly than the end-side springs **190**. The intermediate spring **140** urges the shaft **120** through the bearing **180** while being supported by the intermediate bracket **150** as to be described below.
[0050] As illustrated in FIGS. **2**A and **2**B, the end-side brackets **192** each include a plate-like body **194**, which extends along the guide **110**; and a pair of side walls **196**, which extend upward from the two respective widthwise ends of the body **194**. Hence, the end-side brackets **192** each have a U shape that is open upward when viewed in the front-rear direction. The end-side brackets **192** are fixed to the guide **110**. The side walls **196** each have a hook **196**A, which is provided on the front side or the rear side in the front-rear direction.
[0051] The end-side brackets **192** are provided near the two respective ends of the shaft **120**. Specifically, the end-side brackets **192** are provided at the following locations: between two of the transport-roll pairs **130** that are located on the front side in the front-rear direction, and between the other two transport-roll pairs **130** located on the rear side in the front-rear direction. The end-side brackets **192** are fixed to and supported by an upper portion of the shaft **120** in the top-bottom direction. The hooks **196**A of each of the end-side brackets **192** support the two respective ends of a corresponding one of the end-side springs **190** such that the end-side bracket **192** is pressed

against the shaft **120** from the upper side in the top-bottom direction. That is, the end-side springs **190** urge the shaft **120** by the central portions **190**C thereof while being supported by the respective end-side brackets **192**.

[0052] As illustrated in FIGS. **4**A and **4**B, the intermediate bracket **150** includes a front wall **151**, a rear wall **152**, side walls **153**, and folds **154**. The intermediate bracket **150** is located at an intermediate position between the two end-side brackets **192** in the front-rear direction and between the shaft **120** and the guide **110** in the top-bottom direction.

[0053] As illustrated in FIG. **3**, the front wall **151** stands upward on the front side of the intermediate bracket **150** in the front-rear direction. The front wall **151** includes a pair of walls that are spaced apart from each other in the widthwise direction with the shaft **120** interposed therebetween.

[0054] As illustrated in FIGS. **4**A and **4**B, the rear wall **152** stands upward on the rear side of the intermediate bracket **150** in the front-rear direction. The rear wall **152** includes a pair of walls that are spaced apart from each other in the widthwise direction with the shaft **120** interposed therebetween.

[0055] As illustrated in FIGS. **4**A and **4**B, the side walls **153** are a pair of walls that each extend in the front-rear direction and stand upward in the top-bottom direction. The side walls **153** are spaced apart from each other in the widthwise direction with the shaft **120** interposed therebetween. The side walls **153** are higher than the front wall **151** and the rear wall **152**. The side walls **153** include respective hooks **153**A at the front ends thereof in the front-rear direction. The hooks **153**A support the respective ends of the intermediate spring **140** at a position P0, which is defined in the front-rear direction. Thus, the intermediate spring **140** supported by the side walls **153** urges the shaft **120** by the central portion **140**C thereof. The position P0 is the absolute position of the guide **110** and the intermediate bracket **150** in the apparatus body **10***a*. That is, the guide **110** and the intermediate bracket **150** are fixed to the apparatus body **10***a*.

[0056] As illustrated in FIGS. **4**A and **4**B, the folds **154** are projections located above the respective hooks **153**A in the top-bottom direction and are obtained by folding respective front end portions, in the front-rear direction, of the side walls **153** toward the shaft **120**. The folds **154** are located on the rear side relative to the intermediate spring **140** in the front-rear direction and closer to the respective ends **140**A and **140**B of the intermediate spring **140** than to the central portion **140**C in the transport direction CV. The folds **154** prevent the intermediate spring **140** from deforming rearward in the front-rear direction. As illustrated in FIG. **3**, the folds **154** are located above the center axis C1 of the shaft **120** in the top-bottom direction.

[0057] The above configuration exerts a nipping pressure to be applied to the transport-roll pairs **130**.

Adjustment of Nipping Pressure

[0058] The transport device **38** includes a nipping-pressure-adjusting mechanism **100**, which is configured to exert the nipping-pressure-adjusting function. The nipping-pressure-adjusting mechanism **100** includes a structure in which the bearing **180** is supported in such a manner as to be slidable relative to the shaft **120**, and a structure in which a movable part **160** is provided in such a manner as to be slidable relative to the shaft **120**.

[0059] The bearing **180** is slidable (reciprocatable) in the front-rear direction on the outer peripheral side of the shaft **120**, for adjusting the nipping pressure. Specifically, the inside diameter of the inner ring of the bearing **180** is slightly smaller than the outside diameter of the shaft **120**, and the shaft **120** is inserted into the inner ring, so that the bearing **180** is slidable on the shaft **120**. As illustrated in FIG. **5**, the position of the bearing **180** in the front-rear direction of the shaft **120** is denoted by P1. That is, the position P1 is the reference position of the bearing **180** relative to the shaft **120**. The position P1 is an exemplary first position.

[0060] Herein, adjustment refers to switching between a state where the intermediate spring **140** is effective on the shaft **120** and a state where the intermediate spring is not effective on the shaft **120**.

The way of adjusting the nipping pressure is automatically determined by the relationship between the position P1 of the bearing **180** and the position P0.

[0061] Referring to FIGS. **2**A and **2**B, the movable part **160** has an arch shape with an uneven outer surface. The movable part **160** is supported independently of the shaft **120**. Specifically, the movable part **160** includes two arch-shaped members that each extend in the front-rear direction and are arranged with the bearing **180** interposed therebetween in the front-rear direction. The movable part **160** is supported by the intermediate bracket **150** in such a manner as to be slidable in the front-rear direction, with the shaft **120** extending through the openings of the two arch-shaped members. Specifically, as illustrated in FIG. **6**, the movable part **160** is radially spaced apart from the outer periphery of the shaft **120**. In this state, the movable part **160** is supported in such a manner as to be slidable in the front-rear direction on the intermediate bracket **150** but is restricted from moving in the top-bottom direction. The movable part **160** includes a main member **162**, a handle **176**, an assist member **178**, and a returning member **170**.

[0062] As illustrated in FIGS. **3**, **4**A, **4**B, and **6**, the main member **162** has an arch shape and is located on the front side of the movable part **160** in the front-rear direction. The main member **162** has on the inner side thereof an opening through which the shaft **120** is allowed to pass (see FIG. **6**). The main member **162** is supported by the intermediate bracket **150** with the aid of a guiding member (not illustrated). The main member **162** is slidable on the intermediate bracket **150** in the front-rear direction while being restricted from moving in the top-bottom direction. The main member **162** is located on the front side relative to the intermediate spring **140** in the front-rear direction. When the movable part **160** is moved rearward in the front-rear direction, a tapered portion **166**, to be described below, goes into the gap between the shaft **120** and the intermediate spring **140**, thereby moving the intermediate spring **140** away from the shaft **120** (details will be described separately below).

[0063] As illustrated in FIGS. **4**B and **6**, the tapered portion **166** is provided at the upper surface of the main member **162** and is inclined from the front side toward the rear side in the front-rear direction. The tapered portion **166** is a portion of the main member **162**. The tapered portion **166** has a distal end EG, which is located closer to the shaft **120** than the center CS of the intermediate spring **140**. The main member **162** has a rear end face **166**A, which is located on the rear side in the front-rear direction and is rounded. The distal end EG refers to the front-side endpoint of the rounded part in the front-rear direction. The length of the tapered portion **166** in the front-rear direction is longer than the diameter (twice the radius RS) of the intermediate spring **140**. When the intermediate spring **140** is placed on the tapered portion **166**, that is, when the position P1 of the bearing **180** is shifted from the position P0, the tapered portion **166** receives an urging force from the intermediate spring **140**.

[0064] As illustrated in FIGS. **4**A and **4**B, the handle **176** is located at the front end of the main member **162** in the front-rear direction and has a flange shape projecting from the main member **162** in the top-bottom direction and in the widthwise direction. The handle **176** is a plate extending in the top-bottom direction and in the widthwise direction. The handle **176** is provided for the operator (not illustrated) to operate in moving the movable part **160** in the front-rear direction. The tapered portion **166** extends up to the handle **176**. The movable part **160** is movable frontward in the front-rear direction until coming into contact with the front wall **151** of the intermediate bracket **150**.

[0065] The assist member **178** has an arch shape. In the state, illustrated in FIG. **6**, where the urging force of the intermediate spring **140** is effective, the assist member **178** is positioned such that the intermediate spring **140** is held between the main member **162** and the assist member **178** in the front-rear direction, with a distance DM provided between the main member **162** and the assist member **178**. The assist member **178** has on the inner side thereof an opening through which the shaft **120** is allowed to pass. As illustrated in FIGS. **7**A and **7**B, the assist member **178** has a projection **178**A at the rear end thereof in the front-rear direction. The projection **178**A exerts a

stopper function of stopping the movement of the movable part **160** in the front-rear direction, by coming into contact with the rear wall **152** of the intermediate bracket **150**. The distance DM between the assist member **178** and the main member **162** is longer than twice the radius RS of the intermediate spring **140** (i.e., than the diameter of the intermediate spring **140**).

[0066] As illustrated in FIG. **5**, the returning member **170** is located between the main member **162** and the assist member **178** and connects the main member **162** and the assist member **178** to each other. In the present exemplary embodiment, the returning member **170**, the main member **162**, and the assist member **178** are integrated with each other.

[0067] The returning member **170** is recessed in the widthwise direction on a side thereof that faces the shaft **120**. Specifically, the returning member **170** is shaped such that two end portions thereof in the front-rear direction project toward the shaft **120** relative to a central portion thereof in the front-rear direction, and the bearing **180** is held between the two end portions. That is, the returning member **170** included in the movable part **160** causes the bearing **180** to move in the front-rear direction by moving in the front-rear direction. Specifically, when the bearing **180** comes into contact with the rear one of the end portions of the returning member **170** in the front-rear direction, the bearing **180** is moved frontward in the front-rear direction. On the other hand, when the bearing **180** comes into contact with the front one of the end portions of the returning member **170** in the front-rear direction, the bearing **180** is moved rearward in the front-rear direction.

[0068] Thus, the nipping-pressure-adjusting mechanism **100** adjusts the nipping pressure to be applied to the transport-roll pairs **130**, in correspondence with the position of the movable part **160**, or the bearing **180**.

[0069] Then, the image forming apparatus **10** transfers the set of toner images formed by the main operation section **14** to the sheet member P transported from the sheet container section **12** through the transport section **18**.

Operational Effects

[0070] Operational effects produced by the transport device **38** according to the present exemplary embodiment will now be described. As illustrated in FIGS. **4**A and **4**B, when the position P1 coincides with the position P0, the bearing **180** receives, at the outer peripheral surface thereof, an urging force from the intermediate spring **140**. When the bearing **180** receives the urging force, a nipping pressure is applied to the transport-roll pairs **130** through the shaft **120**. In this state, since the intermediate spring **140** has a greater elastic modulus than the end-side springs **190**, the nipping pressure is greater than in a case where the nipping pressure is applied to the transport-roll pairs **130** only by using the end-side springs **190**.

[0071] Now, how to adjust the nipping pressure will be described. To change the nipping pressure, the operator grips the handle **176** of the movable part **160** and moves the movable part **160**, altogether with the bearing **180**, rearward in the front-rear direction. As illustrated in FIGS. **7**A and **7**B, when the position P1 is shifted from the position P0, that is, when the position P1 is on the rear side relative to the position P0 in the front-rear direction, the bearing **180** is free from the urging force of the intermediate spring **140**. Instead, the movable part **160**, more specifically the tapered portion **166**, receives the urging force. When the position P1 is shifted from the position P0, the intermediate spring **140** moves toward the handle **176** along the tapered portion **166** of the movable part **160**. When the assist member **178** of the movable part **160** comes into contact with the intermediate bracket **150**, the movable part **160** stops moving in the front-rear direction.

[0072] The transport device **38** according to the present exemplary embodiment includes the shaft **120** provided with the transport-roll pairs **130** configured to transport the sheet member P, the shaft **120** extending in the front-rear direction intersecting the transport direction CV and being rotatably supported; the intermediate spring **140** configured to apply a nipping pressure to the transport-roll pairs **130** by urging the shaft **120** from the outer peripheral side of the shaft **120**; and the movable part **160** supported independently of the shaft **120** and configured to move the intermediate spring **140** away from the shaft **120** by moving in the front-rear direction in such a manner as to go into a

gap between the shaft **120** and the intermediate spring **140**.
[0073] The transport device **38** according to the present exemplary embodiment further includes the bearing **180** provided on the outer peripheral side of the shaft **120** and being movable from the position P1 to the position P0 with the movement of the movable part **160**. The position P1 is a position where the bearing **180** transmits the urging force of the intermediate spring **140** to the shaft **120**. The position P0 is a position that is shifted from the position P1 in the front-rear direction and where the bearing **180** is free from the urging force.
[0074] In the transport device **38** according to the present exemplary embodiment, the movable part **160** includes the tapered portion **166** that is inclined toward the bearing **180** and that is to receive the urging force.
[0075] In the transport device **38** according to the present exemplary embodiment, the intermediate spring **140** has a circular sectional shape and is positioned such that he central portion **140**C is in contact with the bearing **180** with the two ends **140**A and **140**B being supported at the respective locations across the shaft **120** from each other in the transport direction CV. Furthermore, when the bearing **180** is at the position P1, the distal end EG of the tapered portion **166** is located closer to the shaft **120** than the center CS of the central portion **140**C.
[0076] In the transport device **38** according to the present exemplary embodiment, the movable part **160** includes the returning member **170** located apart from the bearing **180** in the front-rear direction and projecting toward the shaft **120**. The returning member **170** is configured to move the bearing **180** along with the movable part **160** in the front-rear direction. In such a configuration, when the movable part **160** is moved rearward in the front-rear direction, the bearing **180** is moved rearward in the front-rear direction.
[0077] In the transport device **38** according to the present exemplary embodiment, the movable part **160** includes the handle **176** provided for the operator to operate in moving the movable part **160** in the front-rear direction.
[0078] The image forming apparatus **10** according to the present exemplary embodiment includes the transport section **18** including the transport device **38** described above, and the main operation section **14** configured to form an image on a sheet member P transported by the transport section **18**.
Modifications
[0079] While the present disclosure has been described in detail by taking a specific exemplary embodiment, the present disclosure is not limited to the above exemplary embodiment. It is apparent to those skilled in the art that the present disclosure can be embodied in various other ways within the scope of the present disclosure.
[0080] While the above image forming apparatus **10** is an electrophotographic apparatus, the image forming apparatus **10** is not limited thereto. The image forming apparatus **10** may be an inkjet apparatus.
[0081] While the above intermediate spring **140** is supported by the intermediate bracket **150**, the intermediate spring **140** is not limited thereto. The intermediate spring **140** may be supported by the apparatus body **10***a* with the aid of the intermediate bracket **150**, or may be directly supported by the apparatus body **10***a*. Furthermore, the intermediate spring **140** may be a helical compression spring or a leaf spring.
[0082] The transport device **38** according to the above exemplary embodiment includes the bearing **180** provided on the outer peripheral side of the shaft **120** and being movable from the position P1 to the position P0 with the movement of the movable part **160**. The position P1 is a position where the bearing **180** transmits the urging force of the intermediate spring **140** to the shaft **120**. The position P0 is a position that is shifted from the position P1 in the front-rear direction and where the bearing **180** is free from the urging force. Such a bearing **180** is not essential. The bearing **180** may be a slide bearing. Moreover, the bearing **180** may be omitted. Instead, the intermediate spring **140** may directly urge the shaft **120**.

[0083] While the movable part **160** according to the above exemplary embodiment includes the tapered portion **166** provided at the upper surface thereof, the movable part is not limited thereto. For example, as illustrated in FIGS. **8**A and **8**B, a movable part **260** may be employed, in which a flat portion **266** extends flat in the front-rear direction at the upper surface of the movable part **260**. In such a case, when the operator (not illustrated) operates a handle **276**, the flat portion **266** receives a constant urging force from the intermediate spring **140**. Alternatively, both the tapered portion and the flat portion may be provided at the upper surface of the movable part. Note that the elements of such a modification other than the movable part **260** are the same as the basic elements employed in the above exemplary embodiment.

[0084] In the transport device **38** according to the above exemplary embodiment, the intermediate spring **140** has a circular sectional shape and is positioned such that the central portion **140**C is in contact with the bearing **180** with the two ends **140**A and **140**B being supported at the respective locations across the shaft **120** from each other in the transport direction CV. Furthermore, when the bearing **180** is at the position P1, the distal end EG of the tapered portion **166** is located closer to the shaft **120** than the center CS of the central portion **140**C. Such an intermediate spring **140** is not essential. The intermediate spring **140** may have a rectangular sectional shape, as long as the intermediate spring **140** is able to urge the bearing **180** and the movable part **160**.

[0085] In the transport device **38** according to the above exemplary embodiment, the movable part **160** includes the returning member **170** located apart from the bearing **180** in the front-rear direction and projecting toward the shaft **120**. The returning member **170** is configured to move the bearing **180** along with the movable part **160** frontward in the front-rear direction. Such a movable part **160** is not essential. For example, the movable part **160** and the returning member **170** may be separate from each other.

[0086] In the transport device **38** according to the above exemplary embodiment, while the movable part **160** includes the handle **176** provided for the operator to operate in moving the movable part **160** in the front-rear direction, the movable part **160** is not limited thereto. For example, the movable part **160** and the handle **176** may be separate from each other.

[0087] While the image forming apparatus **10** according to the above exemplary embodiment includes the transport section **18** including the transport device **38** described above; and the main operation section **14** configured to form an image on a sheet member P transported by the transport section **18**, the image forming apparatus **10** is not limited thereto. The present disclosure may be applied to an apparatus constituted by a sheet feeding device and the transport device, or an apparatus constituted by a post-processing device, such as a bookbinder or a sheet folder, and the transport device.

APPENDIX

(((1)))

[0088] A transport device comprising: [0089] a shaft body provided with a transport member configured to transport a medium, the shaft body extending in a first direction intersecting a transport direction in which the medium is to be transported, the shaft body being rotatably supported; [0090] an urging part configured to apply a nipping pressure to the transport member by urging the shaft body from an outer peripheral side of the shaft body; and [0091] a movable part supported independently of the shaft body and configured to move the urging part away from the shaft body by moving in the first direction in such a manner as to go into a gap between the shaft body and the urging part.

(((2)))

[0092] The transport device according to (((1))), further comprising: [0093] a receiving part provided on the outer peripheral side of the shaft body and being movable from a first position to a second position with a movement of the movable part, the first position being a position where the receiving part transmits an urging force of the urging part to the shaft body, the second position being a position that is shifted from the first position in the first direction and where the receiving

part is free from the urging force.
(((3)))
[0094] The transport device according to (((2))), [0095] wherein the movable part includes a tapered portion that is inclined toward the receiving part and that is to receive the urging force.
(((4)))
[0096] The transport device according to (((3))), [0097] wherein the urging part has a circular sectional shape and is positioned such that a central portion of the urging part is in contact with the receiving part with two ends of the urging part being supported at respective locations across the shaft body from each other in the transport direction, and [0098] wherein when the receiving part is at the first position, a distal end of the tapered portion is located closer to the shaft body than a center of the central portion.
(((5)))
[0099] The transport device according to any of (((2))) to (((4))), [0100] wherein the movable part includes a returning member located apart from the receiving part in the first direction and projecting toward the shaft body, the returning member being configured to move the receiving part along with the movable part in an opposite direction that is opposite to the first direction.
(((6)))
[0101] The transport device according to any of (((2))) to (((5))), [0102] wherein the movable part includes a handle provided for an operator to operate in moving the movable part in the first direction or the opposite direction.
(((7)))
[0103] An image forming apparatus comprising: [0104] the transport device according to any of (((1))) to (((6))); and [0105] an image forming unit configured to form an image on the medium transported by the transport device.

Claims

1. A transport device comprising: a shaft body provided with a transport member configured to transport a medium, the shaft body extending in a first direction intersecting a transport direction in which the medium is to be transported, the shaft body being rotatably supported; an urging part configured to apply a nipping pressure to the transport member by urging the shaft body from an outer peripheral side of the shaft body; and a movable part supported independently of the shaft body and configured to move the urging part away from the shaft body by moving in the first direction in such a manner as to go into a gap between the shaft body and the urging part.
2. The transport device according to claim 1, further comprising: a receiving part provided on the outer peripheral side of the shaft body and being movable from a first position to a second position with a movement of the movable part, the first position being a position where the receiving part transmits an urging force of the urging part to the shaft body, the second position being a position that is shifted from the first position in the first direction and where the receiving part is free from the urging force.
3. The transport device according to claim 2, wherein the movable part includes a tapered portion that is inclined toward the receiving part and that is to receive the urging force.
4. The transport device according to claim 3, wherein the urging part has a circular sectional shape and is positioned such that a central portion of the urging part is in contact with the receiving part with two ends of the urging part being supported at respective locations across the shaft body from each other in the transport direction, and wherein when the receiving part is at the first position, a distal end of the tapered portion is located closer to the shaft body than a center of the central portion.
5. The transport device according to claim 2, wherein the movable part includes a returning member located apart from the receiving part in the first direction and projecting toward the shaft

body, the returning member being configured to move the receiving part along with the movable part in an opposite direction that is opposite to the first direction.

6. The transport device according to claim 5, wherein the movable part includes a handle provided for an operator to operate in moving the movable part in the first direction or the opposite direction.

7. An image forming apparatus comprising: the transport device according to claim 1; and an image forming unit configured to form an image on the medium transported by the transport device.

8. An image forming apparatus comprising: the transport device according to claim 2; and an image forming unit configured to form an image on the medium transported by the transport device.

9. An image forming apparatus comprising: the transport device according to claim 3; and an image forming unit configured to form an image on the medium transported by the transport device.

10. An image forming apparatus comprising: the transport device according to claim 4; and an image forming unit configured to form an image on the medium transported by the transport device.

11. An image forming apparatus comprising: the transport device according to claim 5; and an image forming unit configured to form an image on the medium transported by the transport device.

12. An image forming apparatus comprising: the transport device according to claim **6**; and an image forming unit configured to form an image on the medium transported by the transport device.