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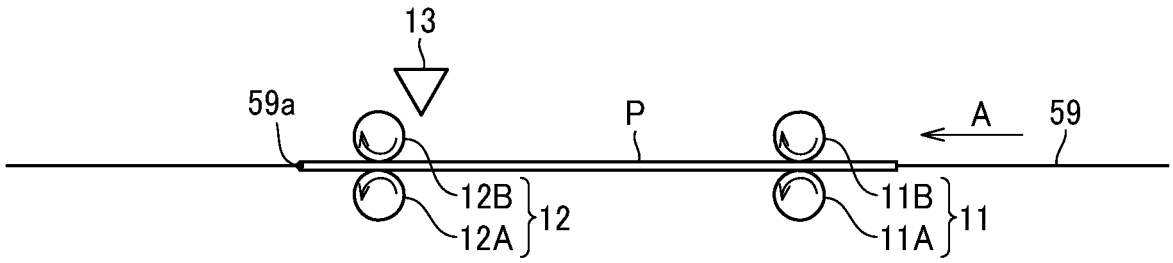
(54) **CONVEYOR AND IMAGE FORMING APPARATUS**

(57) A conveyor (10) includes a pair of upstream conveyance members and a pair of downstream conveyance members (12). The pair of upstream conveyance members (11) rotates to convey a sheet (P) while nipping a sheet (P) at a nip between the pair of upstream conveyance members. The pair of downstream conveyance members (12) disposed downstream from the pair of upstream conveyance members (11) in a sheet conveyance direction, rotates to convey a sheet (P) while nipping the sheet (P) at a nip between the pair of downstream conveyance members. One pair of the pair of upstream conveyance members (11) and the pair of downstream conveyance members (12) idle when the one pair of the pair of upstream conveyance members (11) and the pair of downstream conveyance members (12) rotates in a direction opposite to the sheet conveyance direction.

FIG. 3



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Description

BACKGROUND

Technical Field

[0001] Embodiments of the present disclosure relate to a conveyor and an image forming apparatus.

Related Art

[0002] A conveyor is known that nips a sheet at a nip formed by a pair of rollers as conveyance members that rotate while sliding on each other to convey the sheet in an image forming apparatus. In such an image forming apparatus, the rotation of the pair of rollers is temporarily stopped at a timing at which a sheet is conveyed to the position of the pair of rollers at a position upstream from an image former, and the conveyance of the sheet is stopped in a state in which the pair of rollers nips the sheet. Then, when the rotation of the pair of rollers resumed at desired timing, the sheet can be fed to the image forming device at a desired timing. When a large-size sheet is conveyed, the conveyance of the sheet is stopped and resumed in a state in which the sheet is nipped by different pairs of rollers upstream and downstream in a sheet conveyance direction.

[0003] However, the timing at which the pair of upstream rollers stops and resumes rotating and the timing at which the pair of downstream rollers stops and resumes rotating may shift from each other. For this reason, the sheet may be pulled between the pair of upstream rollers and the pair of downstream rollers. As a result, the sheet may slip. Accordingly, the surface of the sheet may be scratched and slip marks may remain on an image formed on the sheet. Thus, the image quality may deteriorate. In particular, such a problem as described above may be remarkable in a sheet having high rigidity such as thick paper.

[0004] For example, Japanese Unexamined Patent Application Publication No. 2002-370849 discloses a conveyor in which multiple sheet-stop positions are disposed such that a change of an interval between sheets generated at the temporal stop of sheet conveyance is corrected when the sheet conveyance is resumed. In Japanese Unexamined Patent Application Publication No. 2002-370849, the interval between sheets can be corrected.

[0005] However, the conveyor disclosed in Japanese Unexamined Patent Application Publication No. 2002-370849 does not fully solve a problem such as deterioration of image quality caused when a sheet is pulled.

SUMMARY

[0006] An object of the present disclosure is to prevent a sheet from being pulled by a pair of upstream conveyance members and a pair of downstream conveyance members when the conveyance of the sheet is stopped or resumed.

[0007] To solve the above problem, according to an embodiment of the present disclosure, a conveyor includes a pair of upstream conveyance members to rotate and a pair of downstream conveyance members disposed downstream from the pair of upstream conveyance members in a sheet conveyance direction. The pair of upstream conveyance members nip and convey a sheet at a nip between the pair of upstream conveyance members to convey the sheet. The pair of downstream conveyance members nip and convey the sheet at a nip between the pair of downstream conveyance members to convey the sheet. One pair of the pair of upstream conveyance members and the pair of downstream conveyance members idles when rotating in a direction opposite to the sheet conveyance direction.

[0008] According to the present disclosure, a sheet can be prevented from being pulled by a pair of upstream conveyance members and a pair of downstream conveyance members when the conveyance of the sheet is stopped or resumed.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] A more complete appreciation of the disclosure and many of the attendant advantages and features thereof can be readily obtained and understood from the following detailed description with reference to the accompanying drawings, wherein:

FIG. 1 is a diagram illustrating a schematic configuration of an image forming system according to an embodiment of the present disclosure;

FIG. 2 is a diagram illustrating a period signal generator disposed in a transfer cylinder, according to an embodiment of the present disclosure;

FIG. 3 is a side view of a conveyor according to an embodiment of the present disclosure;

FIG. 4 is a flowchart illustrating a procedure in which conveyance of a sheet is stopped and resumed in the conveyor of FIG. 3, according to an embodiment of the present disclosure;

FIGS. 5A and 5B are diagrams illustrating how a sheet is pulled by an upstream conveyance roller pair and a downstream conveyance roller pair, according to an embodiment of the present disclosure;

FIG. 6 is a perspective view of an upstream conveyance roller pair and a driving mechanism of the upstream conveyance roller pair according to an embodiment of the present disclosure;

FIGS. 7A and 7B are cross-sectional views of a one-way clutch according to an embodiment of the present disclosure;

FIG. 8 is a perspective view of a downstream driving roller including a switching mechanism and a driving mechanism of the downstream driving roller, accord-

ing to an embodiment of the present disclosure;

FIG. 9 is a side view of a conveyor in a state in which conveyance of a small-sized sheet is stopped, according to an embodiment of the present disclosure;

FIG. 10 is a flowchart illustrating a procedure in which the switching mechanism of FIG. 8 is turned on or off, according to an embodiment of the present disclosure;

FIG. 11 is a flowchart illustrating a procedure in which conveyance of a sheet is stopped and resumed in the conveyor of FIG. 3, according to an embodiment different from the embodiment illustrated in FIG. 4; and

FIG. 12 is a flowchart illustrating a procedure in which conveyance of a sheet is stopped and resumed in the conveyor of FIG. 3, according to an embodiment different from the embodiment illustrated in FIGS. 4 and 11.

[0010] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted. Also, like or similar reference numerals designate like or similar components throughout the several views.

DETAILED DESCRIPTION

[0011] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

[0012] Referring now to the drawings, embodiments of the present disclosure are described below. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0013] Embodiments of the present disclosure are described below with reference to the drawings in the following description. In the drawings, like reference numerals denote like components and redundant or overlapping descriptions of those components may be simplified or omitted as appropriate.

[0014] An image forming system that includes an image forming apparatus according to an embodiment of the present disclosure is described with reference to FIG. 1 in the following description. The image forming system conveys a sheet of paper as an example of a sheet and forms an image on the sheet.

[0015] FIG. 1 is a diagram illustrating a schematic configuration of an image forming system 1 according to the present embodiment.

[0016] The image forming system 1 according to the present embodiment typically includes a feeding apparatus 100, an application apparatus 200, and an image forming apparatus 300. The image forming system 1 applies treatment liquid to a sheet P, which is a sheet fed from the feeding apparatus 100, in the application apparatus 200. After the treatment liquid has been applied to the sheet P, the image forming system 1 forms an image with ink, which is liquid for image formation, in the image forming apparatus 300, and ejects the sheet P.

[0017] The feeding apparatus 100 includes an upper feeder 110a and a lower feeder 110b as feeders. Each of the upper feeder 110a and the lower feeder 110b includes a feeding tray 130 serving as a sheet stacker on which multiple sheets P are stacked, and a feeding device 120 to separate and feed the sheets P one by one from the feeding tray 130.

[0018] A sheet P fed from the upper feeder 110a is conveyed to a common conveyance path 111 via a first conveyance path 11 1d. A sheet P fed from the lower feeder 110b is conveyed to the common conveyance path 111 via a second conveyance path 111c.

[0019] The common conveyance path 111 is branched to a first conveyance path 111a and a second conveyance path 111b in the middle of the common conveyance path 111. The first conveyance path 111a conveys a sheet P to an application conveyance path 201 via an application device 210 as an application device of the application apparatus 200. The second conveyance path 111b conveys a sheet P to the image forming apparatus 300 without causing the sheet P to pass through the application device 210 of the application apparatus 200. A switching claw 112 is disposed at a position at which the common conveyance path 111 is branched to the first conveyance path 111a and the second conveyance path 11 1b. The switching claw 112 serves as a branching guide to guide a sheet P to the first conveyance path 111a or the second conveyance path 111b. When the treatment liquid is applied to a sheet P, the sheet P is guided by the switching claw 112 and conveyed to the first conveyance path 111a. When the treatment liquid is not applied to a sheet P, the sheet P is guided by the switching claw 112 and conveyed to the second conveyance path 111b.

[0020] A conveyance path 111e in FIG. 1 is a relay conveyance path that conveys a sheet P fed from an optional feeding device attached to the right side of the feeding apparatus 100 in FIG. 1.

[0021] The application apparatus 200 includes the application device 210 as an application device to apply the treatment liquid to a sheet P. The application apparatus 200 includes the application conveyance path 201 that passes through the application device 210 and a relay conveyance path 202 that does not pass through the application device 210. The application conveyance path 201 is connected to the first conveyance path 111a of the feeding apparatus 100, and the relay conveyance path 202 is connected to the second conveyance path 111b of the feeding apparatus 100.

[0022] The application apparatus 200 includes an application reverse conveyance path 203 and an application ejection path 206. The application reverse conveyance path 203 reverses a sheet P onto one side to which the treatment liquid has been applied and conveys the sheet P to the application device 210 again. The sheet P is conveyed via the application ejection path 206 to the image forming apparatus 300.

[0023] The common conveyance path 111 is branched to the application reverse conveyance path 203 and the application ejection path 206 at a position downstream in a sheet conveyance direction from a junction at which the application conveyance path 201 and the relay conveyance path 202 merge. An application switching claw 204 that guides a sheet P to either the application reverse conveyance path 203 or the application ejection path 206 is disposed at a position at which the application reverse conveyance path 203 and the application ejection path 206 are branched.

[0024] A sheet ejection purge 207 is disposed on an upper surface of the application apparatus 200 to eject a sheet P remaining in a conveyance path when a jam occurs. The sheet P that remains on the conveyance path when a jam occurs is conveyed to the application reverse conveyance path 203 and ejected to the sheet ejection purge 207.

[0025] The application device 210 applies the treatment liquid to one side of the sheet P, which is delivered from the first conveyance path 111a of the feeding apparatus 100 to the application conveyance path 201. Thus, a liquid film layer of the treatment liquid is formed on the one side of the sheet P. When the treatment liquid is applied to only one side of the sheet P, the sheet P is guided to the application ejection path 206 by the application switching claw 204 and is conveyed to the image forming apparatus 300.

[0026] On the other hand, when the treatment liquid is applied to both sides of a sheet P, the sheet P is guided to the conveyance path 203 by the application switching claw 204. After the sheet P is switched back on the conveyance path 203, the sheet P is guided to a re-feeding claw 205 and conveyed to the application device 210 again. The other side of the sheet P is applied with the treatment liquid by the application device 210, and the liquid film layer of the treatment liquid is formed on both sides of the sheet P. Subsequently, the sheet P is guided to the application ejection path 206 by the application switching claw 204 and is conveyed to the image forming apparatus 300.

[0027] The sheet P, which is delivered from the second conveyance path 111b of the feeding apparatus 100 to the relay conveyance path 202, is guided to the application ejection path 206 by the application switching claw 204 and is conveyed to the image forming apparatus 300 without being applied with the treatment liquid.

[0028] On the conveyance paths 111a, 111b, 111c, 111d, and 111e of the feeding apparatus 100 and on the application conveyance path 201, the application reverse conveyance path 203, and the application ejection path 206 of the application apparatus 200, multiple conveyance roller pairs to nip and convey the sheet P are disposed. Each of the conveyance roller pairs includes a drive motor, and each of the multiple conveyance roller pairs can be independently controlled to convey a sheet P.

[0029] In addition, sheet sensors 60a, 60b, 61a, 61b, 62, 63, and 64 that detect a sheet P are disposed in the respective conveyance paths 111a, 111b, 111c, 111d, and 111e of the feeding apparatus 100. In addition, the application conveyance path 201 and the application reverse conveyance path 203 of the application apparatus 200 includes sheet sensors 221 and 222, respectively. A sheet conveyance distance from a position at which the sheet sensor 221 detects a sheet P on the application conveyance path 201 to an application nip N of the application device 210 is equal to a sheet conveyance distance from a position at which the sheet sensor 222 detects a sheet P on the application reverse conveyance path 203 to the application nip N of the application device 210.

[0030] A sheet P that is delivered from the first conveyance path 111a of the feeding apparatus 100 to the application conveyance path 201 is nipped and conveyed by the conveyance roller pairs of the application conveyance path 201. Subsequently, the leading end of the sheet P is detected by the sheet sensor 221 of the application conveyance path 201. After the sheet P is conveyed by a predetermined distance, the conveyance of the sheet P is temporarily stopped. Then, the conveyance of the sheet P is resumed at a predetermined timing, and the sheet P is conveyed to the application device 210. The application device 210 applies the treatment liquid to one side of the sheet P. Subsequently, the sheet P is conveyed to the application ejection path 206 and to the image forming apparatus 300.

[0031] On the other hand, when the treatment liquid is applied to both sides of a sheet P, the application switching claw 204 is brought into a posture in which the application switching claw 204 guides the sheet P to the application reverse conveyance path 203. Thus, the sheet P is guided to the application reverse conveyance path 203. When the sheet sensor 222 of the application reverse conveyance path 203 detects the trailing end of the sheet P, the conveyance roller pairs of the application reverse conveyance path 203 are reversely rotated to switch back the sheet P. In addition, the re-feeding claw 205 is rotated by a predetermined angle to change the posture of the re-feeding claw 205 such that the re-feeding claw 205 guides the sheet P to the application device 210. After the leading end of the sheet P is detected by the sheet sensor 222 of the application reverse conveyance path 203 and the sheet P is conveyed by a predetermined distance, the conveyance of the sheet P is temporarily stopped. Then, the conveyance of the sheet P is resumed at a predetermined timing to convey the sheet P to the application device 210, and the other side of the

sheet P is applied with the treatment liquid by the application device 210. Subsequently, the sheet P is conveyed to the application ejection path 206 and to the image forming apparatus 300.

[0032] The image forming apparatus 300 includes the conveyor 10, a transfer cylinder 306, a sheet bearing drum 309, an ink discharger 301, and a transfer cylinder 307.

[0033] The conveyor 10 is disposed upstream from the transfer cylinder 306 in the sheet conveyance direction. The conveyor 10 temporarily stops a conveyed sheet P and conveys the sheet P to the transfer cylinder 306 at a predetermined timing.

[0034] The leading end of the sheet P that has been conveyed to the transfer cylinder 306 is gripped by a sheet gripper disposed on the surface of the transfer cylinder 306, and the sheet P is conveyed as the surface of the transfer cylinder 306 moves. The sheet P that has been conveyed by the transfer cylinder 306 is transferred to the sheet bearing drum 309 at a position facing the sheet bearing drum 309.

[0035] A sheet gripper is also disposed on the surface of the sheet bearing drum 309, and the leading end of the sheet P is gripped by the sheet gripper. In addition, multiple suction holes are dispersedly formed on the surface of the sheet bearing drum 309. Accordingly, a suction air flow directed to the inside of the sheet bearing drum 309 is generated in each of the suction holes by a suction device 308. The leading end of the sheet P that has been transferred from the transfer cylinder 306 to the sheet bearing drum 309 is gripped by the sheet gripper, and the sheet P is attracted to the surface of the sheet bearing drum 309 by the suction air flows and is conveyed as the surface of the sheet bearing drum 309 moves.

[0036] The ink discharger 301 according to the present embodiment discharges ink of four colors of cyan (C), magenta (M), yellow (Y), and black (K) to form an image, and includes individual liquid discharge heads for respective ink of colors. The configuration of the liquid discharge head is not limited to any particular configuration, and the liquid discharge head can adopt any configuration as long as the liquid discharge head discharges liquid. The ink discharger 301 may include, for example, a liquid discharge head to discharge special ink, such as white, gold, and silver, or a liquid discharge head to discharge liquid that does not form an image, such as a surface coating liquid, as needed.

[0037] The discharge operation of the liquid discharge heads of the ink discharger 301 is controlled by a drive signal corresponding to image data. When the sheet P borne on the sheet bearing drum 309 passes through a region facing the ink discharger 301, ink of each of the colors is discharged from the respective liquid discharge head. Thus, an image corresponding to the image data is formed. Note that, in the present embodiment, the image forming apparatus 300 forms an image on a sheet P.

[0038] In addition, the image forming apparatus 300 includes a reverse path 303. When images are formed on both sides of a sheet P, the sheet P is guided to the reverse path 303 by a switching claw 304 disposed at a branch point between the reverse path 303 and the sheet ejection path 302. The sheet P that has been guided to the reverse path 303 is switched back on a switch-back path 303a, guided to a re-feed path 303b by a re-feed claw 305, and conveyed to the ink discharger 301 again. After an image has been formed on the other side of the sheet P by the ink discharger 301, the sheet P is conveyed to the sheet ejection path 302 and ejected.

[0039] On the other hand, when an image is formed on one side of a sheet P, the ink discharger 301 forms the image on the one side of the sheet P. Then, the sheet P is conveyed to the sheet ejection path 302 and ejected.

[0040] FIG. 2 is a diagram illustrating a period signal generator 350 disposed in the transfer cylinder 306, according to the present embodiment.

[0041] As illustrated in FIG. 2, the period signal generator 350 includes a disc-shaped feeler 352 with a part of which being cut out, and an optical sensor 351 to detect the presence or absence of the feeler 352. The feeler 352 is attached to the rotation shaft of the transfer cylinder 306 and rotates integrally with the transfer cylinder 306.

[0042] A period signal is transmitted when the optical sensor 351 switches from a state in which the optical sensor 351 detects the feeler 352 to a state in which the optical sensor 351 does not detect the feeler 352, or when the optical sensor 351 switches from the state in which the optical sensor 351 does not detect the feeler 352 to the state in which the optical sensor 351 detects the feeler 352. Accordingly, a period signal that indicates a rotation period of the transfer cylinder 306 can be generated. Matching the rotation period of the transfer cylinder 306 with the timing at which conveyance of a sheet P by the conveyor 10, to be described below, is resumed, allows the sheet P to be conveyed to the sheet bearing drum 309 at a desired timing. Thus, an image is formed on the surface of the sheet P.

[0043] Next, a configuration of the conveyor 10 disposed upstream from the transfer cylinder 306 in the sheet conveyance direction is described with reference to FIG. 3, according to the present embodiment. Note that, in the present embodiment, the conveyor 10 disposed in the image forming apparatus 300 is described as an example. However, the conveyor 10 according to embodiments of the present disclosure is not limited to such a configuration. In other words, in some embodiments, the conveyor 10 can be disposed at a predetermined position on the sheet conveyance path of the image forming system 1, such as at a position in the feeding apparatus 100, the application apparatus 200, or the image forming apparatus 300.

[0044] As illustrated in FIG. 3, the conveyor 10 includes an upstream conveyance roller pair 11 as a pair of upstream conveyance members, a downstream conveyance roller pair 12 as a pair of downstream conveyance members, and a conveyance sensor 13 as a sensor.

[0045] The upstream conveyance roller pair 11 includes an upstream driving roller 11A and an upstream driven roller 11B. The downstream conveyance roller pair 12 includes a downstream driving roller 12A and a downstream driven roller 12B. The upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 are disposed on a conveyance path 59 and rotate in directions indicated by arrows in FIG. 3. When the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 rotate as described above, each of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 nips a sheet P at corresponding one of a nip between the upstream driving roller 11A and the upstream driven roller 11B and a nip between the downstream driving roller 12A and the downstream driven roller 12B. The conveyance path 59 is a sheet conveyance path in the image forming apparatus 300 that extends from the application ejection path 206 (see FIG. 1). A direction indicated by arrow A illustrated in FIG. 3 is the sheet conveyance direction of the sheet P.

[0046] On the conveyance path 59, the conveyor 10 temporarily stops conveyance of a sheet P to convey the sheet P at a timing in synchronization with the transfer cylinder 306 (see FIG. 1) such that the ink discharger 301 discharges ink to predetermined positions of the sheet P. Specifically, as illustrated in FIG. 3, the leading end of the sheet P is conveyed to a stop position 59a or the vicinity of the stop position 59a, and the sheet P is temporarily stopped at a position at which the sheet P is nipped by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12.

[0047] FIG. 4 is a flowchart illustrating an operation in which the conveyor 10 temporarily stops and resumes the conveyance of a sheet P, according to the present embodiment.

[0048] As illustrated in FIG. 4, when a predetermined time has elapsed after the conveyance sensor 13 is turned on to detect a sheet P (steps S1 and S2), the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 stop rotating to stop the conveyance of the sheet P (step S3). Subsequently, the rotation of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 and the conveyance of the sheet P are resumed after a predetermined time has elapsed from a timing at which the period signal of the transfer cylinder 306 is turned on (steps S4, S5, and S6). Such a configuration as described above allows the sheet P to be conveyed in accordance with the rotation of the transfer cylinder 306. Accordingly, the sheet P can be conveyed to the ink discharger 301 at a desired timing.

[0049] In the conveyor 10 that has such a configuration as described above, when the conveyance of a sheet P by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 is stopped or resumed, a timing at which the upstream conveyance roller pair 11 stops or resumes rotating and a timing at which the downstream conveyance roller pair 12 stops or resumes rotating may be shifted.

[0050] For example, as illustrated in FIG. 5A, the downstream conveyance roller pair 12 may stop rotating at a timing later than a timing at which the upstream conveyance roller pair 11 stops rotating, or the downstream conveyance roller pair 12 may resume rotating at a timing earlier than a timing at which the upstream conveyance roller pair 11 resumes rotating. In this case, the sheet P receives a force to be conveyed in the direction indicated by arrow A by the rotation of the downstream conveyance roller pair 12. On the other hand, since the trailing end of the sheet P is nipped by the upstream conveyance roller pair 11 whose rotation is stopped, a force in directions indicated by dotted arrows is generated in the upstream conveyance roller pair 11. Accordingly, the force acts as a resistance force that prevents the sheet P from moving in the direction indicated by arrow A. In other words, the sheet P is pulled by both the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12. As a result, the surface of the sheet P and the surfaces of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 rub against each other. Accordingly, the surface of the sheet P may be damaged. Further, slip marks may be formed on an image printed on the sheet P. Accordingly, the quality of the image may be deteriorated. As illustrated in FIG. 5B, when the upstream conveyance roller pair 11 stops rotating at a timing later than a timing at which the downstream conveyance roller pair 12 stops rotating or the upstream conveyance roller pair 11 resumes rotating at a timing earlier than a timing at which the downstream conveyance roller pair 12 resumes rotating, the upstream conveyance roller pair 11 rotates in the sheet conveyance direction as illustrated in FIG. 5B. Accordingly, a force that causes the downstream conveyance roller pair 12 to rotate in a direction opposite to the sheet conveyance direction is generated. As a result, similarly, the sheet P is pulled by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12, which causes such a problem as described above. Such damages on the surface of a sheet P and slip marks formed on an image on the sheet P as described above are highly likely to occur in a sheet such as thick paper having a high rigidity. Note that, in the following description, rotation of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 in the sheet conveyance direction is referred to as forward rotation, and rotation of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 in a direction opposite to a direction of the forward rotation is referred to as reverse rotation.

[0051] As an example of a solution to the above-described problem, a configuration of the upstream conveyance roller pair 11 and a driving mechanism of the upstream conveyance roller pair 11 according to the present embodiment is described with reference to FIG. 6. FIG. 6 is a perspective view of the upstream convey-

ance roller pair 11 and the driving mechanism of the upstream conveyance roller pair 11, according to the present embodiment.

[0052] As illustrated in FIG. 6, a drive shaft 11A1 of the upstream driving roller 11A is held by a pulley 15 via a one-way clutch 14. The pulley 15 is connected to a pulley 17 and a motor 18 serving as a drive source of the pulley 17 via a drive belt 16.

[0053] Both ends of a drive shaft 11B1 of the upstream driven roller 11B are held by holders 19. One end of each of springs 20 is fixed to corresponding one of the holders 19. The other end of each of the springs 20 is fixed to, for example, a housing of the image forming apparatus 300 (see FIG. 1). The springs 20 bias the upstream driven roller 11B toward the upstream driving roller 11A via the holders 19. Due to such biasing forces of the springs 20, each of roller portions of the upstream driven roller 11B is pressed against corresponding one of roller portions of the driving roller 11A. Accordingly, a nip is formed between each of the roller portions of the upstream driven roller 11B and the corresponding one of roller portions of the driving roller 11A.

[0054] The driving force of the motor 18 is transmitted to the drive shaft 11A1 via the pulley 17, the drive belt 16, the pulley 15, and the one-way clutch 14. Accordingly, the driving roller 11A is rotated. The above-described rotation of the driving roller 11A drives the driven roller 11B pressed against the driving roller 11A, to rotate. In some embodiments, the relation between the driving roller 11A and the driven roller 11B in an up-and-down direction may be reversed.

[0055] The downstream conveyance roller pair 12 has a configuration similar to the configuration of the upstream conveyance roller pair 11 described above except that the one-way clutch 14 is not provided for the downstream conveyance roller pair 12.

[0056] FIGS. 7A and 7B are cross-sectional views of the one-way clutch 14 according to the present embodiment. In the present embodiment, the cam type one-way clutch 14 is employed.

[0057] As illustrated in FIG. 7A, when the pulley 15 rotates in a counterclockwise direction in FIG. 7A, the pulley 15 and the drive shaft 11A1 are locked and both the pulley 15 and the drive shaft 11A1 rotate. In other words, a rotational force of the pulley 15 is transmitted to the drive shaft 11A1 via rollers of the one-way clutch 14. Thus, the drive shaft 11A1 rotates integrally with the pulley 15. On the other hand, as illustrated in FIG. 7B, when the pulley 15 rotates in a clockwise direction in FIG. 7B, the driving force of the pulley 15 is not transmitted to the drive shaft 11A1. In other words, the driving force of the motor 18 is transmitted to the drive shaft 11A1 via the pulley 15. Accordingly, the drive shaft 11A1 rotates in the counterclockwise direction in FIG. 7A, which is a rotation direction in the sheet conveyance direction. On the other hand, when the drive shaft 11A1 rotates in the clockwise direction as illustrated in FIG. 7B, the pulley 15 does not rotate integrally with the drive shaft 11A1. Accordingly, the driving roller 11A idles.

[0058] As described above, in the present embodiment, the upstream conveyance roller pair 11 idles when the upstream conveyance roller pair 11 rotates in the direction opposite to the sheet conveyance direction. Accordingly, even when only the downstream conveyance roller pair 12 rotates and a force in a direction of the reverse rotation is generated against the upstream conveyance roller pair 11 as illustrated in FIG. 5A, the upstream conveyance roller pair 11 idles. Accordingly, a sheet P is not pulled by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12. Accordingly, such a configuration as described above can prevent the surface of the sheet P from being scratched and slip marks on an image formed on the sheet P from being formed due to slip of the sheet P. Further, only the driving roller of the upstream conveyance roller pair 11 idles during the reverse rotation of the upstream conveyance roller pair 11, and the downstream conveyance roller pair 12 does not idle during the reverse rotation of the downstream conveyance roller pair 12. Accordingly, when the rotation of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 is stopped, the downstream conveyance roller pair 12 acts as a resistance to stop the conveyance of the sheet P.

[0059] As described above, the downstream conveyance roller pair 12 idles during the reverse rotation of the downstream conveyance roller pair 12 in the present embodiment. However, conversely, the upstream conveyance roller pair 11 may idle during the reverse rotation of the upstream conveyance roller pair 11. Accordingly, as illustrated in FIG. 5B, when only the upstream conveyance roller pair 11 rotates and a force in the reverse rotation direction is generated against the downstream conveyance roller pair 12. As a result, the sheet P can be prevented from being pulled by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12.

[0060] Next, the conveyor 10 according to a modification of the above embodiments of the present disclosure is described.

[0061] As illustrated in FIG. 8, the downstream driving roller 12A according to the modification includes, in addition to the one-way clutch 14 described above, a switching mechanism 30 that switches whether the downstream driving roller 12A idles during the reverse rotation.

[0062] The switching mechanism 30 includes, for example, a pulley 31, a drive belt 32, a pulley 33, a switch shaft 34, and an electromagnetic clutch 35. The pulley 31 is attached to the drive shaft 12A1. The drive belt 32 is stretched by the pulley 31 and the pulley 33. The pulley 33 is fixed to the switch shaft 34.

[0063] When the electromagnetic clutch 35 is turned on, the switch shaft 34 and the motor shaft 181 connected to the motor 18 are coupled to each other. Accordingly, a rotational force of the drive shaft 12A1 is transmitted to the motor shaft 181 via the electromagnetic clutch 35,

the switch shaft 34, the pulley 33, the drive belt 32, and the pulley 31 regardless of whether the drive shaft 12A1 rotates in the forward rotation direction or in the reverse rotation direction. In other words, even when the drive shaft 12A1 rotates in the reverse rotation direction and the rotational force of the drive shaft 12A1 is not transmitted from the one-way clutch 14 to the pulley 15, the driving roller 12A does not idle.

[0064] As illustrated in FIG. 9, when a small-sized sheet P1 is conveyed, the electromagnetic clutch 35 of the switching mechanism 30 is turned on. The small-sized sheet P1 is nipped only by the downstream conveyance roller pair 12 at the stop position 59a.

[0065] In a case in which the sheet P1 is nipped only by the downstream conveyance roller pair 12, when the downstream conveyance roller pair 12 idles in the reverse rotation direction, the sheet P does not stop and flows downstream due to inertia when the downstream conveyance roller pair 12 stops rotating. Such a configuration as described above allows the conveyance of the sheet P to be stopped when the downstream conveyance roller pair 12 stops rotating, even if the sheet P1 has a small size.

[0066] As illustrated in FIG. 10, when a print instruction is given to the image forming system 1, the size of a sheet P is determined (step S11). Whether the electromagnetic clutch 35 is turned on or off is determined based on the size of the sheet P (steps S12 and S13).

[0067] It is also possible to intentionally shift a timing at which the rotation of one of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 is stopped or resumed.

[0068] For example, an embodiment illustrated in the flowchart of FIG. 11 is different from the embodiment illustrated in the flowchart of FIG. 4 in that, when the conveyance sensor 13 is turned on to detect a sheet P (step S21), first, only the upstream conveyance roller pair 11 is stopped after a predetermined time has elapsed (steps S22 and 23). Then, after the predetermined time has elapsed, the driving of the downstream conveyance roller pair 12 is stopped (steps S24 and S25). In addition, when the driving of the downstream conveyance roller pair 12 is resumed, first, only the driving of the downstream conveyance roller pair 12 is resumed. Then, after a predetermined time has elapsed, the driving of the upstream conveyance roller pair 11 is resumed (steps S28, S29, and S2A).

[0069] As described above, shifting the timing at which the rotation of one of the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 is stopped or resumed causes only the downstream conveyance roller pair 12 to reliably rotate as illustrated in FIG. 5A when the conveyance of the sheet P is stopped or resumed. Accordingly, a state in which only the upstream conveyance roller pair 11 rotates as illustrated in FIG. 5B can be prevented. In the present modification, the upstream conveyance roller pair 11 includes the above-described one-way clutch 14. Accordingly, the upstream conveyance roller pair 11 idles during the reverse rotation. Accordingly, a sheet P can be reliably prevented from being pulled by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12.

[0070] On the contrary, as illustrated in FIG. 12, when the conveyance of a sheet P is stopped, the downstream conveyance roller pair 12 stops rotating. The upstream conveyance roller pair 11 stops rotating after a predetermined time has elapsed from the stop of rotation of the downstream conveyance roller pair 12 (steps S33 to S35). Then, the downstream conveyance roller pair 12 resumes rotating when the conveyance of the sheet P is resumed. The downstream conveyance roller pair 12 may resume rotating after a predetermined time has elapsed from the resume of the conveyance of the sheet P (steps S38, S39, S3A). Such a configuration as described above causes only the upstream conveyance roller pair 11 to reliably rotate as illustrated in FIG. 5B and prevents only the downstream conveyance roller pair 12 to rotate as illustrated in FIG. 5A. In the present modification, the downstream conveyance roller pair 12 includes the above-described one-way clutch 14 and idles during the reverse rotation. Accordingly, a sheet P can be reliably prevented from being pulled by the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12.

[0071] In the above-described configuration in which the timings at which the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 stop or resume rotating are shifted, not only the timings at which the upstream conveyance roller pair 11 and the downstream conveyance roller pair 12 stop or resume rotating are shifted as illustrated in FIGS. 11 and 12 but also only one of the timings may be shifted.

[0072] Embodiments of the present disclosure are not limited to the embodiments and modification described above, and various modifications and improvements are possible without departing from the gist of the present disclosure.

[0073] The conveyance members included in the pair of upstream conveyance members or the pair of downstream conveyance members according to embodiments of the present disclosure are not limited to the conveyance rollers according to the present embodiment as long as the conveyance members form a nip between the conveyors to convey a sheet. The conveyance member may be an endless conveyance belt. For example, the conveyance belt and a conveyance roller may form a nip to convey a sheet.

[0074] The recording medium may be, in addition to the sheet P, for example, a sheet of plain paper, thick paper, thin paper, a postcard, an envelope, applied paper, art paper, tracing paper, overhead projector (OHP) sheet, plastic film, prepreg, copper foil.

[0075] The above-described embodiments are illustrative and do not limit the present disclosure. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, elements

and/or features of different illustrative embodiments may be combined with each other and/or substituted for each other within the scope of the present disclosure.

[0076] Any one of the above-described operations may be performed in various other ways, for example, in an order different from the one described above.

Claims

1. A conveyor (10) comprising:

a pair of upstream conveyance members (11) to rotate to convey a sheet (P) while nipping a sheet (P) at a nip between the pair of upstream conveyance members; and
a pair of downstream conveyance members (12) disposed downstream from the pair of upstream conveyance members (11) in a sheet conveyance direction, to rotate to convey a sheet (P) while nipping the sheet (P) at a nip between the pair of downstream conveyance members,
wherein one pair of the pair of upstream conveyance members (11) and the pair of downstream conveyance members (12) idles when the one pair of the pair of upstream conveyance members (11) and the pair of downstream conveyance members (12) rotates in a direction opposite to the sheet conveyance direction.

2. The conveyor (10) according to claim 1, further comprising a switching mechanism (30),

wherein the pair of downstream conveyance members (12) idles when the pair of downstream conveyance members (12) rotates in the direction opposite to the sheet conveyance direction, and
wherein the switching mechanism (30) switches whether the pair of downstream conveyance members (12) idles when the pair of downstream conveyance members (12) rotates in the direction opposite to the sheet conveyance direction.

3. The conveyor (10) according to claim 1,

wherein the pair of downstream conveyance members (12) idles when the pair of downstream conveyance members (12) rotates in the direction opposite to the sheet conveyance direction, and
wherein the pair of downstream conveyance members (12) stops rotating at a timing earlier than a timing at which the pair of upstream conveyance members (11) stops rotating when conveyance of the sheet is stopped.

4. The conveyor (10) according to claim 1 or 3,

wherein the pair of downstream conveyance members (12) idles when the pair of downstream conveyance members (12) rotates in the direction opposite to the sheet conveyance direction, and
wherein the pair of upstream conveyance members (11) starts rotating at a timing earlier than a timing at which the pair of downstream conveyance members (12) starts rotating when conveyance of the sheet is resumed from a state in which the conveyance of the sheet is stopped.

5. The conveyor (10) according to claim 1,

wherein the pair of upstream conveyance members (11) idles when the pair of upstream conveyance members (11) rotates in the direction opposite to the sheet conveyance direction, and
wherein the pair of upstream conveyance members (11) stops rotating at a timing earlier than a timing at which the pair of downstream conveyance members (12) stops rotating when conveyance of the sheet is stopped.

6. The conveyor (10) according to claim 1 or 5,

wherein the pair of upstream conveyance members (11) idles when the pair of upstream conveyance members (11) rotates in the direction opposite to the sheet conveyance direction, and
wherein the pair of downstream conveyance members (12) starts rotating at a timing earlier than a timing at which the pair of upstream conveyance members (11) starts rotating when conveyance of the sheet is resumed from a state in which the conveyance of the sheet is stopped.

7. An image forming apparatus (300) comprising:
the conveyor (10) according to any one of claims 1 to 6.

FIG. 1

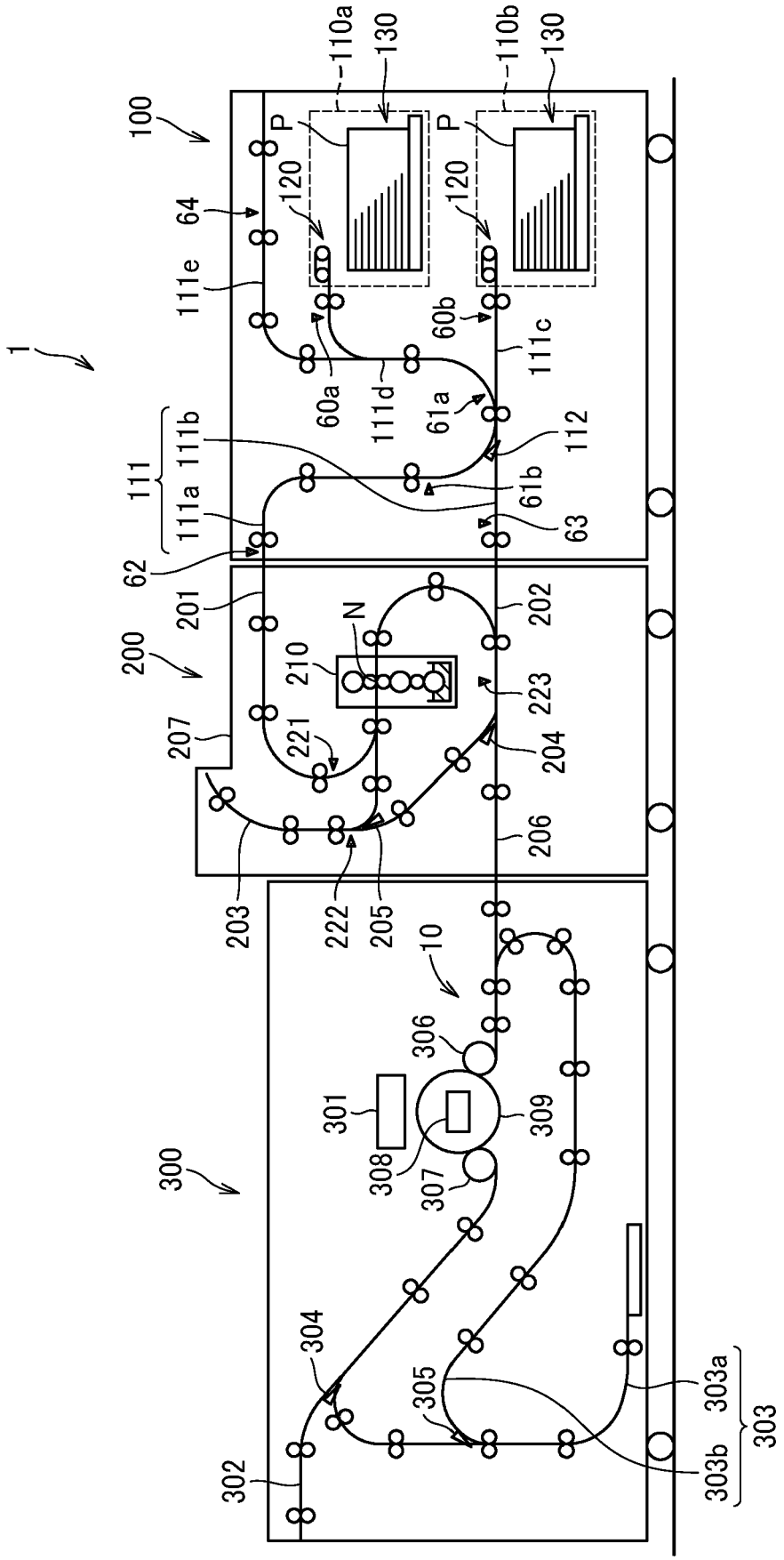

1
100
110a
130
110b
130
P
P
120
120
64
111e
60b
111c
60a
111d
61a
112
111
111b
111a
61b
63
62
200
201
202
N
210
223
207
221
204
206
203
222
205
10
300
306
301
309
308
307
304
305
303a
303b
303
302

FIG. 2

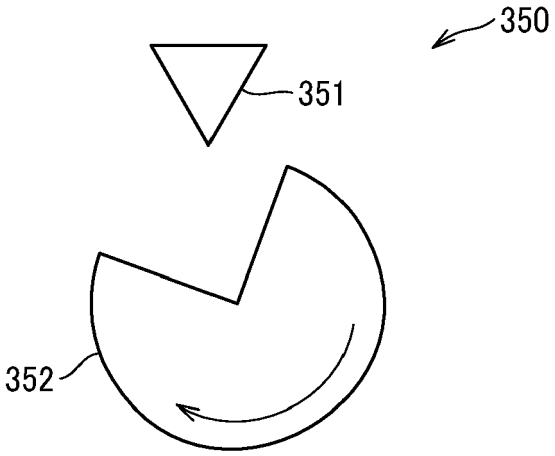


FIG. 3

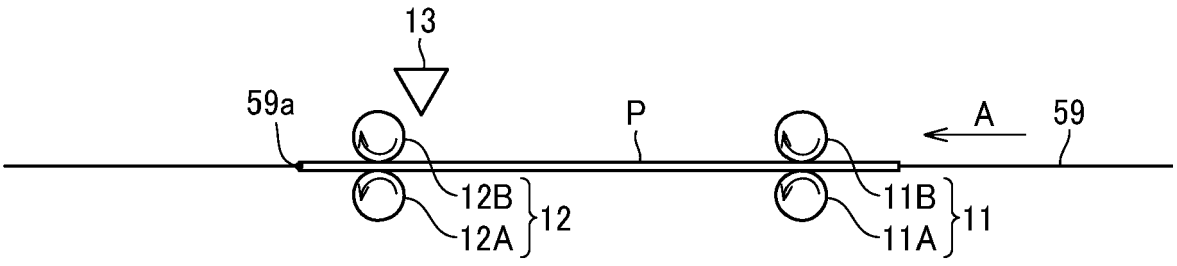


FIG. 4

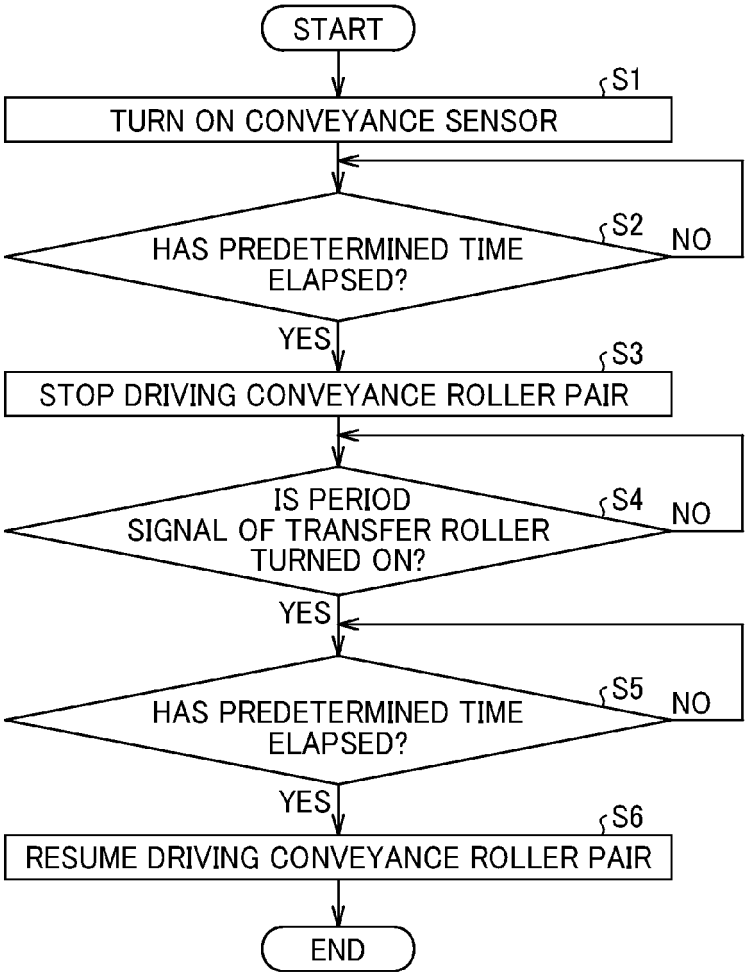


FIG. 5A

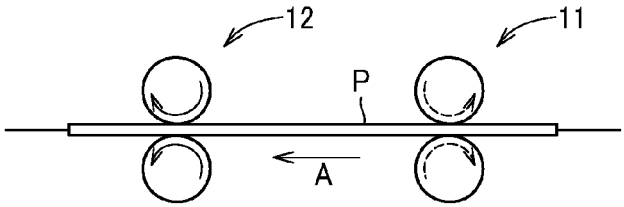


FIG. 5B

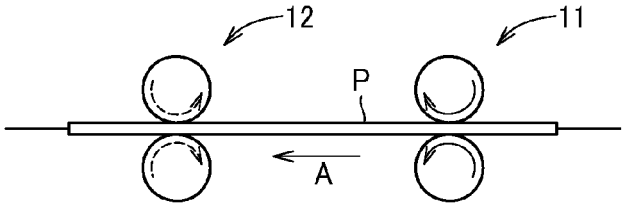


FIG. 6

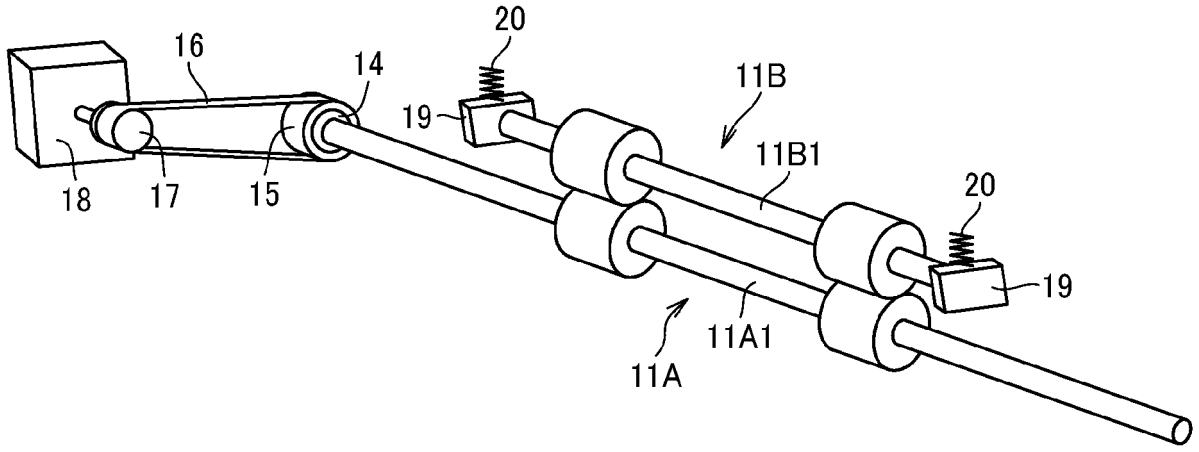


FIG. 7A

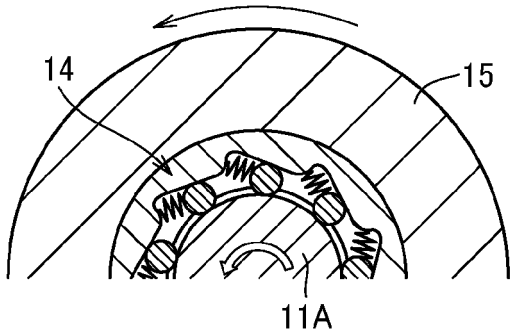


FIG. 7B

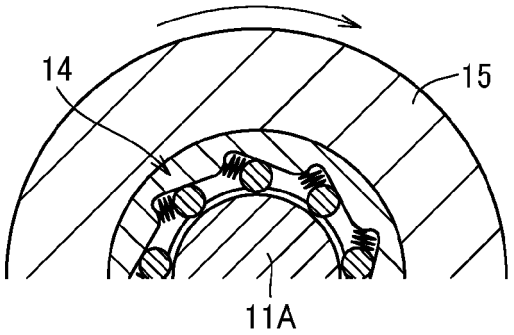


FIG. 8

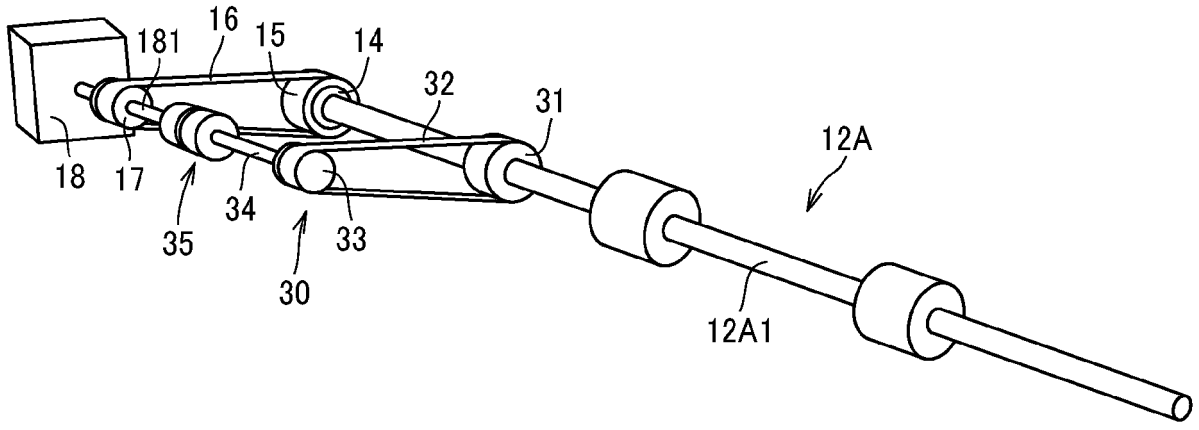


FIG. 9

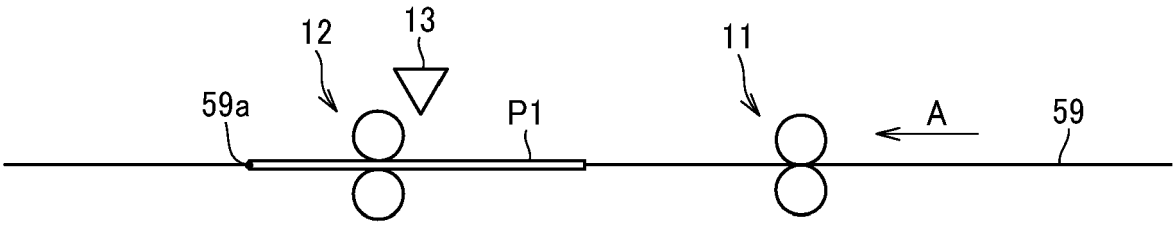

12
13
11
59a
P1
A
59

FIG. 10

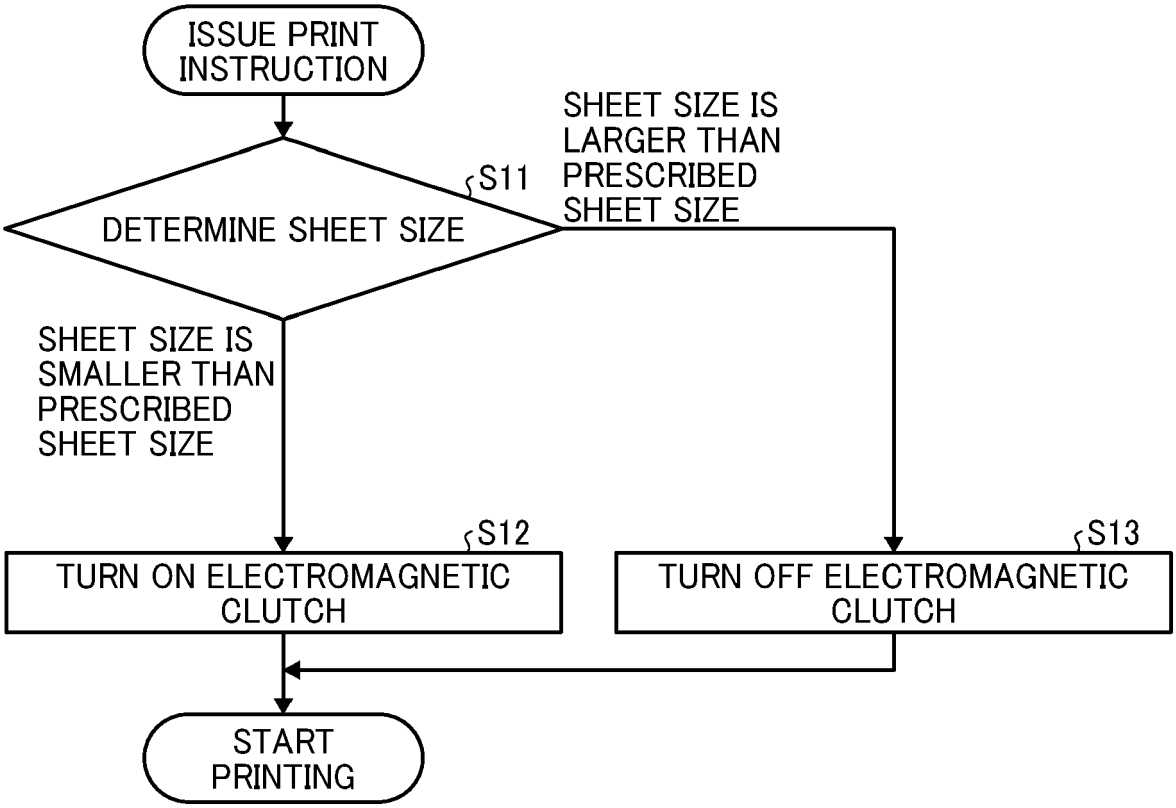

ISSUE PRINT INSTRUCTION
DETERMINE SHEET SIZE
S11
SHEET SIZE IS LARGER THAN PRESCRIBED SHEET SIZE
SHEET SIZE IS SMALLER THAN PRESCRIBED SHEET SIZE
S12
TURN ON ELECTROMAGNETIC CLUTCH
S13
TURN OFF ELECTROMAGNETIC CLUTCH
START PRINTING

FIG. 11

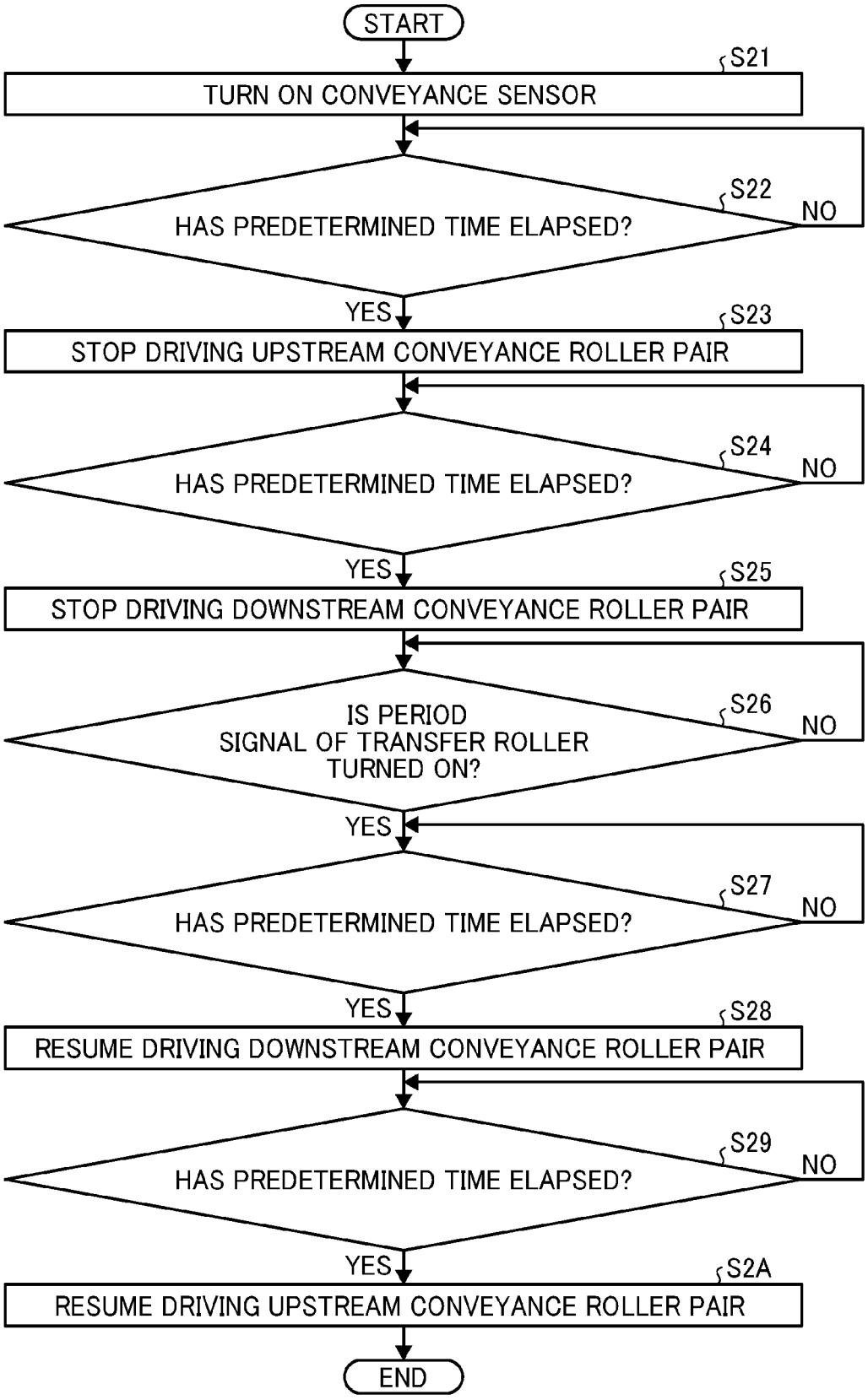
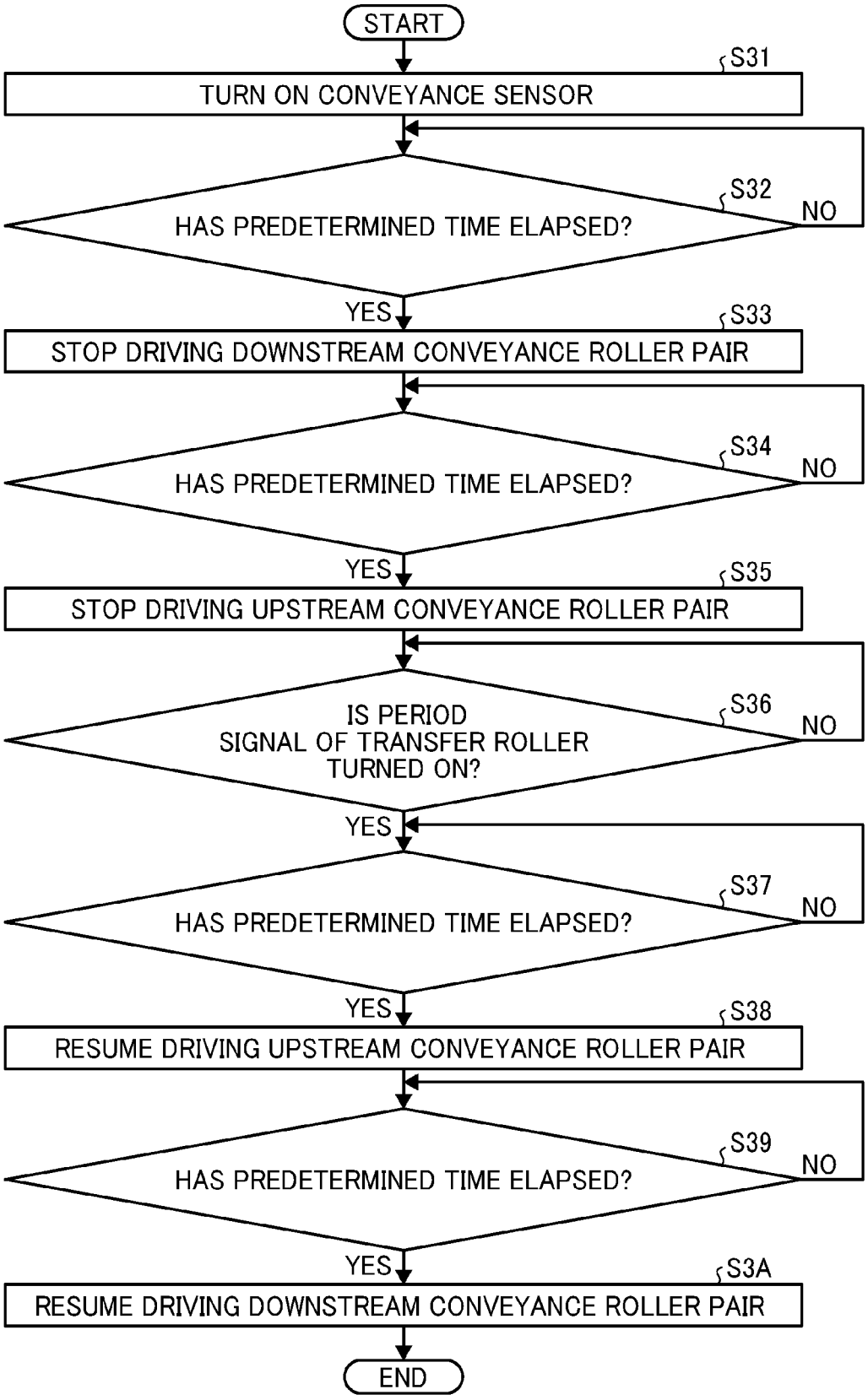

START
S21
TURN ON CONVEYANCE SENSOR
S22
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S23
STOP DRIVING UPSTREAM CONVEYANCE ROLLER PAIR
S24
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S25
STOP DRIVING DOWNSTREAM CONVEYANCE ROLLER PAIR
S26
IS PERIOD SIGNAL OF TRANSFER ROLLER TURNED ON?
NO
YES
S27
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S28
RESUME DRIVING DOWNSTREAM CONVEYANCE ROLLER PAIR
S29
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S2A
RESUME DRIVING UPSTREAM CONVEYANCE ROLLER PAIR
END

FIG. 12


START
S31
TURN ON CONVEYANCE SENSOR
S32
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S33
STOP DRIVING DOWNSTREAM CONVEYANCE ROLLER PAIR
S34
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S35
STOP DRIVING UPSTREAM CONVEYANCE ROLLER PAIR
S36
IS PERIOD SIGNAL OF TRANSFER ROLLER TURNED ON?
NO
YES
S37
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S38
RESUME DRIVING UPSTREAM CONVEYANCE ROLLER PAIR
S39
HAS PREDETERMINED TIME ELAPSED?
NO
YES
S3A
RESUME DRIVING DOWNSTREAM CONVEYANCE ROLLER PAIR
END

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EUROPEAN SEARCH REPORT

Application Number
EP 23 15 8447

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2001 253595 A (RICOH KK) 18 September 2001 (2001-09-18) * the whole document *	1-7	INV. B65H5/06 B65H7/02
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B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 July 2023	Athanasiadis, A

CATEGORY OF CITED DOCUMENTS

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06-07-2023

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