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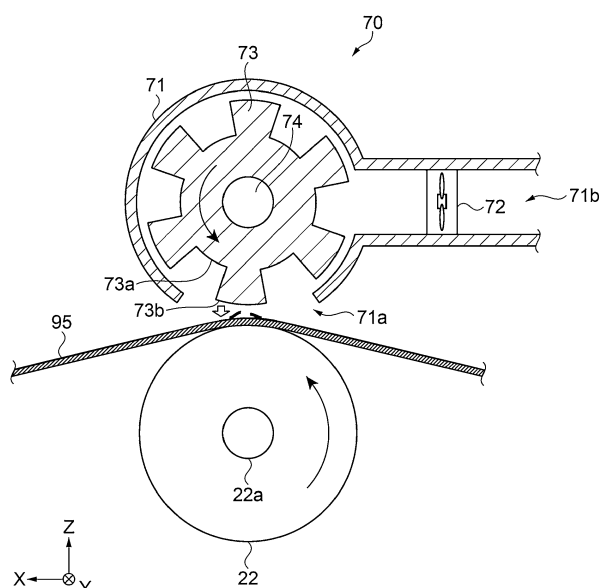
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(54) **PRINTING APPARATUS**

(57) Fluff on a medium is removed without spoiling the aesthetic properties of the medium. A printing apparatus according to this application example includes a transport belt serving as a medium support unit that transports a medium in a transport direction while supporting the medium, a medium supply unit that supplies the medium to the transport belt, a printing unit including a head unit serving as a head that ejects a liquid onto the medium while moving relative to the medium, and a rotating mem-

ber provided in a position facing the medium between the medium supply unit and the printing unit. The rotating member has a rotating shaft longer in an intersecting direction that is orthogonal to the transport direction, and recesses and protrusions that form a repeating uneven surface in a rotation direction of the rotating member. The rotating member is rotated in a state where a predetermined gap is maintained between the rotating member and the medium.

FIG. 3



Description

BACKGROUND

1. Technical Field

[0001] The present invention relates to printing apparatuses.

2. Related Art

[0002] Ink jet printing apparatuses that print images or the like onto a medium such as cotton, silk, or wool by ejecting a liquid such as ink from a head having nozzles have been used for some time. Such a medium has fluff on its surface, and the fluff or dust stirred up by vertical vortices produced by relative movement between the head and the medium during printing may adhere to the head and lead to ejection malfunctions in the nozzles. As such, printing apparatuses having a function for removing the fluff or dust on the surface of the medium (called simply "fluff" hereinafter) before printing have been proposed. For example, JP-A-2015-89636 discloses a printing apparatus that removes deposits adhering to a printing surface of a medium by bringing the printing surface into contact with an adhesive roller.

[0003] However, when removing fluff adhering to the surface of a medium with the printing apparatus according to JP-A-2015-89636, there is a risk that the fluff will be pulled up on the surface of the medium when the adhesive roller and the medium separate, the surface of the medium will be damaged by the adhesive roller, or the like, spoiling the aesthetic properties of the medium.

SUMMARY

[0004] Having been conceived in order to solve at least part of the aforementioned problem, the invention can be implemented as the following aspects or application examples. Application Example 1

[0005] A printing apparatus according to this application example includes a medium support unit that transports a medium in a transport direction while supporting the medium, a medium supply unit that supplies the medium to the medium support unit, a printing unit including a head that ejects a liquid onto the medium while moving relative to the medium, and a rotating member provided in a position facing the medium between the medium supply unit and the printing unit. The rotating member has a rotating shaft longer in an intersecting direction that is orthogonal to the transport direction, and recesses and protrusions that form a repeating uneven surface in a rotation direction of the rotating member. The rotating member is rotated in a state where a predetermined gap is maintained between the rotating member and the medium.

[0006] According to this application example, the printing apparatus includes the rotating member, which has

a rotating shaft longer in the intersecting direction, and the rotating member including recesses and protrusions that form a repeating uneven surface in the rotation direction, the rotating member being located between the medium supply unit and the printing unit. When the rotating member is rotated in a state where the predetermined gap is maintained between the rotating member and the medium, and one of the protrusions in the rotating member faces the surface of the medium, a gas between the medium and the rotating member is compressed, which causes the atmospheric pressure to rise locally at that area. When the rotating member is rotated further and one of the recesses in the rotating member faces the surface of the medium, the gas that has been pressurized by the compression decompresses, producing an airflow moving toward the inside of the recess. Accordingly, fluff adhering to the surface of the medium can be caused to rise and can then be removed. The printing apparatus according to this application example uses compression and decompression of the gas present between the medium and the rotating member to remove the fluff without making contact with the medium, and thus the aesthetic properties of the medium can be maintained.

Application Example 2

[0007] Preferably, the printing apparatus according to the above-described application example further includes a suction unit that suctions the rotating member, and the rotating member rotates under a suction force from the suction unit.

[0008] According to this application example, the printing apparatus includes the suction unit that suctions the rotating member, and the rotating member rotates under the suction force from the suction unit. Accordingly, the rotating member can be rotated efficiently. Furthermore, fluff that has risen from the medium can be collected by the suction force of the suction unit.

Application Example 3

[0009] Preferably, the printing apparatus according to the above-described application example includes a rotating member driving unit that rotates the rotating member, and a suction force is produced by the rotating member driving unit rotating the rotating member.

[0010] According to this application example, the printing apparatus includes the rotating member driving unit that rotates the rotating member, and the rotating member produces a suction force by rotating. Fluff that has risen from the medium can be collected by this suction force.

Application Example 4

[0011] Preferably, in the printing apparatus according to the above-described application example, the prede-

terminated gap is less than or equal to a gap between the head and the medium, and a relative speed between the rotating member and the medium when the rotating member rotates is greater than or equal to a relative speed between the head and the medium when printing onto the medium.

[0012] According to this application example, the gap between the rotating member and the medium is less than or equal to the gap between the head and the medium, and the rotating member rotates such that the relative speed between the rotating member and the medium is greater than or equal to the relative speed between the head and the medium. Accordingly, fluff that may be stirred up from the surface of the medium and adhere to the head during the relative movement of the head and the medium when printing onto the medium can be removed by the rotating member in advance.

Application Example 5

[0013] Preferably, the printing apparatus according to the above-described application example includes a rotating member raising/lowering device that raises/lowers the rotating member.

[0014] According to this application example, the printing apparatus includes the rotating member raising/lowering device that raises/lowers the rotating member, and can therefore handle media of different thicknesses.

Application Example 6

[0015] Preferably, in the printing apparatus according to the above-described application example, the rotating member raising/lowering device changes the predetermined gap in accordance with a type of the medium.

[0016] According to this application example, the rotating member raising/lowering device of the printing apparatus changes the gap between the rotating member and the medium in accordance with the type of the medium, and thus fluff adhering to the surface of the medium can be favorably removed.

Application Example 7

[0017] Preferably, the printing apparatus according to the above-described application example includes a detection unit that detects a height of the medium, and the rotating member raising/lowering device changes the predetermined gap in accordance with the height of the medium detected by the detection unit.

[0018] According to this application example, the printing apparatus includes the detection unit that detects the height of the medium, and the rotating member raising/lowering device changes the gap between the rotating member and the medium in accordance with the height of the medium detected by the detection unit, and thus fluff adhering to the surface of the medium can be favorably removed.

Application Example 8

[0019] Preferably, in the printing apparatus according to the above-described application example, the rotating member has the recesses and the protrusions forming a repeating uneven surface in the intersecting direction.

[0020] According to this application example, the rotating member has the recesses and the protrusions forming a repeating uneven surface in the intersecting direction. Accordingly, the recesses are defined by the protrusions formed in the rotation direction and the intersecting direction, and thus the force of the airflow produced when the compressed gas is decompressed by the recesses can be increased.

Application Example 9

[0021] Preferably, in the printing apparatus according to the above-described application example, the protrusions in the rotating member have chamfered portions in which at least one end portion along the rotation direction is chamfered.

[0022] According to this application example, the protrusions in the rotating member have chamfered portions in which at least one end portion along the rotation direction is chamfered, and thus the effect of the protrusions compressing the gas can be increased. Additionally, damage to the medium can be reduced in situations where fluff having extended threads makes contact with the protrusions.

Application Example 10

[0023] Preferably, in the printing apparatus according to the above-described application example, the recesses in the rotating member are formed as concave depressions.

[0024] According to this application example, the recesses in the rotating member are formed as concave depressions. Accordingly, a spiral airflow is produced when the compressed gas is decompressed by the recesses, and thus the force of the airflow can be increased.

Application Example 11

[0025] Preferably, in the printing apparatus according to the above-described application example, the protrusions in the rotating member are formed having a broader surface area than the recesses.

[0026] According to this application example, the protrusions in the rotating member have a broader surface area than the recesses, and thus the effect of the protrusions compressing the gas can be increased.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Embodiments of the invention will now be described by way of example only with reference to the

accompanying drawings, wherein like numbers reference like elements.

Fig. 1 is a schematic diagram illustrating the overall configuration of a printing apparatus according to a first embodiment.

Fig. 2 is a side view illustrating the configuration of a fluff removal section.

Fig. 3 is a cross-sectional view illustrating operations of the fluff removal section.

Fig. 4 is a perspective view illustrating the shape of a rotating member.

Fig. 5 is a cross-sectional view illustrating operations of the fluff removal section.

Fig. 6 is a cross-sectional view illustrating operations of the fluff removal section.

Fig. 7 is an electrical block diagram illustrating the electrical configuration of the printing apparatus.

Fig. 8 is a flowchart illustrating a fluff removal method.

Fig. 9 is a table illustrating a relationship between a medium type, a head height, and a rotating member height.

Fig. 10 is a schematic diagram illustrating the overall configuration of a printing apparatus according to a second embodiment.

Fig. 11 is a plan view illustrating the configuration of a detection unit.

Fig. 12 is a side view illustrating the configuration of the detection unit.

Fig. 13 is a side view illustrating the configuration of a fluff removal section.

Fig. 14 is a cross-sectional view illustrating operations of the fluff removal section.

Fig. 15 is a perspective view illustrating the shape of a rotating member.

Fig. 16 is a cross-sectional view illustrating operations of the fluff removal section.

Fig. 17 is an electrical block diagram illustrating the electrical configuration of the printing apparatus.

Fig. 18 is a flowchart illustrating a fluff removal method.

Fig. 19 is a perspective view illustrating a rotating member according to a first variation.

Fig. 20 is a perspective view illustrating a rotating member according to a second variation.

Fig. 21 is a perspective view illustrating a rotating member according to a third variation.

Fig. 22 is a perspective view illustrating a rotating member according to a fourth variation.

Fig. 23 is a perspective view illustrating a rotating member according to a fifth variation.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0028] Hereinafter, embodiments of the invention will be described with reference to the drawings. Note that the appended drawings depict the measurements of the

various layers and various members as different from their actual measurements in order to illustrate those layers and members at recognizable sizes.

[0029] Figs. 1 to 3, 5, 6, 10 to 14, and 16 illustrate an X axis, a Y axis, and a Z axis as three mutually-orthogonal axes for the sake of simplicity, with the tip side of the arrows indicating the axial directions being "+ sides" and the base end sides being "- sides". A direction parallel to the X axis is called an "X-axis direction", a direction parallel to the Y axis is called a "Y-axis direction", and a direction parallel to the Z axis is called a "Z-axis direction".

First Embodiment

Overall Configuration of Printing Apparatus

[0030] Fig. 1 is a schematic diagram illustrating the overall configuration of a printing apparatus according to a first embodiment. First, the overall configuration of a printing apparatus 100 according to the embodiment will be described with reference to Fig. 1. As an example, the embodiment will describe an ink jet printing apparatus 100 that prints onto a medium 95 by forming an image or the like on the medium 95.

[0031] As illustrated in Fig. 1, the printing apparatus 100 includes a medium transport section 20, a medium contact section 60, a printing unit 40, a drying unit 27, a fluff removal section 70, a cleaning unit 50, and so on. The printing apparatus 100 also includes a controller 1 that controls these elements. The elements of the printing apparatus 100 are attached to a frame portion 90.

[0032] The medium transport section 20 transports the medium 95 in a transport direction. The medium transport section 20 includes a medium supply unit 10, transport rollers 21 and 22, a transport belt 23, a belt rotation roller 24, a belt driving roller 25, transport rollers 26 and 28, and a medium collection unit 30. A transport path of the medium 95, from the medium supply unit 10 to the medium collection unit 30, will be described first. The embodiment assumes that the direction following the force of gravity corresponds to the Z axis, the direction in which the medium 95 is transported in the printing unit 40 is the X axis, and a width direction of the medium 95, orthogonal to both the Z axis and the X axis, is the Y axis. Positional relationships along the transport direction of the medium 95 or a movement direction of the transport belt 23 are also referred to as "upstream" and "downstream".

[0033] The medium supply unit 10 supplies the medium 95, on which an image is to be formed, to the transport belt 23, which serves as a medium support unit. A woven fabric, a nonwoven fabric, or the like constituted of natural fibers, cotton, silk, hemp, mohair, wool, cashmere, regenerated fiber, synthetic fiber, nylon, polyurethane, polyester, a mixed-spun fabric including the foregoing, or the like can be used as the medium 95. A pretreatment agent for facilitating color development, fixation, or the like may be applied to the woven fabric or nonwoven fabric. The medium supply unit 10 includes a supply shaft

part 11 and a shaft bearing part 12. The supply shaft part 11 is formed having a barrel shape or a circular column shape, and is provided to be capable of rotating in a circumferential direction. The medium 95, which has a band shape, is wound upon the supply shaft part 11 as a roll. The supply shaft part 11 is removably attached to the shaft bearing part 12. Accordingly, the medium 95 that is already wound upon the supply shaft part 11 can be attached to the shaft bearing part 12 along with the supply shaft part 11.

[0034] The shaft bearing part 12 rotatably supports both ends of the supply shaft part 11 in the axial direction thereof. The medium supply unit 10 has a rotational driving unit (not illustrated) that rotationally drives the supply shaft part 11. The rotational driving unit rotates the supply shaft part 11 in a direction in which the medium 95 is fed out. The operation of the rotational driving unit is controlled by the controller 1. The transport rollers 21 and 22 relay the medium 95 from the medium supply unit 10 to the transport belt 23 via the fluff removal section 70.

[0035] The transport belt 23 is a medium support unit that transports the medium 95 in the transport direction while supporting the medium 95. The transport belt 23 is held between at least two rollers that rotate the transport belt 23, and the rotational movement of the transport belt 23 transports the medium 95 in the transport direction (the +X-axis direction). Specifically, the transport belt 23 is formed in an endless shape by connecting both end portions of a band-shaped belt, and is stretched between two rollers, namely the belt rotation roller 24 and the belt driving roller 25. The transport belt 23 is held with a predetermined tension applied thereto so that the part thereof between the belt rotation roller 24 and the belt driving roller 25 is horizontal. An adhesive layer 29 to which the medium 95 adheres is provided on a surface (support surface) 23a of the transport belt 23. The transport belt 23 supports (holds) the medium 95 supplied from the transport roller 22 and adhered to the adhesive layer 29 with the medium contact section 60, which will be described later. This makes it possible to handle fabrics and the like that are elastic as the medium 95.

[0036] The belt rotation roller 24 and the belt driving roller 25 support an inner circumferential surface 23b of the transport belt 23. Note that the configuration may be such that a support portion that supports the transport belt 23, such as a roller, is provided between the belt rotation roller 24 and the belt driving roller 25.

[0037] The belt driving roller 25 rotationally drives the transport belt 23, and includes a motor (not illustrated) that rotationally drives the belt driving roller 25. With respect to the transport direction of the medium 95, the belt driving roller 25 is provided downstream from the printing unit 40, and the belt rotation roller 24 is provided upstream from the printing unit 40. When the belt driving roller 25 is rotationally driven, the transport belt 23 rotates along with the rotation of the belt driving roller 25, and the belt rotation roller 24 is rotated by the rotation of the transport belt 23. The medium 95 supported by the trans-

port belt 23 is transported in the transport direction (the +X-axis direction) by the rotation of the transport belt 23, and an image is formed on the medium 95 by the printing unit 40, which will be described later.

[0038] In the embodiment, the medium 95 is supported on a side where the surface 23a of the transport belt 23 faces the printing unit 40 (a +Z-axis side), and the medium 95 is transported from the belt rotation roller 24 side toward the belt driving roller 25 side along with the transport belt 23. Meanwhile, on a side where the surface 23a of the transport belt 23 faces the cleaning unit 50 (a -Z-axis side), only the transport belt 23 moves from the belt driving roller 25 side toward the belt rotation roller 24 side. Although the transport belt 23 is described as including the adhesive layer 29 to which the medium 95 adheres, the configuration is not limited thereto. For example, the transport belt may be an electrostatic attraction-type belt that attracts the medium to the belt with static electricity.

[0039] The transport roller 26 separates the medium 95 on which an image has been formed from the adhesive layer 29 of the transport belt 23. The transport rollers 26 and 28 relay the medium 95 from the transport belt 23 to the medium collection unit 30.

[0040] The medium collection unit 30 collects the medium 95 transported by the medium transport section 20. The medium collection unit 30 includes a take-up shaft part 31 and a shaft bearing part 32. The take-up shaft part 31 is formed having a barrel shape or a circular column shape, and is provided to be capable of rotating in a circumferential direction. The medium 95, which has a band shape, is taken up on the take-up shaft part 31 as a roll. The take-up shaft part 31 is removably attached to the shaft bearing part 32. Accordingly, the medium 95 taken up onto the take-up shaft part 31 can be removed along with the take-up shaft part 31.

[0041] The shaft bearing part 32 rotatably supports both ends of the take-up shaft part 31 in the axial direction thereof. The medium collection unit 30 has a rotational driving unit (not illustrated) that rotationally drives the take-up shaft part 31. The rotational driving unit rotates the take-up shaft part 31 in a direction in which the medium 95 is taken up. The operation of the rotational driving unit is controlled by the controller 1.

[0042] Next, the elements provided along the medium transport section 20, namely the medium contact section 60, the fluff removal section 70, the printing unit 40, the drying unit 27, and the cleaning unit 50, will be described.

[0043] The medium contact section 60 brings the medium 95 into contact with the transport belt 23. The medium contact section 60 is provided upstream from the printing unit 40 with respect to the transport direction (on the -X-axis side). The medium contact section 60 includes a pressure roller 61, a pressure roller driving unit 62, and a roller support portion 63. The pressure roller 61 is formed having a barrel shape or a circular column shape, and is provided to be capable of rotating in a circumferential direction. The pressure roller 61 is arranged with the axial direction thereof to intersect with the trans-

port direction, so as to rotate in a direction corresponding to the transport direction. The roller support portion 63 is provided on the inner circumferential surface 23b side of the transport belt 23, facing the pressure roller 61 with the transport belt 23 located therebetween.

[0044] The pressure roller driving unit 62 moves the pressure roller 61 in the transport direction (the +X-axis direction) and in the direction opposite from the transport direction (the -X-axis direction) while pressing the pressure roller 61 downward in the vertical direction (the -Z-axis side). The medium 95 overlapping the transport belt 23 is pressed against the transport belt 23 between the pressure roller 61 and the roller support portion 63. Accordingly, the medium 95 can be reliably caused to adhere to the adhesive layer 29 provided on the surface 23a of the transport belt 23, and thus the medium 95 can be prevented from lifting on the transport belt 23.

[0045] The fluff removal section 70 includes a rotating member 73, which will be described later, and is provided in a position between the medium supply unit 10 and the printing unit 40, facing the medium 95. The fluff removal section 70 will be described in detail later.

[0046] The printing unit 40 is arranged above (on the +Z-axis side of) the position where the transport belt 23 is arranged, and prints onto the medium 95 located on the surface 23a of the transport belt 23. The printing unit 40 includes a head unit 42 serving as a head that ejects a liquid onto the medium 95 while moving relative to the medium 95. The printing apparatus 100 according to the embodiment is configured so that the medium 95 and the head unit 42 move relative to each other by the head unit 42 moving, relative to the medium 95, in an intersecting direction that intersects with the transport direction (the width direction of the medium 95). To describe in further detail, the printing unit 40 includes the head unit 42, a carriage 43 in which the head unit 42 is mounted, and a carriage movement section 45 that moves the carriage 43 in the width direction of the medium 95 (the Y-axis direction) intersecting with the transport direction. The head unit 42 according to the embodiment is constituted by a plurality of subunits (not illustrated). Furthermore, each sub-unit includes a plurality of nozzles (not illustrated) that eject, onto the medium 95 located on the transport belt 23, droplets of ink (yellow, cyan, magenta, black, and so on), serving as the liquid, that is supplied from ink supply units (not illustrated).

[0047] The carriage movement section 45 is provided above (on the +Z-axis side of) the transport belt 23. The carriage movement section 45 includes a pair of guide rails 45a and 45b extending in the Y-axis direction. The head unit 42 is supported (via the carriage 43) by the guide rails 45a and 45b so as to be capable of moving back and forth in the Y-axis direction along with the carriage 43.

[0048] The carriage movement section 45 includes a movement mechanism and a power source (not illustrated). For example, a mechanism combining a ball screw with a ball nut, a linear guide mechanism, or the like can

be employed as the movement mechanism. Furthermore, the carriage movement section 45 includes a motor (not illustrated) as the power source for moving the carriage 43 along the guide rails 45a and 45b. Various types of motors can be employed as the motor, such as a stepping motor, a servo motor, or a linear motor. When the motor is driven under the control of the controller 1, the head unit 42 moves in the Y-axis direction along with the carriage 43.

[0049] The drying unit 27 is provided between the transport roller 26 and the transport roller 28. The drying unit 27 dries the ink ejected onto the medium 95. The drying unit 27 includes an IR heater, for example, and can dry the ink ejected onto the medium 95 in a short amount of time by driving the IR heater. Accordingly, the band-shaped medium 95 on which an image or the like has been formed can be taken up onto the take-up shaft part 31.

[0050] The cleaning unit 50 is arranged between the belt rotation roller 24 and the belt driving roller 25 in the X-axis direction. The cleaning unit 50 includes a cleaning section 51, a pressure section 52, and a movement section 53. The movement section 53 moves the cleaning unit 50 as a whole along a floor surface 99, and is fixed to a predetermined position.

[0051] The pressure section 52 is a lifting device constituted by an air cylinder 56 and a ball bushing 57, for example, and brings the cleaning section 51 provided thereabove into contact with the surface 23a of the transport belt 23. The cleaning section 51 cleans, from below (the -Z-axis direction), the surface (support surface) 23a of the transport belt 23 that is stretched between the belt rotation roller 24 and the belt driving roller 25 with a predetermined tension applied thereto and that moves from the belt driving roller 25 toward the belt rotation roller 24.

[0052] The cleaning section 51 includes a cleaning tank 54, a cleaning roller 58, and a blade 55. The cleaning tank 54 is a tank holding cleaning liquid used to clean off ink, foreign objects, and the like adhering to the surface 23a of the transport belt 23, and the cleaning roller 58 and the blade 55 are provided on an inner side of the cleaning tank 54. For example, water, a watersoluble solvent (an alcohol aqueous solution or the like), or the like can be used as the cleaning liquid, and a surfactant, a defoaming agent, or the like may be added thereto as necessary.

[0053] When the cleaning roller 58 rotates, the cleaning liquid is supplied to the surface 23a of the transport belt 23, and the cleaning roller 58 and the transport belt 23 slide against each other. Accordingly, ink, fibers from the fabric serving as the medium 95, and so on adhering to the transport belt 23 are removed with the cleaning roller 58.

[0054] The blade 55 can be formed from a flexible material such as silicon rubber, for example. The blade 55 is provided downstream from the cleaning roller 58 with respect to the transport direction of the transport belt 23. Cleaning liquid remaining on the surface 23a of the trans-

port belt 23 is removed by the blade 55 and the transport belt 23 sliding against each other.

[0055] Fig. 2 is a side view illustrating the configuration of the fluff removal section. Figs. 3, 5, and 6 are cross-sectional views illustrating operations of the fluff removal section. Fig. 4 is a perspective view illustrating the shape of the rotating member. The configuration of the fluff removal section 70 will be described next with reference to Figs. 2 to 4. In Figs. 3, 5, and 6, white arrows indicate the direction of an airflow.

[0056] The fluff removal section 70 removes, in advance, fluff stirred up from the medium 95 by vortices in the vertical direction (the Z-axis direction) produced by relative movement between the head unit 42 and the medium during printing.

[0057] As illustrated in Figs. 2 and 3, the fluff removal section 70 is provided above (on the +Z-axis side of) the transport roller 22. The transport roller 22 has a circular column shape longer in the intersecting direction, and includes a rotating shaft 22a in the center thereof. The transport roller 22 is rotatably supported on the frame portion 90 by the rotating shaft 22a.

[0058] The fluff removal section 70 includes the rotating member 73, a suction unit 72 that suctions the rotating member 73, and a housing 71 that covers the rotating member 73 and the suction unit 72.

[0059] The rotating member 73 has a circular column shape longer in the intersecting direction than the width of the medium 95, and includes a rotating shaft 74 in the center thereof. The rotating member 73 is rotatably supported on a rotating member raising/lowering device 75 erected from the frame portion 90 by the rotating shaft 74. The rotating member 73 rotates in a circumferential direction.

[0060] The rotating member 73 has recesses 73a and protrusions 73b that form a repeating uneven surface in the rotation direction of the rotating member 73 (the circumferential direction). Due to the recesses 73a and the protrusions 73b, the rotating member 73 has a gear shape when viewed as a cross-section from the Y-axis direction, and forms a rectangle longer in the Y-axis direction when viewed in plan view. The rotating member 73 can be formed by extrusion using a material such as aluminum, injection molding using a material such as a resin, or the like. The rotating member 73 may be formed in segments in the intersecting direction, or may be formed as a single integrated part. Note that the recesses 73a and the protrusions 73b in the rotating member 73 may be formed in a spiral shape along the Y-axis direction, although they need not be.

[0061] The housing 71 covers the rotating member 73 in a barrel shape manner, and has a suction port 71a in a position facing the medium 95 on the transport roller 22. The housing 71 also has a barrel-shaped exhaust port 71b extending in the -X-axis direction, and the suction unit 72 that suctions the rotating member 73 is provided inside the exhaust port 71b. The suction unit 72 is what is known as a rotating fan. When the suction unit

72 is driven, an airflow moving away from the suction port 71a toward the exhaust port 71b is produced by suction force from the suction unit 72, and the rotating member 73 rotates from the suction port 71a toward the exhaust port 71b. Accordingly, the rotating member 73 is rotated efficiently by the suction unit 72, without needing to be powered. Note that a collection unit (not illustrated) that collects fluff is provided in the exhaust port 71b of the housing 71.

[0062] The rotating member raising/lowering device 75 raises and lowers the fluff removal section 70, including the rotating member 73, in the Z-axis direction. The rotating member raising/lowering device 75 includes a movement mechanism and a power source (not illustrated). For example, a mechanism combining a ball screw with a ball nut, a linear guide mechanism, or the like can be employed as the movement mechanism. Furthermore, a motor (not illustrated) is provided in the rotating member raising/lowering device 75 as a power source for moving the fluff removal section 70 in the Z-axis direction. Various types of motors can be employed as the motor, such as a stepping motor, a servo motor, or a linear motor. The rotating member raising/lowering device 75 is controlled by the controller 1. This makes it possible to handle media 95 having different thicknesses.

Electrical Configuration

[0063] Fig. 7 is an electrical block diagram illustrating the electrical configuration of the printing apparatus. The electrical configuration of the printing apparatus 100 will be described next with reference to Fig. 7.

[0064] The printing apparatus 100 includes an input device 6 through which print information and the like are inputted, the controller 1 that controls the various elements of the printing apparatus 100, and so on. A desktop or laptop personal computer (PC), a tablet terminal, a mobile terminal, or the like can be used as the input device 6. The input device 6 may be provided as an entity separate from the printing apparatus 100.

[0065] The controller 1 is configured including an interface unit (I/F) 2, a central processing unit (CPU) 3, a storage unit 4, a control circuit 5, and so on. The interface unit 2 sends and receives data between the input device 6 and the controller 1, which handles input signals, images, and so on. The CPU 3 is a computational processing device for controlling the processing of input signals from a detector group 7 of various types of detectors, printing operations carried out by the printing apparatus 100, and so on.

[0066] The storage unit 4 is a storage medium for securing a region that holds programs, a work area, and so on for the CPU 3, and includes a storage element such as a random access memory (RAM) or an electrically erasable programmable read-only memory (EEPROM).

[0067] The controller 1 controls the head unit 42 to eject ink toward the medium 95 using control signals outputted from the control circuit 5. The controller 1 causes the

carriage 43 in which the head unit 42 is mounted to move back and forth in a main scanning direction (the Y-axis direction) by controlling the driving of the motor included in the carriage movement section 45 using control signals outputted from the control circuit 5. The controller 1 causes the transport belt 23 to rotate by controlling the driving of the motor included in the belt driving roller 25 using control signals outputted from the control circuit 5. The medium 95 located on the transport belt 23 moves in the transport direction (the +X-axis direction) as a result.

[0068] An image or the like is formed on the medium 95 through printing operations in which the controller 1 repeats a main scan, in which the carriage movement section 45 and the head unit 42 are controlled so that the head unit 42 (the carriage 43) moves while ink is ejected from ejection heads, and a sub scan, in which the belt driving roller 25 is controlled so that the medium 95 is transported in the transport direction, in an alternating manner.

[0069] The controller 1 controls a voltage of the suction unit 72 using control signals outputted from the control circuit 5, and adjusts the number of rotations of the rotating member 73 by varying the suction force produced by the suction unit 72. The controller 1 causes the rotating member raising/lowering device 75 to rise and lower by controlling the driving of the motor included in the rotating member raising/lowering device 75 using control signals outputted from the control circuit 5.

Fluff Removal Method

[0070] Fig. 8 is a flowchart illustrating a fluff removal method. Fig. 9 is a table illustrating a relationship between a medium type, a head height, and a rotating member height. A method for removing fluff from the medium 95 in the printing operations performed by the printing apparatus 100 will be described next with reference to Figs. 3 and 5 to 9.

[0071] Step S1 is a print information reception step of receiving print information. The controller 1 receives print data, print information, or the like of an image to be recorded on the medium 95, inputted from the input device 6, and stores that data, information, or the like in the storage unit 4.

[0072] Step S2 is a rotating member height determination step of determining the height of the rotating member 73. Information of the type of the medium 95 being used is included in the print information received in step S1. The storage unit 4 holds, in advance, a table indicating a relationship between the medium type, the head height, and the rotating member height, as indicated in Fig. 9, for example.

[0073] Types of the medium 95 that can be printed onto by the printing apparatus 100 are registered in the table held in the storage unit 4. A head height and a rotating member height are defined for each type of the medium 95. "Head height" refers to the height of the head unit 42 relative to the medium 95 (that is, a gap between the

head unit 42 and the medium 95), whereas "rotating member height" refers to the height of the rotating member 73 relative to the medium 95 (a predetermined gap between the rotating member 73 and the medium 95).

For example, cotton contains fluff with long hairs, and the height of the fluff varies greatly, and thus if the type of the medium 95 is cotton, the head height is set to a comparatively high 4 mm. The rotating member 73 will not damage the medium 95 even if the rotating member 73 makes contact with the ends of the fluff, and thus the rotating member height is set to 3.5 mm, which is slightly lower than the head height. Nylon, meanwhile, has a lower fluff height, and thus if the type of the medium 95 is nylon, the head height and the rotating member height are both set to the same 2 mm. In this manner, the predetermined gap between the rotating member 73 and the medium 95 is changed in accordance with the type of the medium. Additionally, the predetermined gap between the rotating member 73 and the medium 95 is set to be less than or equal to the gap between the head unit 42 and the medium 95.

[0074] Step S3 is a rotating member raising/lowering step of raising/lowering the rotating member 73. The controller 1 raises/lowers and holds the rotating member 73 to the rotating member height (the predetermined gap between the rotating member 73 and the medium 95) determined in step S2 by controlling the rotating member raising/lowering device 75.

[0075] Step S4 is a suction step of suctioning the rotating member 73. The controller 1 controls the suction unit 72 to cause the rotating member 73 to rotate under the suction force of the suction unit 72. A relative speed between the rotating member 73 and the medium 95 when the rotating member 73 rotates is preferably greater than or equal to a relative speed between the head unit 42 and the medium 95 when the medium 95 is printed onto.

[0076] The process by which fluff stirred up from the medium 95 is removed by the fluff removal section 70 will be described here.

[0077] The rotating member 73 rotates away from the suction port 71a and toward the exhaust port 71b. As illustrated in Fig. 3, when the rotating member 73 rotates and one of the protrusions 73b approaches the medium 95, a gas present between the rotating member 73 and the medium 95 is compressed by the protrusion 73b toward the medium 95 side such that the atmospheric pressure at that area rises locally.

[0078] As illustrated in Fig. 5, when the rotating member 73 rotates further and one of the recesses 73a reaches a position facing the medium 95, the gas that was compressed to a high-pressure state decompresses, producing an airflow toward the inside of the recess 73a. Due to this airflow, fluff adhering to the surface of the medium 95 rises and moves into the recess 73a along with the gas. The predetermined gap between the rotating member 73 and the medium 95 is changed in accordance with the type of the medium 95, and thus the fluff

can be moved (removed) from the medium 95 in a favorable manner.

[0079] As illustrated in Fig. 6, when the rotating member 73 rotates further and the recess 73a containing the fluff reaches the exhaust port 71b, the fluff is exhausted to the exterior of the fluff removal section 70 under the suction force of the suction unit 72 and is collected. In this manner, the printing apparatus 100 according to the embodiment uses compression and decompression of the gas present between the medium 95 and the rotating member 73 to remove the fluff without making contact with the medium 95, and thus the aesthetic properties of the medium 95 can be maintained.

[0080] As described above, the rotating member 73 rotates with the predetermined gap between the rotating member 73 and the medium 95 being less than or equal to the gap between the head unit 42 and the medium 95, and with the relative speed between the rotating member 73 and the medium 95 being greater than or equal to the relative speed between the head unit 42 and the medium 95. Accordingly, fluff that may be stirred up from the surface of the medium 95 and adhere to the head unit 42 during the relative movement of the head unit 42 and the medium 95 when printing onto the medium 95 can be removed by the fluff removal section 70 in advance.

[0081] Step S5 is a sub-scanning step in which the transport belt 23 is transported in the transport direction. The controller 1 controls the belt driving roller 25 to move in the transport direction. As a result, the medium 95 facing the rotating member 73 upon the transport roller 22 also moves in the transport direction (the +X-axis direction).

[0082] Step S6 is a main scanning step in which ink is ejected toward the medium 95. The controller 1 controls the head unit 42 and the carriage movement section 45 to make a main scan in which ink is ejected toward the medium 95 from the head unit 42 while moving the carriage 43 mounting the head unit 42 in the width direction of the medium 95 (the Y-axis direction) intersecting with the transport direction.

[0083] Step S7 is a step of confirming whether there is a next line of print data. The controller 1 determines whether there is a next line of print data by referring to the print data held in the storage unit 4. If there is a next line of print data (step S7: Yes), the process returns to step S5, and steps S5 to S7 are repeated. As a result, the main scan and the sub scan are repeated whilst suction is continued, and an image or the like is printed onto the medium 95. However, if there is not a next line of print data (step S7: No), the controller 1 stops the driving of the suction unit 72 and ends the printing operations of the printing apparatus 100.

[0084] Although the embodiment describes the rotating member 73 as rotating under the suction force of the suction unit 72, the configuration may be such that the rotating member 73 includes a motor and rotates under the driving of the motor. This makes it possible to easily control the number of rotations of the rotating member 73.

[0085] Additionally, although the embodiment describes a configuration in which the fluff removal section 70 including the rotating member 73 is provided above the transport roller 22 as an example, the configuration may be such that the fluff removal section is provided upstream from the printing unit 40 (above the transport belt 23 serving as the medium support unit, for example).

[0086] Additionally, although the embodiment describes a configuration in which the fluff removal section 70 is provided in a serial head-type printing apparatus 100 that ejects ink onto the medium 95 while moving the head unit 42 in the width direction of the medium 95, the configuration is not limited thereto. The same effects can be achieved by a configuration in which the fluff removal section is provided in a line head-type printing apparatus that ejects ink from a fixed head unit, which is preferably longer than the width of the medium 95, while moving the medium in the transport direction.

[0087] As described thus far, the printing apparatus 100 according to the embodiment can achieve the following effects.

[0088] The printing apparatus 100 includes the rotating shaft 74, which is longer in the intersecting direction (the Y-axis direction), and the rotating member 73, which has the recesses 73a and the protrusions 73b formed along the rotation direction. The printing apparatus 100 also includes the suction unit 72 that suctions the rotating member 73 so as to cause the rotating member 73 to rotate. Accordingly, the rotating member 73 is rotated efficiently by the suction unit 72, without needing to be powered. Furthermore, the fluff that has risen from the medium 95 can be collected by the suction force of the suction unit.

[0089] When the rotating member 73 rotates and one of the protrusions 73b approaches the medium 95 due to the rotating member 73 rotating, a gas present between the rotating member 73 and the medium 95 is compressed by the protrusion 73b toward the medium 95 side such that the atmospheric pressure at that area rises locally. When the rotating member 73 rotates further and one of the recesses 73a reaches a position facing the medium 95, the gas that was compressed to a high-pressure state decompresses, producing an airflow toward the inside of the recess 73a. When the rotating member 73 rotates further and the recess 73a containing the fluff reaches the exhaust port 71b, the fluff is exhausted to the exterior of the fluff removal section 70 under the suction force of the suction unit 72 and is collected. The printing apparatus 100 uses compression and decompression of the gas present between the medium 95 and the rotating member 73 to remove the fluff without making contact with the medium 95, and thus the aesthetic properties of the medium 95 can be maintained.

[0090] The printing apparatus 100 includes the rotating member raising/lowering device 75 that raises/lowers the rotating member 73, and can therefore handle media 95 of different thicknesses.

[0091] Additionally, the printing apparatus 100 chang-

es the predetermined gap between the rotating member 73 and the medium 95 in accordance with the type of the medium 95, and thus the fluff can be removed from the medium 95 in a favorable manner.

[0092] The rotating member 73 of the printing apparatus 100 rotates with the predetermined gap between the rotating member 73 and the medium 95 being less than or equal to the gap between the head unit 42 and the medium 95, and with the relative speed between the rotating member 73 and the medium 95 being greater than or equal to the relative speed between the head unit 42 and the medium 95. Accordingly, fluff that may be stirred up from the surface of the medium 95 and adhere to the head unit 42 during the relative movement of the head unit 42 and the medium 95 when printing onto the medium 95 can be removed by the fluff removal section 70 in advance.

Second Embodiment

[0093] Fig. 10 is a schematic diagram illustrating the overall configuration of a printing apparatus according to a second embodiment. Fig. 11 is a plan view illustrating the configuration of a detection unit. Fig. 12 is a side view illustrating the configuration of the detection unit. Fig. 13 is a side view illustrating the configuration of a fluff removal section. First, the overall configuration of a printing apparatus 200 according to the embodiment will be described with reference to Figs. 10 to 13. Hereinafter, constituent elements that are the same as those in the first embodiment will be given the same reference numerals, and descriptions thereof will be omitted.

[0094] As illustrated in Fig. 10, the printing apparatus 200 includes the medium transport section 20, the medium contact section 60, the printing unit 40, the drying unit 27, a fluff removal section 170, the cleaning unit 50, a detection unit 180, and so on.

[0095] The detection unit 180 is provided between the printing unit 40 and the belt rotation roller 24, and detects the height of the medium 95. As illustrated in Figs. 11 and 12, the detection unit 180 is constituted by a first detection unit 181, a second detection unit 182, a third detection unit 183, a fourth detection unit 184, and a reflecting portion 185. The first to fourth detection units 181, 182, 183, and 184 are localized to one side in the width direction of the transport belt 23 (the -Y-axis side).

[0096] As illustrated in Fig. 11, the first detection unit 181, the second detection unit 182, the third detection unit 183, and the fourth detection unit 184 are provided in that order from the upstream to downstream in the transport direction. Additionally, as illustrated in Fig. 12, the first detection unit 181, the second detection unit 182, the third detection unit 183, and the fourth detection unit 184 are provided so that the installation positions thereof become higher, in that order, upward from the transport belt 23 (the +Z-axis direction).

[0097] As illustrated in Fig. 11, the reflecting portion 185 is provided on the other side in the width direction

of the transport belt 23 (the +Y-axis side). The reflecting portion 185 is arranged facing the first to fourth detection units 181, 182, 183, and 184 with the transport belt 23 located therebetween in the width direction. The reflecting portion 185 reflects light L emitted by the first to fourth detection units 181, 182, 183, and 184.

[0098] The first to fourth detection units 181, 182, 183, and 184 are reflective photosensors, each including a light-emitting unit (not illustrated) that emits light and a light-receiving unit (not illustrated) that receives light. The first to fourth detection units 181, 182, 183, and 184 receive the light L emitted from the light-emitting units and reflected by the reflecting portion 185, and output voltages based on the received light amounts to the controller 1.

[0099] Although the detection unit 180 is described as including the first to fourth detection units 181, 182, 183, and 184, the number thereof may be changed for example in accordance with the type of the medium 95. Additionally, the detection unit 180 may be constituted by a plurality of transmissive photosensors.

[0100] When the medium 95 is located on the transport belt 23, the voltages outputted from the first to fourth detection units 181, 182, 183, and 184 change. The controller 1 can therefore detect the height of the medium 95. For example, if a thick piece of cotton is located on the transport belt 23 as the medium 95, the thickness (height) of the cotton blocks the light L from the first and second detection units 181 and 182, which are installed at a low height, and thus the first and second detection units 181 and 182 do not receive the light L. The third detection unit 183 outputs a low voltage value, due to part of the light-receiving unit thereof being blocked, whereas the fourth detection unit 184 outputs a high voltage value, due to the entire light-receiving unit thereof receiving the light L. In this manner, the height of the medium 95 can be detected on the basis of the voltages outputted from the first to fourth detection units 181, 182, 183, and 184.

[0101] Fig. 13 is a side view illustrating the configuration of the fluff removal section. Figs. 14 and 16 are cross-sectional views illustrating operations of the fluff removal section. Fig. 15 is a perspective view illustrating the shape of a rotating member. The configuration of the fluff removal section 170 will be described next with reference to Figs. 13 to 16. In Figs. 14 and 16, white arrows indicate the direction of an airflow.

[0102] As illustrated in Figs. 13 and 14, the fluff removal section 170 is provided above (on the +Z-axis side of) the transport roller 22. The fluff removal section 170 includes a rotating member 173, a rotating member driving unit 176, and a housing 171 that covers the rotating member 173.

[0103] The rotating member 173 is what is known as a cross-flow fan, in which a plurality of disk-shaped partition plates 175 are arranged substantially parallel to each other and a plurality of crescent-shaped vanes 177 are erected circumferentially between the partition plates

175. The rotating member 173 has a circular column shape longer in the intersecting direction than the width of the medium 95, and includes a rotating shaft 174 in the center of the partition plates 175 on both ends. The rotating member 173 is rotatably supported on the rotating member raising/lowering device 75 erected from the frame portion 90 by the rotating shaft 174. The rotating member driving unit 176 that rotates the rotating member 173 is provided at one end of the rotating shaft 174, and the rotating member 173 rotates in the circumferential direction.

[0104] The rotating member 173 has recesses 173a and protrusions 173b formed along the rotation direction. The protrusions 173b are formed by the leading ends of the vanes 177, and the recesses 173a are formed as bottomless recesses 173a between adjacent ones of the vanes 177. The rotating member 173 can be formed by extrusion using a material such as aluminum, injection molding using a material such as a resin, or the like. The rotating member 173 may be formed in segments in the intersecting direction, or may be formed as a single integrated part.

[0105] The housing 171 covers the rotating member 173 with a barrel shape, and has a suction port 171a in a position facing the medium 95 on the transport roller 22, and a rectangular exhaust port 171b extending in the -X-axis direction. When the rotating member 173 rotates away from the suction port 171a and toward the exhaust port 171b, a suction force is produced from the suction port 171a toward the exhaust port 171b. Note that a collection unit (not illustrated) that collects fluff is provided in the exhaust port 171b of the housing 171. Electrical Configuration

[0106] Fig. 17 is an electrical block diagram illustrating the electrical configuration of the printing apparatus. The electrical configuration of the printing apparatus 200 will be described next with reference to Fig. 17.

[0107] The controller 1 analyzes the voltage values outputted from the first to fourth detection units 181, 182, 183, and 184, and finds the height of the medium 95. Additionally, the controller 1 outputs control signals from the control circuit 5 in accordance with the height of the medium 95 in order to change a predetermined gap between the rotating member 173 and the medium 95, and raises/lowers the rotating member raising/lowering device 75 by controlling the driving of the motor included in the rotating member raising/lowering device 75. Furthermore, the controller 1 causes the rotating member 173 to rotate at a desired rotation number by controlling the rotating member driving unit 176 using control signals outputted from the control circuit 5.

Fluff Removal Method

[0108] Fig. 18 is a flowchart illustrating a fluff removal method. A method for removing fluff from the medium 95 in the printing operations performed by the printing apparatus 200 will be described next with reference to Fig.

18. In the flowchart illustrated in Fig. 18, step S101 is the same as step S1 described in the first embodiment and steps S105 to S107 are the same as steps S5 to S7 described in the first embodiment, and thus these steps will not be described.

[0109] Step S102 is a medium height detection step of detecting the height of the medium 95. The controller 1 detects the height of the medium 95 from the voltage values outputted from the first to fourth detection units 181, 182, 183, and 184.

[0110] Step S103 is a rotating member raising/lowering step of raising/lowering the rotating member 173. The controller 1 changes the predetermined gap between the rotating member 173 and the medium 95 in accordance with the height of the medium 95 detected by the first to fourth detection units 181, 182, 183, and 184, by controlling the rotating member raising/lowering device 75. Accordingly, fluff adhering to the surface of the medium 95 can be favorably removed. At this time, the controller 1 sets the predetermined gap between the rotating member 173 and the medium 95 to be substantially the same as the gap between the head unit 42 and the medium 95.

[0111] Step S104 is a rotating member driving step of rotationally driving the rotating member 173. The controller 1 causes the rotating member 173 to rotate by controlling the rotating member driving unit 176. At this time, the controller sets a relative speed between the rotating member 173 and the medium 95 to greater than or equal to a relative speed between the head unit 42 and the medium 95 when the medium 95 is printed onto.

[0112] The process by which fluff stirred up from the medium 95 is removed by the fluff removal section 170 will be described here.

[0113] The rotating member 173 rotates away from the suction port 171a and toward the exhaust port 171b. As illustrated in Fig. 14, when the rotating member 173 rotates and one of the protrusions 173b, corresponding to the leading end of one of the vanes 177, approaches the medium 95, a gas present between the rotating member 173 and the medium 95 is compressed by the protrusion 173b toward the medium 95 side such that the atmospheric pressure at that area rises locally. The vanes 177 have crescent shapes tracing an arc in the rotation direction, and thus the gas can be favorably compressed at the leading ends thereof.

[0114] As illustrated in Fig. 16, when the rotating member 173 rotates further and one of the recesses 173a reaches a position facing the medium 95, the gas that was compressed to a high-pressure state decompresses, producing an airflow toward the recess 173a. Fluff adhering to the surface of the medium 95 rises due to this airflow. Additionally, because the rotating member driving unit 176 rotates the rotating member 173, a suction force moving from the suction port 171a, through the recesses 173a, and toward the exhaust port 171b is produced in the rotating member 173. Accordingly, the fluff that has risen from the medium 95 is exhausted to the exterior of the fluff removal section 170 and is collected.

In this manner, the printing apparatus 200 according to the embodiment uses the suction force produced by the rotation of the rotating member 173, and the compression and decompression of the gas present between the medium 95 and the rotating member 173, to remove the fluff without making contact with the medium 95, and thus the aesthetic properties of the medium 95 can be maintained.

[0115] As described thus far, the printing apparatus 200 according to the embodiment can achieve the following effects.

[0116] The printing apparatus 200 includes the detection unit 180, which is constituted by the first to fourth detection units 181, 182, 183, and 184 that detect the height of the medium 95. The controller 1 changes the predetermined gap between the rotating member 173 and the medium 95 in accordance with the height of the medium 95 detected by the first to fourth detection units 181, 182, 183, and 184. Accordingly, fluff adhering to the surface of the medium 95 can be favorably removed.

[0117] The printing apparatus 200 includes the rotating member driving unit 176 that rotates the rotating member 173. Because the rotating member driving unit 176 rotates the rotating member 173, a suction force moving from the suction port 171a, through the recesses 173a, and toward the exhaust port 171b is produced in the rotating member 173. Accordingly, the fluff that has risen from the medium 95 can be exhausted to the exterior of the fluff removal section 170 and collected.

[0118] The printing apparatus 200 uses the suction force produced by the rotation of the rotating member 173, and the compression and decompression of the gas present between the medium 95 and the rotating member 173, to remove the fluff without making contact with the medium 95, and thus the aesthetic properties of the medium 95 can be maintained.

[0119] Note that the invention is not limited to the embodiments described above, and many variations and alterations thereof are possible as well. Variations on the rotating member that can be used in the fluff removal section 70 of the printing apparatus 100 according to the first embodiment will be described hereinafter.

First Variation

[0120] Fig. 19 is a perspective view illustrating a rotating member according to a first variation. The configuration of a rotating member 273 that can be used in the fluff removal section 70 according to the first embodiment will be described with reference to Fig. 19.

[0121] The rotating member 273 has a barrel shape or a circular column shape, and rotates in a circumferential direction. The rotating member 273 has recesses 273a and protrusions 273b that form a repeating uneven surface in the rotation direction of the rotating member (the circumferential direction). The rotating member 273 also has recesses 273a and protrusions 273b that form a repeating uneven surface in the intersecting direction (the Y-axis direction). In other words, the recesses 273a are

defined by the protrusions 273b arranged in the rotation direction and the protrusions 273b arranged in the intersecting direction. Accordingly, an airflow produced when a gas compressed between the protrusions 273b and the medium 95 with the rotation of the rotating member 273 is decompressed by the recesses 273a does not escape in the intersecting direction, and thus the force of the airflow can be improved. Accordingly, fluff on the medium 95 can be favorably removed.

Second Variation

[0122] Fig. 20 is a perspective view illustrating a rotating member according to a second variation. The configuration of a rotating member 373 that can be used in the fluff removal section 70 according to the first embodiment will be described with reference to Fig. 20.

[0123] The rotating member 373 has a barrel shape or a circular column shape, and rotates in a circumferential direction. The rotating member 373 has recesses 373a and protrusions 373b that form a repeating uneven surface in the rotation direction of the rotating member (the circumferential direction). The protrusions 373b in the rotating member 373 have chamfered portions in which at least one end portion along the rotation direction is chamfered. In this variation, the end portions of the protrusions 373b on the rotation direction side serve as chamfered portions 373c. Thus, the chamfered portions may be curved. Accordingly, the effect of compressing the gas by the protrusions 373b can be improved. Additionally, damage to the medium 95 can be reduced in situations where fluff having extended threads makes contact with the protrusions 373b.

Third Variation

[0124] Fig. 21 is a perspective view illustrating a rotating member according to a third variation. The configuration of a rotating member 473 that can be used in the fluff removal section 70 according to the first embodiment will be described with reference to Fig. 21.

[0125] The rotating member 473 has a barrel shape or a circular column shape, and rotates in a circumferential direction. Recesses 473a in the rotating member 473 are formed as concave depressions (dimples) formed along the rotation direction and the intersecting direction. The rotating member 473 also has protrusions 473b in the regions aside from the recesses 473a. Accordingly, a spiral airflow is produced when a gas compressed between the protrusions 473b and the medium 95 with the rotation of the rotating member 473 is decompressed by the recesses 473a, and thus the force of the airflow is improved and fluff can be favorably removed from the medium 95.

Fourth Variation

[0126] Fig. 22 is a perspective view illustrating a rotat-

ing member according to a fourth variation. The configuration of a rotating member 573 that can be used in the fluff removal section 70 according to the first embodiment will be described with reference to Fig. 22.

[0127] The rotating member 573 has a barrel shape or a circular column shape, and rotates in a circumferential direction. Recesses 573a in the rotating member 573 are formed as long, rounded depressions that are longer in the intersecting direction. The rotating member 573 also has protrusions 573b in the regions aside from the recesses 573a. Furthermore, the protrusions 573b are formed with a broader surface area than the recesses 573a. Setting the surface area of the protrusions 573b in the rotating member 573 to be broader than the surface area of the recesses 573a makes it possible to improve the effect of compressing the gas between the protrusions 573b and the medium 95. Although this variation describes the recesses 573a formed as long, rounded depressions as an example, the recesses are not limited to this shape. The recesses may be circular, rectangular, or the like, as in the preceding variation in Fig. 21.

Fifth Variation

[0128] Fig. 23 is a perspective view illustrating a rotating member according to a fifth variation. The configuration of a rotating member 673 that can be used in the fluff removal section 70 according to the first embodiment will be described with reference to Fig. 23. The rotating member 673 according to this variation includes a motor (not illustrated) that rotationally drives the rotating member 673, and a suction unit 672 in place of the suction unit 72 described in the first embodiment. Note that the basic shape of the rotating member 673 is the same as the rotating member 73, and will thus not be described.

[0129] The rotating member 673 includes a hollow rotating shaft 674. Communication holes 675 that communicate with the hollow rotating shaft 674 are provided in the recesses 73a. The suction unit 672, which sucks a gas from the recesses 73a via the hollow rotating shaft 674 and the communication holes 675, is provided at both ends of the rotating shaft 674. The suction unit 672 is what is known as a rotating fan. Accordingly, fluff on the surface of the medium 95, which has been caused to rise using the compression and decompression of a gas present between the rotating member 673 and the medium 95, can be exhausted efficiently. Note that the hollow rotating shaft including the rotating fan described in this variation may also be applied in the rotating members described in the first to fourth variations.

[0130] It should also be noted that any of the rotating members of the variations can also be used in the second embodiment, the rotating member of the second embodiment can also be used in the first embodiment, and the rotating member in the first embodiment can also be used in the second embodiment. Similarly, the detection unit 180 can be used in the first embodiment. In the first embodiment the height of the rotating member can be set

in the same manner as the second embodiment. Equally, the height of the rotating member in the second embodiment can be set in the same manner as the first embodiment.

Claims

1. A printing apparatus (100) comprising:

a medium support unit (23) configured to transport a medium (95) in a transport direction (X) while supporting the medium;
a medium supply unit (20) configured to supply the medium to the medium support unit;
a printing unit (40) including a head (42) configured to eject a liquid onto the medium while moving relative to the medium; and
a rotating member (73) provided in a position facing the medium between the medium supply unit and the printing unit,
wherein the rotating member has a rotating shaft (74) longer in an intersecting direction (Y) that is orthogonal to the transport direction, and recesses (73a) and protrusions (73b) that form a repeating uneven surface in a rotation direction of the rotating member; and
the rotating member is rotatable in a state where a predetermined gap is maintained between the rotating member and the medium.

2. The printing apparatus according to claim 1, comprising:

a suction unit (72) configured to suction the rotating member,
wherein the rotating member is configured to rotate under a suction force from the suction unit.

3. The printing apparatus according to claim 1 or claim 2, comprising:

a rotating member driving unit (176) configured to rotate the rotating member,
wherein a suction force is produced by the rotating member driving unit rotating the rotating member.

4. The printing apparatus according to any one of the preceding claims,

wherein the predetermined gap is less than or equal to a gap between the head and the medium; and
a relative speed between the rotating member and the medium when the rotating member rotates is greater than or equal to a relative speed between the head and the medium when printing onto the medium.

5. The printing apparatus according to any one of the preceding claims, comprising:
 - a rotating member raising/lowering device (75) configured to raise/lower the rotating member. 5
6. The printing apparatus according to claim 5, wherein the rotating member raising/lowering device changes the predetermined gap in accordance with a type of the medium. 10
7. The printing apparatus according to claim 5 or claim 6, comprising:
 - a detection unit (180) configured to detect a height of the medium, wherein the rotating member raising/lowering device is configured to change the predetermined gap in accordance with the height of the medium detected by the detection unit. 15 20
8. The printing apparatus according to any one of the preceding claims, wherein the rotating member (273, 473, 573, 673) has the recesses and the protrusions forming a repeating uneven surface in the intersecting direction. 25
9. The printing apparatus according to any one of the preceding claims, wherein the protrusions (373b) in the rotating member (373) have chamfered portions (373c) in which at least one end portion along the rotation direction is chamfered. 30
10. The printing apparatus according to any one of the preceding claims, wherein the recesses in the rotating member are formed as concave depressions (473a, 573a). 35
11. The printing apparatus according to any one of the preceding claims, wherein the protrusions in the rotating member are formed having a broader surface area than the recesses. 40

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FIG. 1

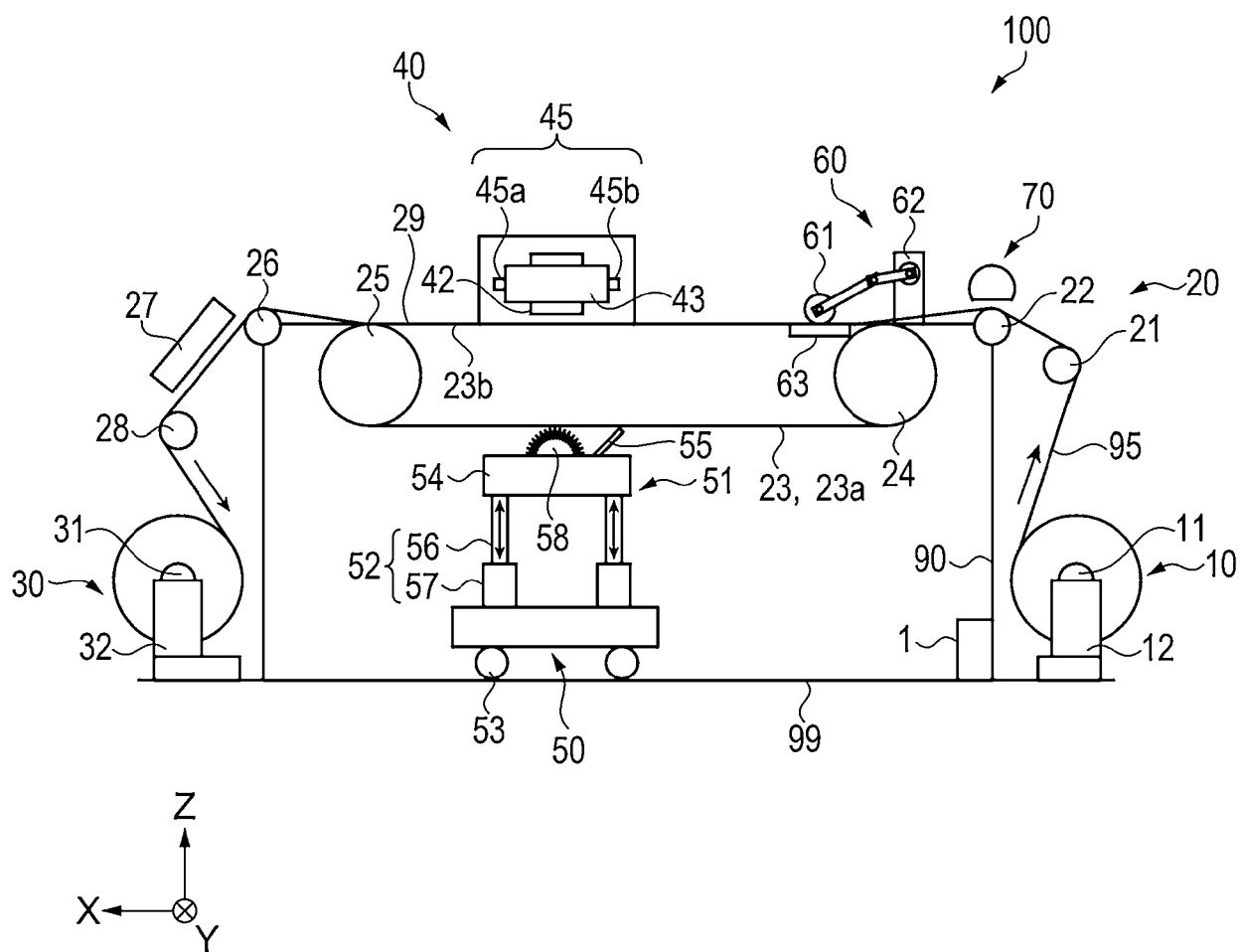


FIG. 2

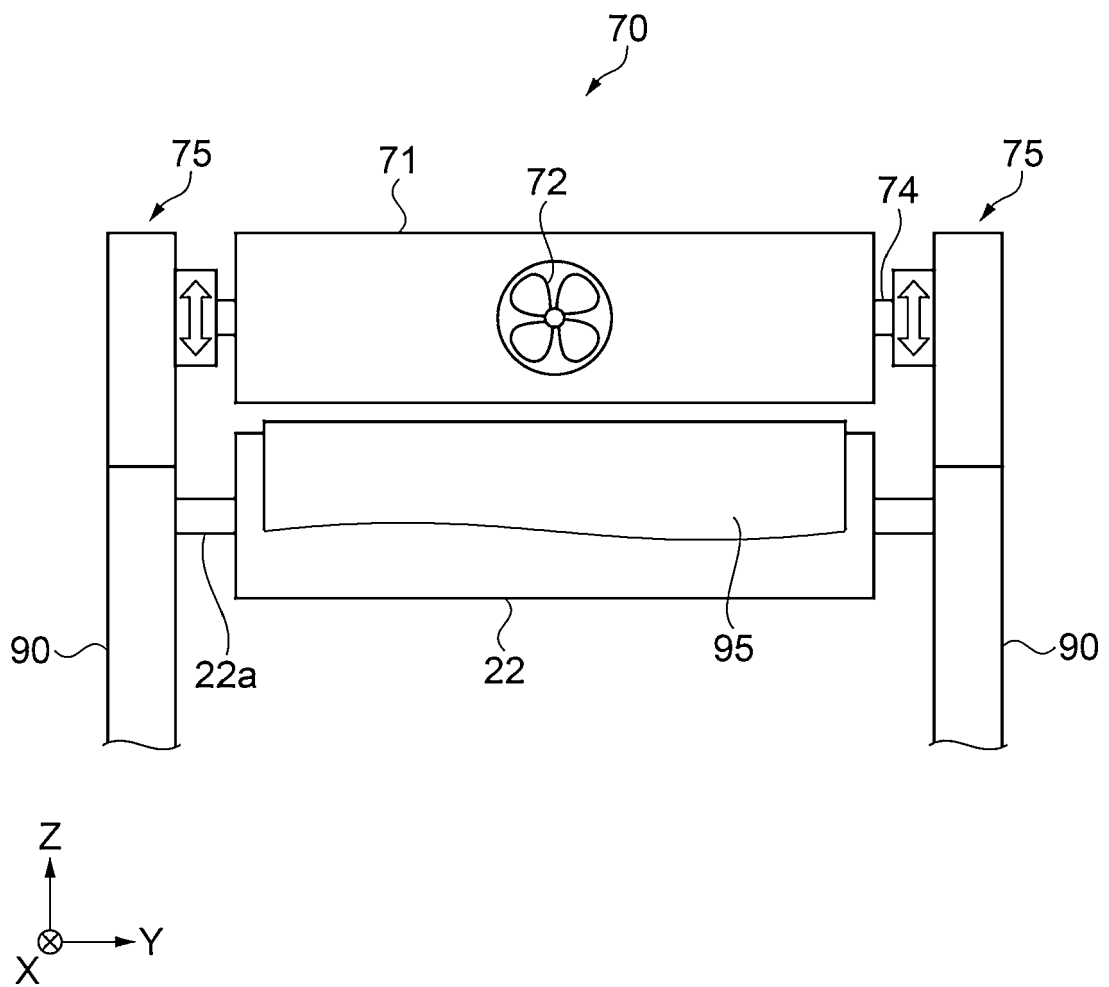


FIG. 3

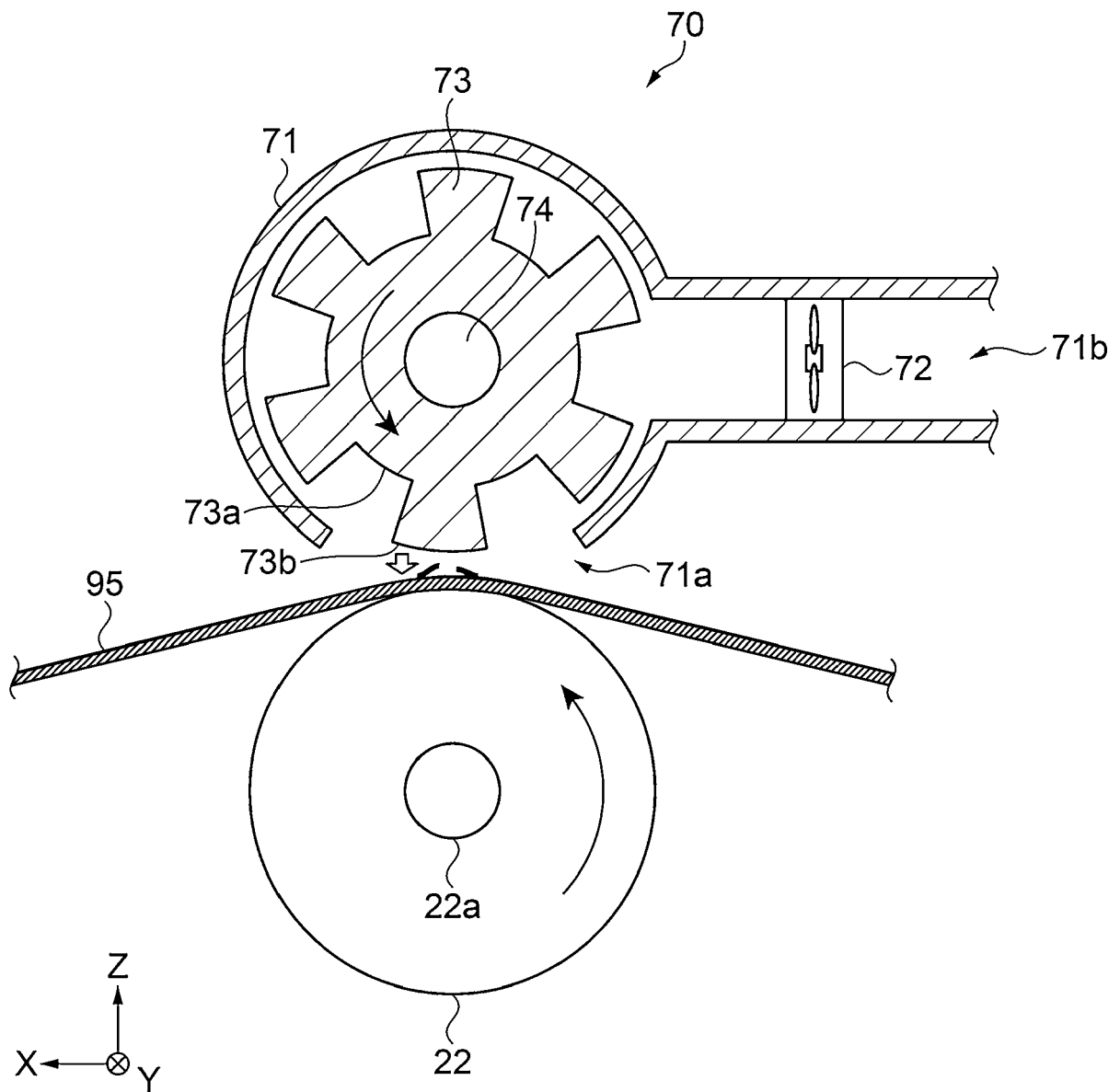


FIG. 4

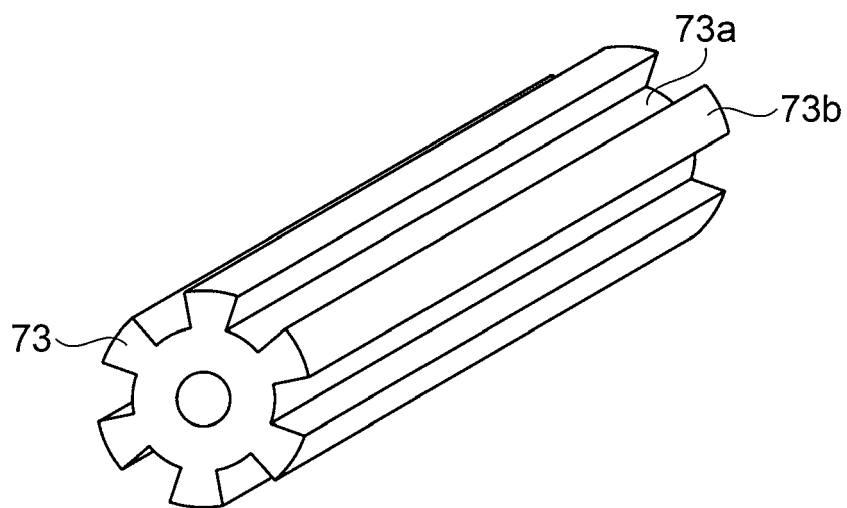


FIG. 5

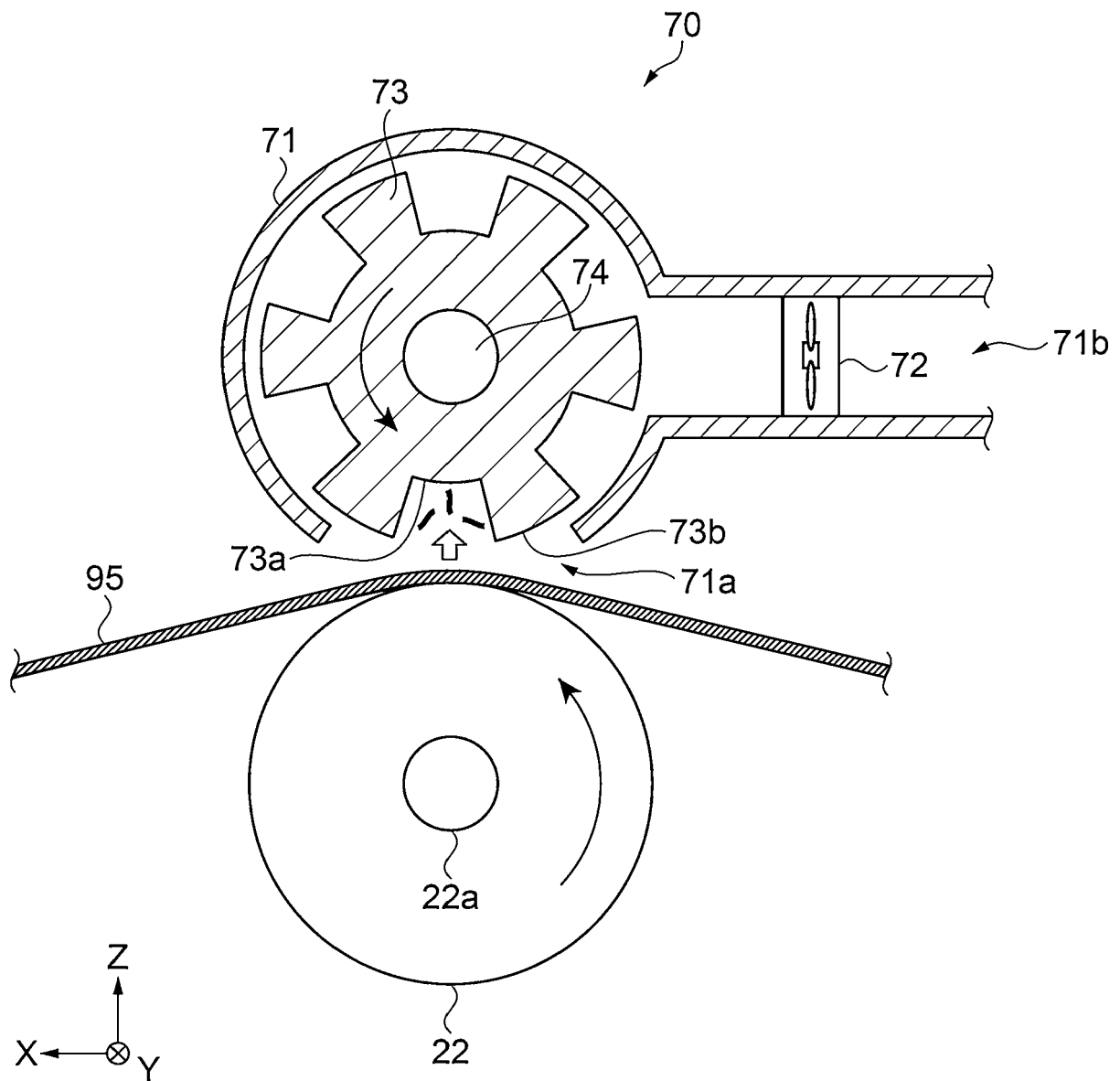


FIG. 6

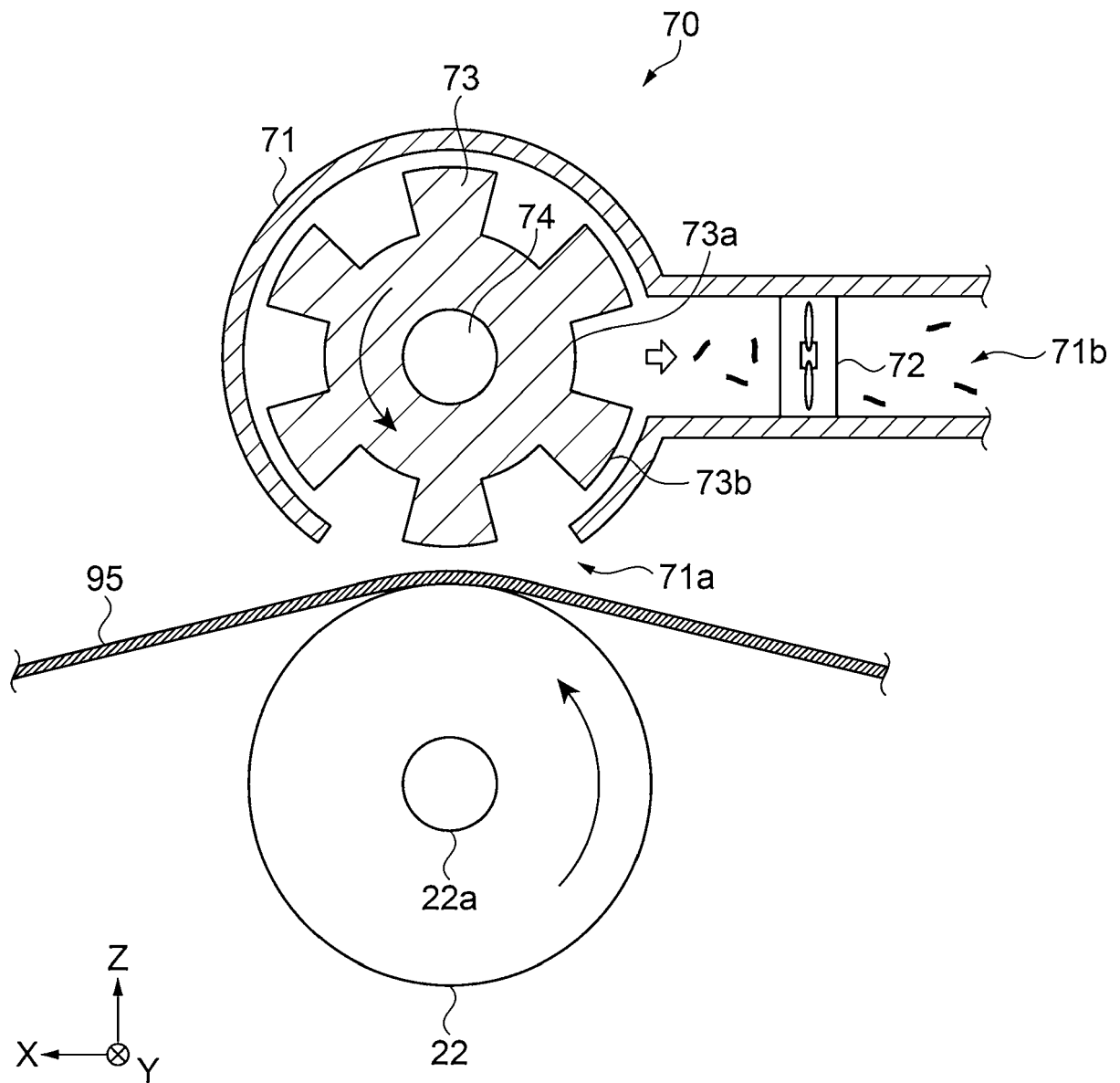


FIG. 7

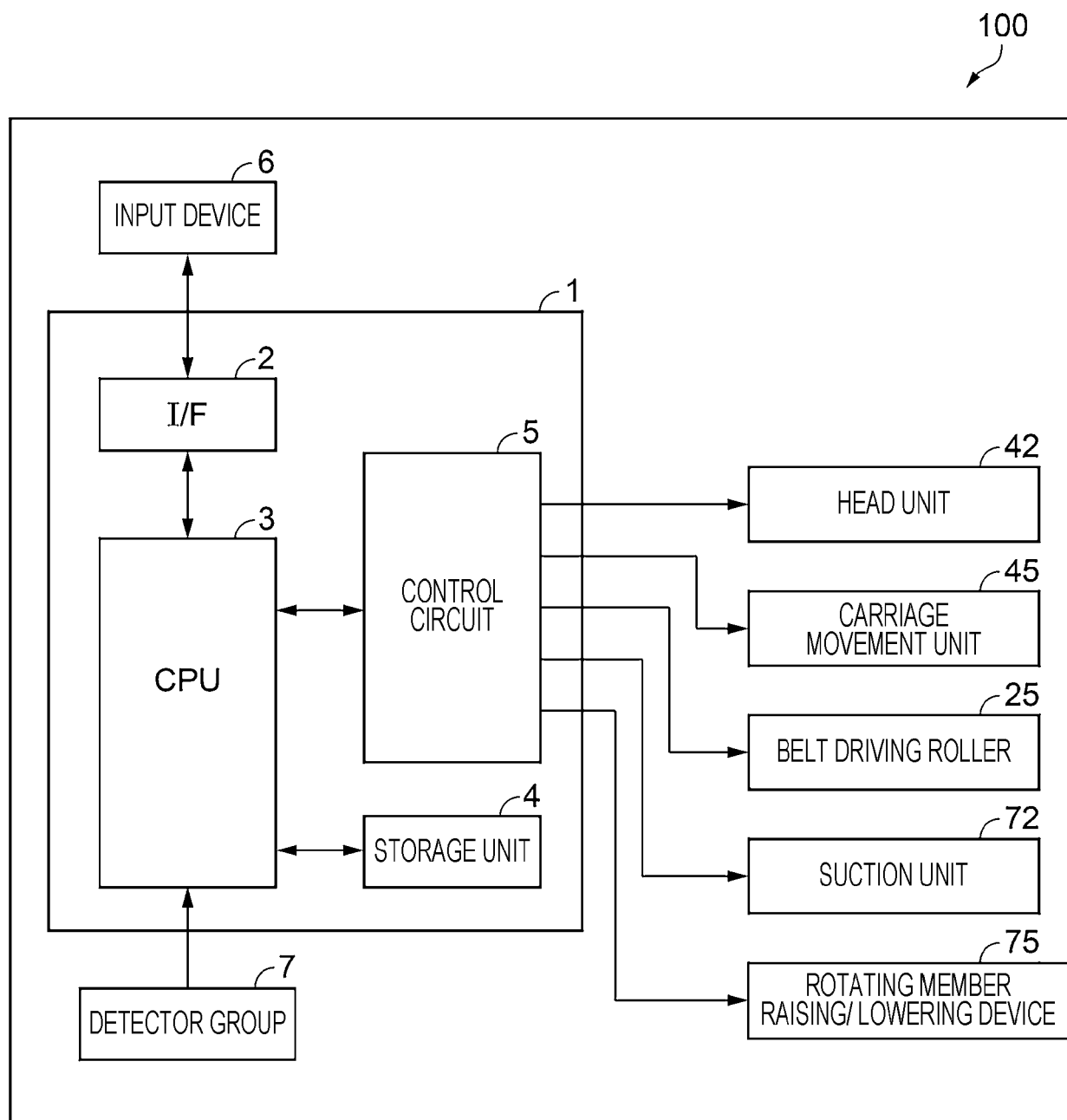


FIG. 8

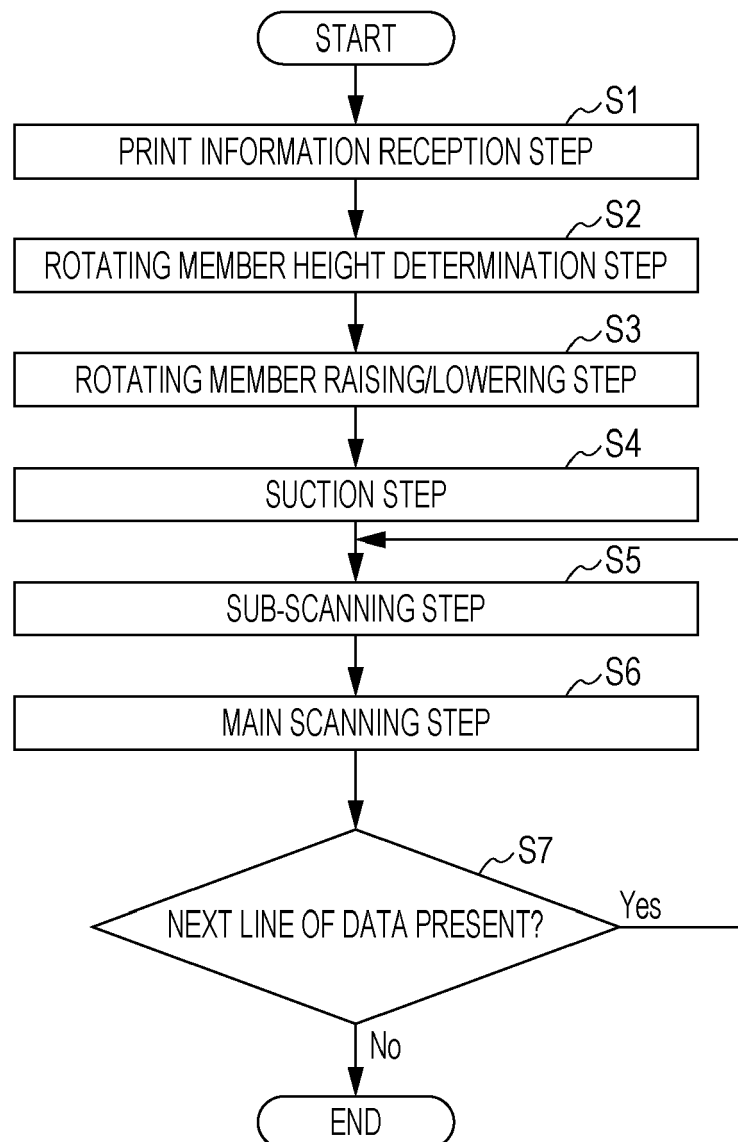


FIG. 9

MEDIUM TYPE	HEAD HEIGHT	ROTATING MEMBER HEIGHT
COTTON	4.0 mm	3.5 mm
SILK	2.0 mm	1.5 mm
NYLON	2.0 mm	2.0 mm

FIG. 10

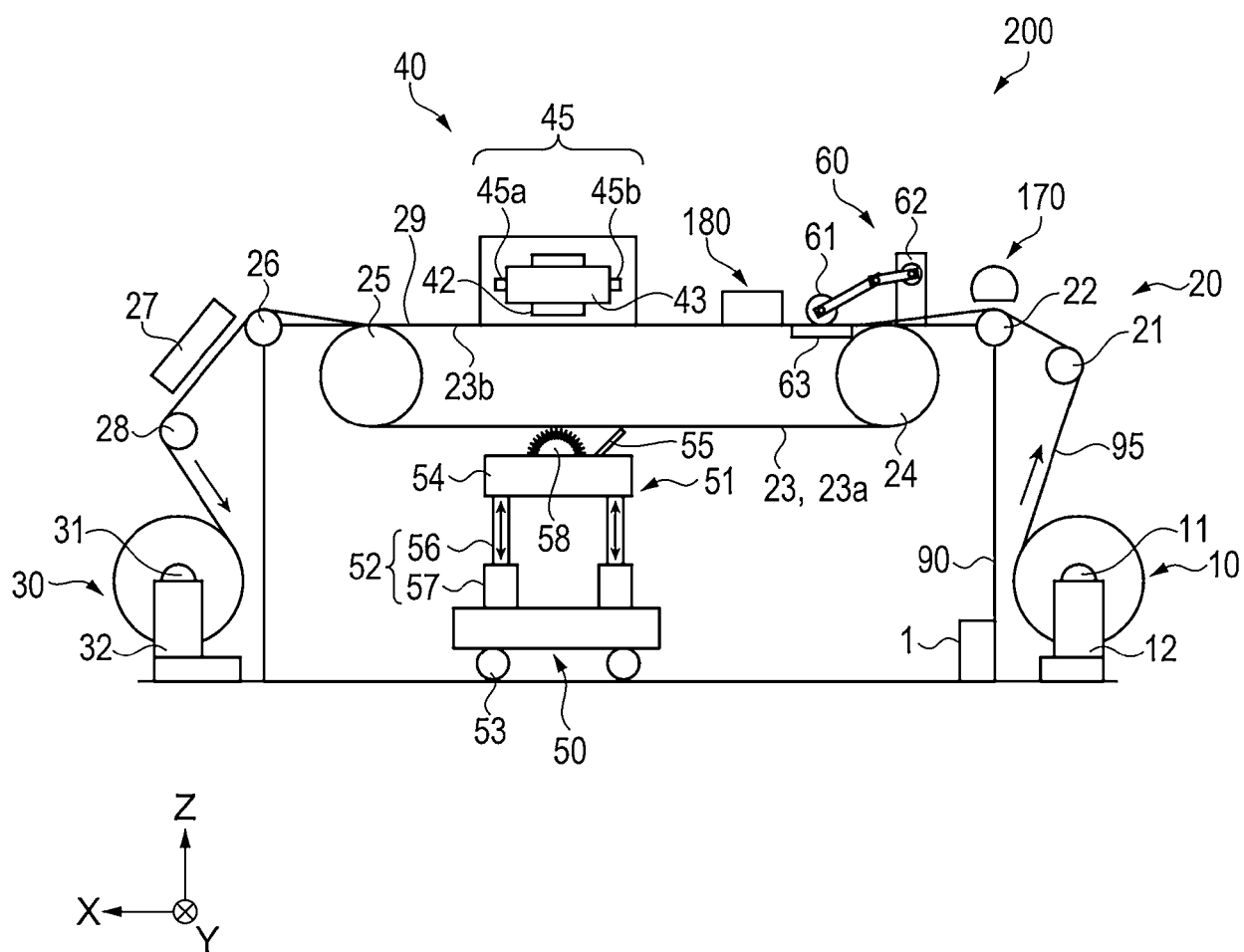


FIG. 11

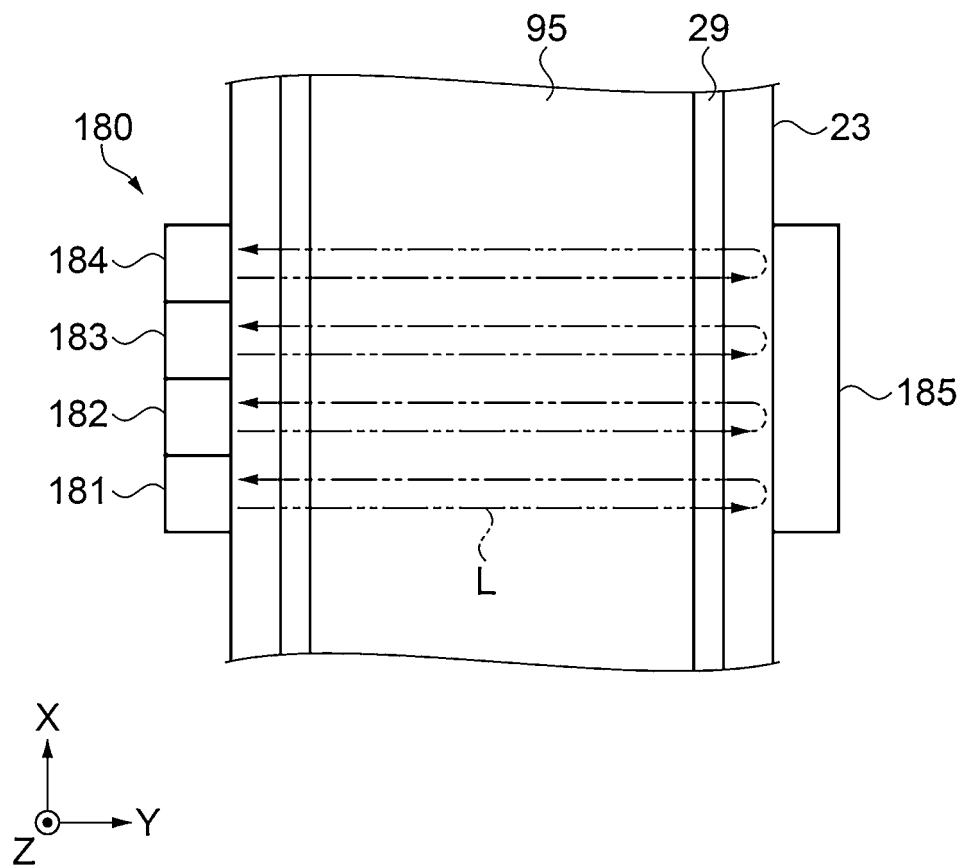


FIG. 12

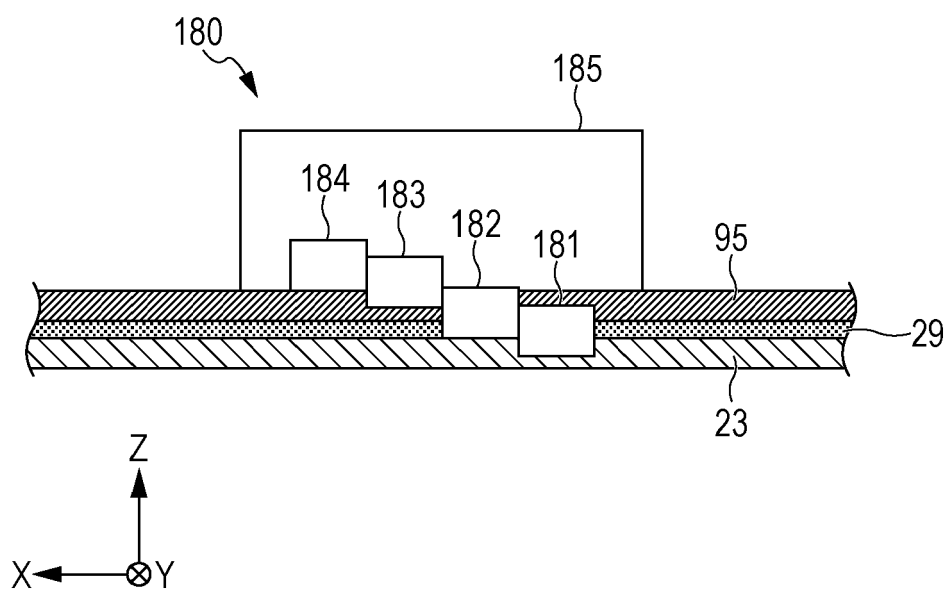


FIG. 13

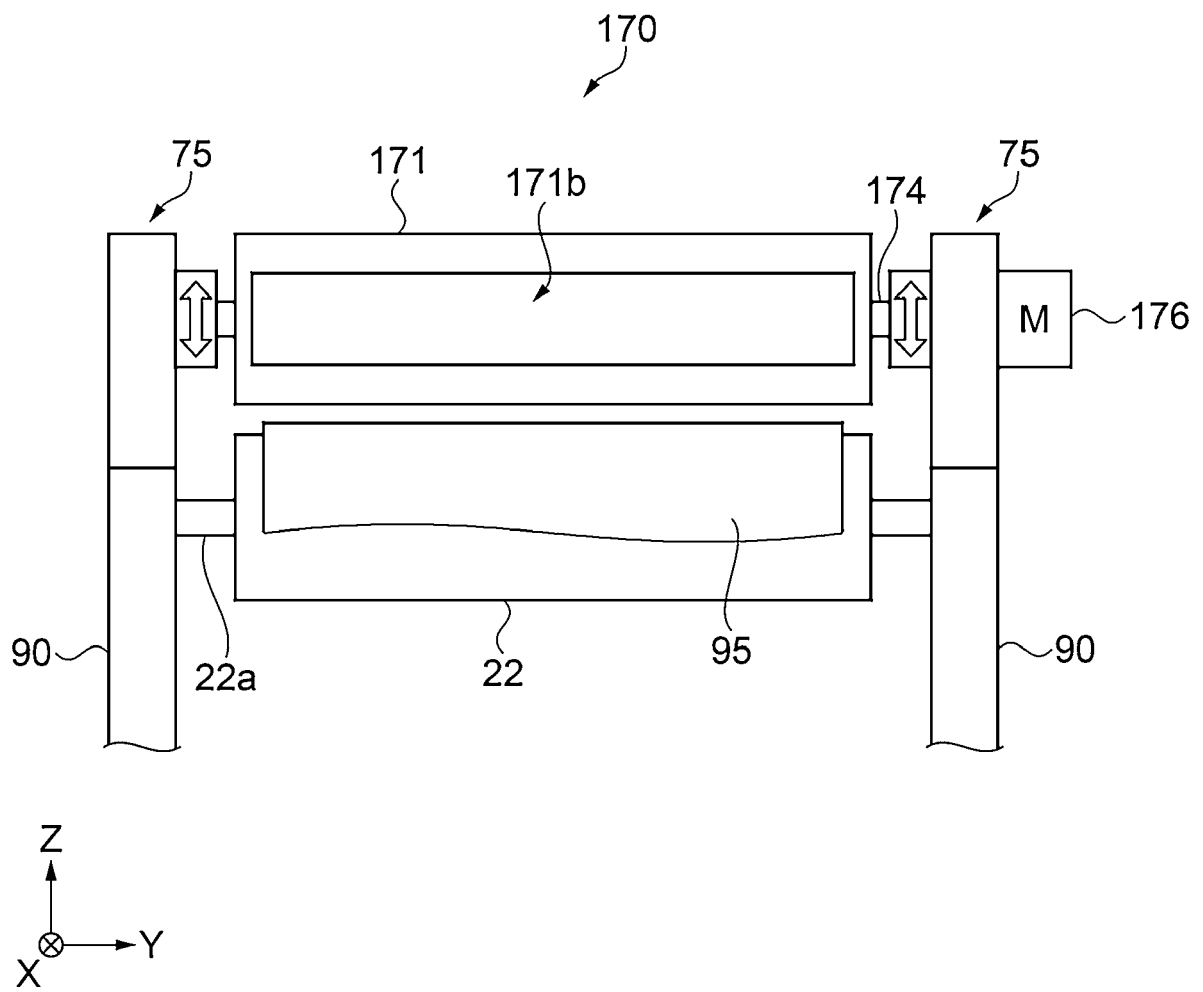


FIG. 14

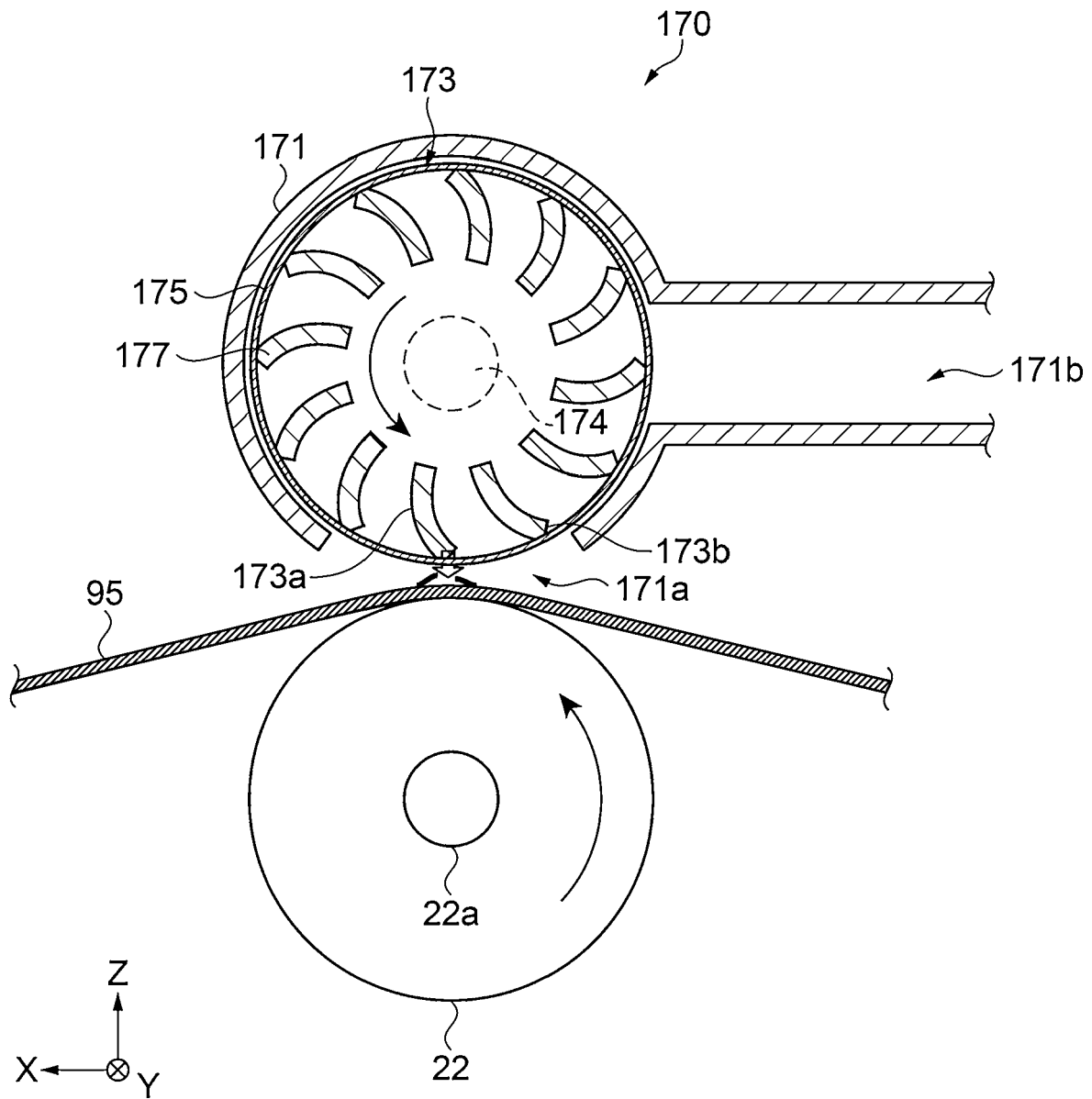


FIG. 15

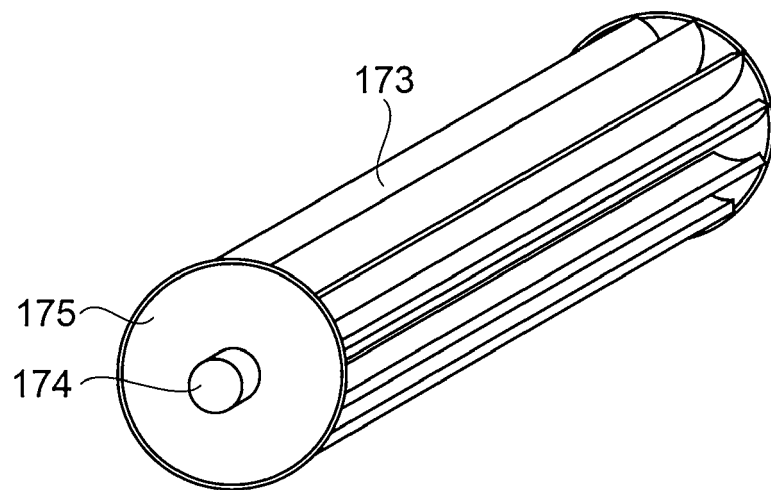


FIG. 16

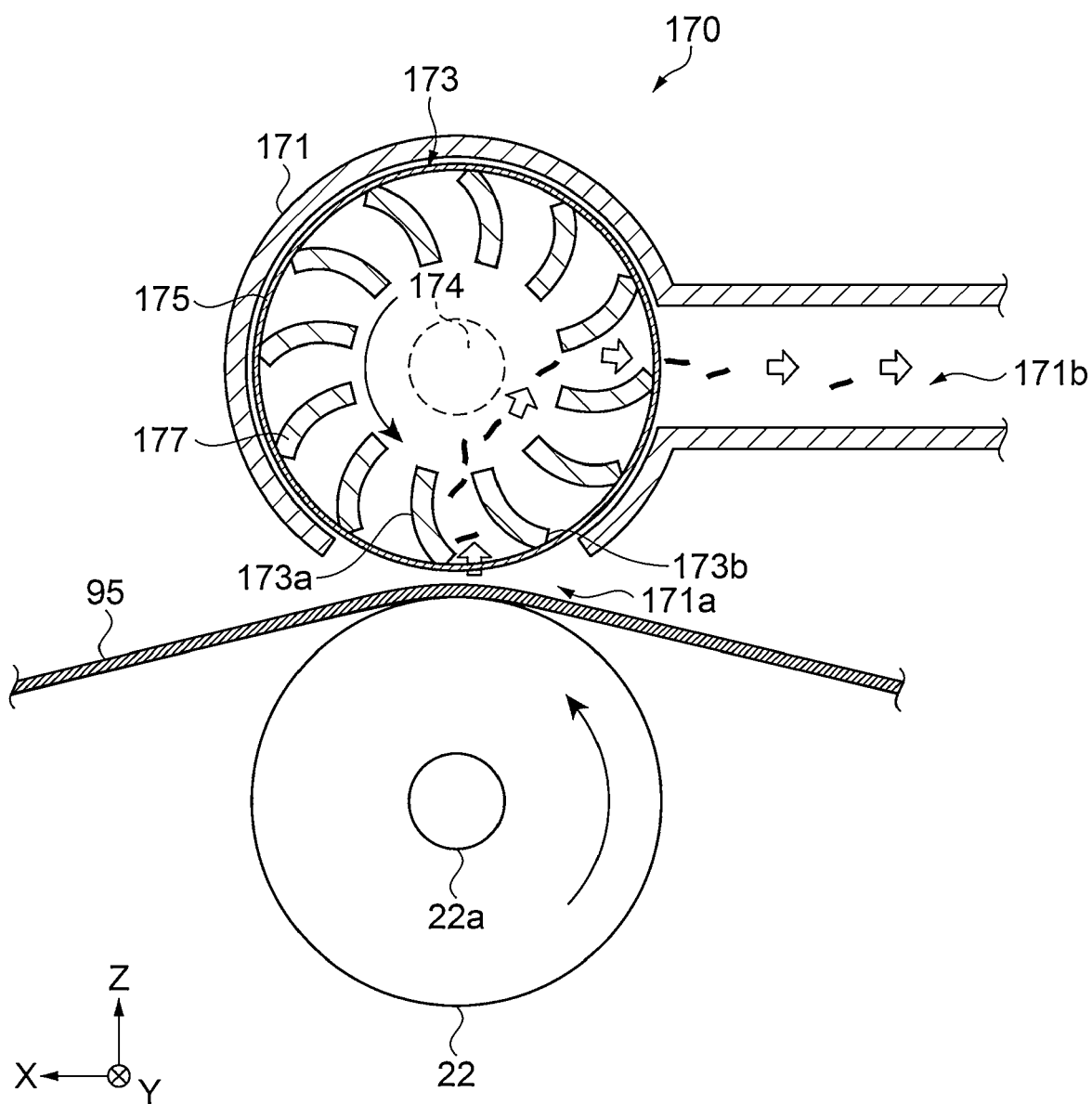


FIG. 17

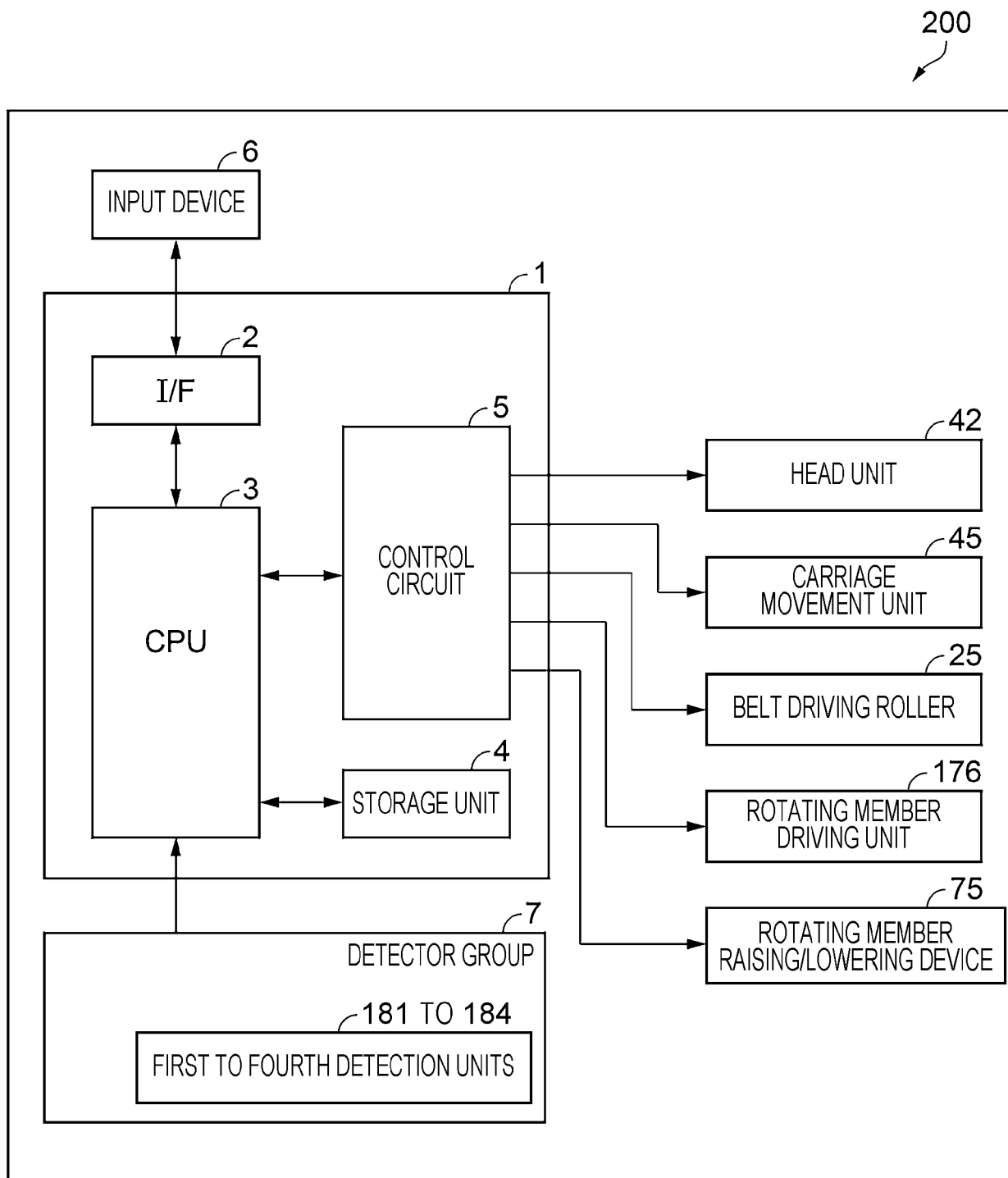


FIG. 18

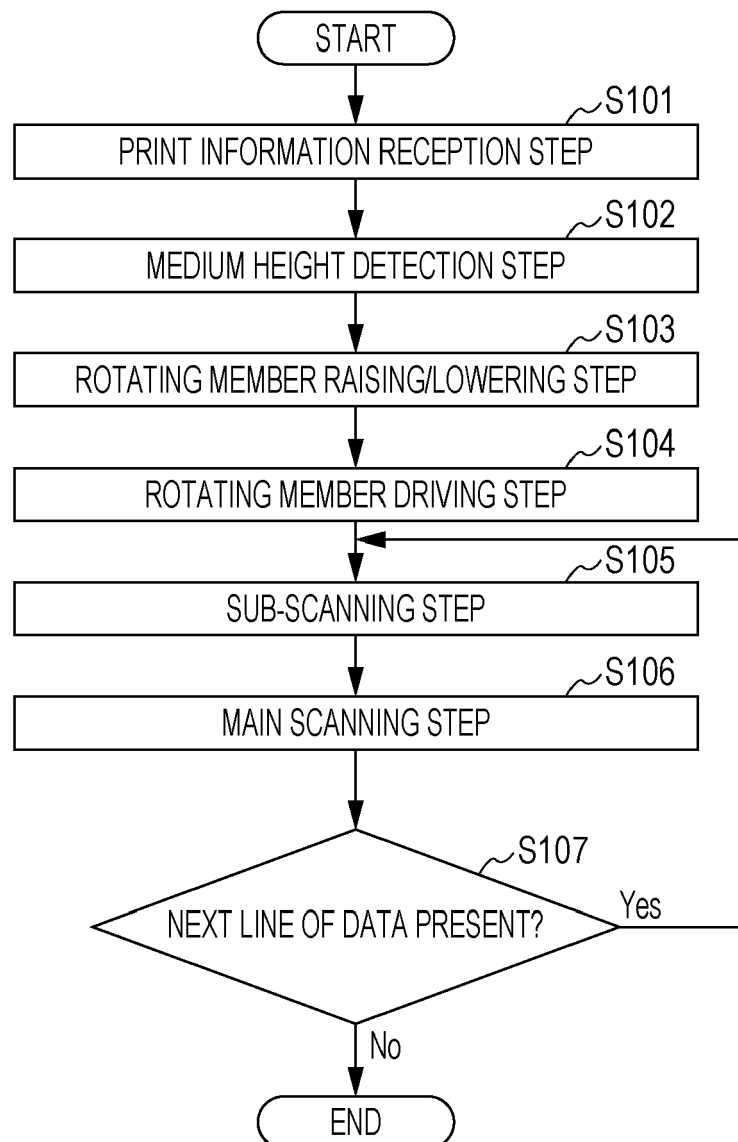


FIG. 19

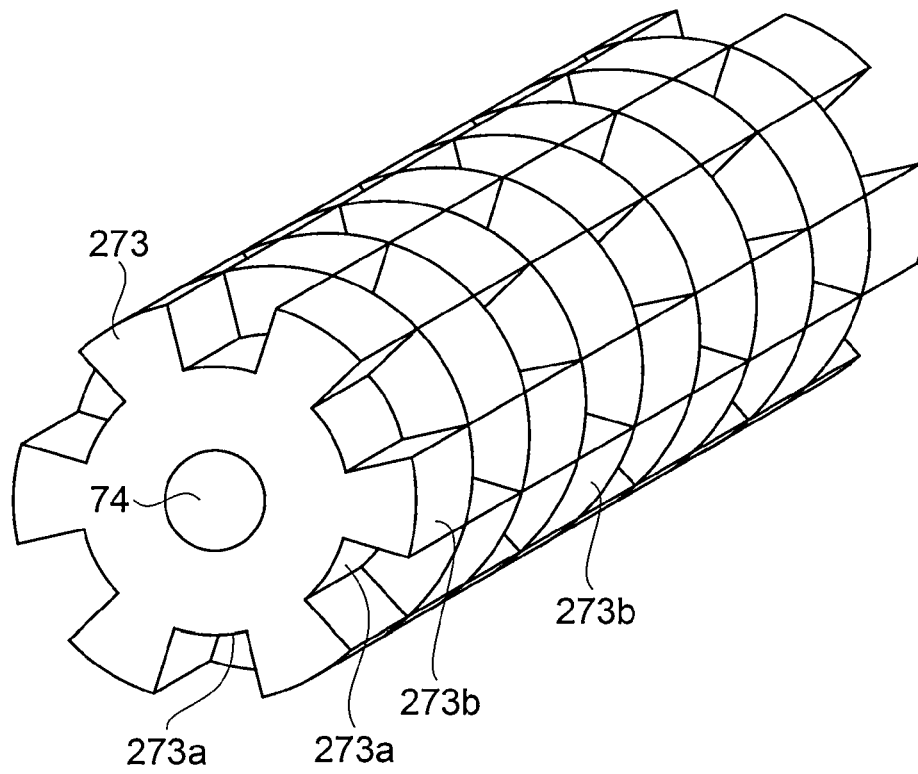


FIG. 20

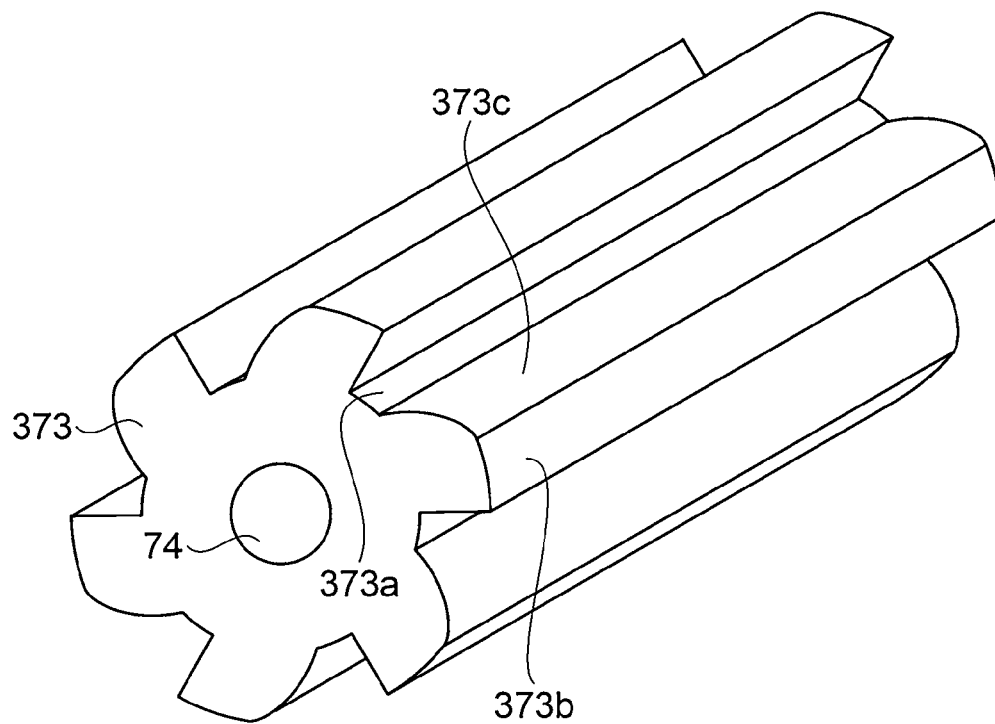


FIG. 21

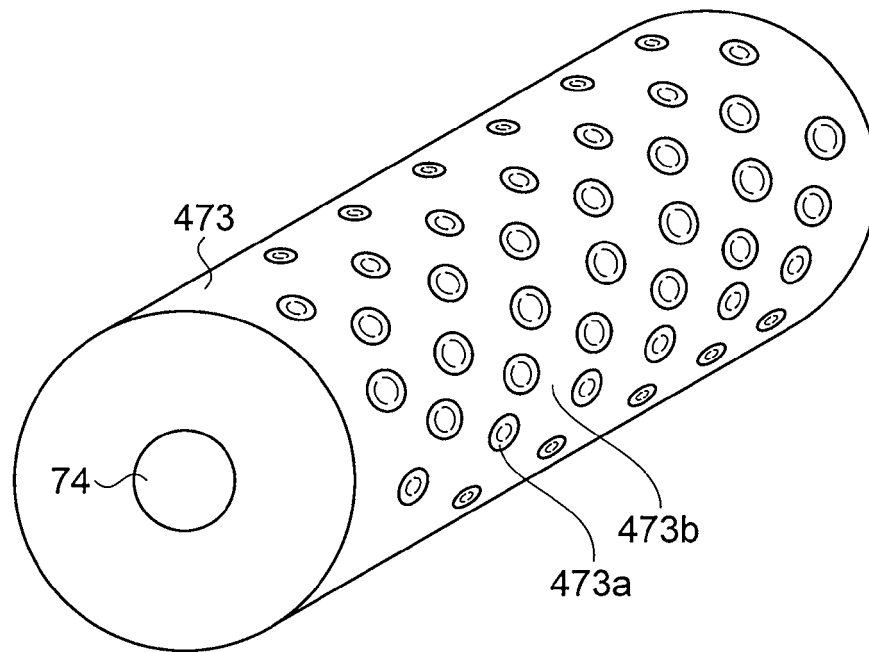


FIG. 22

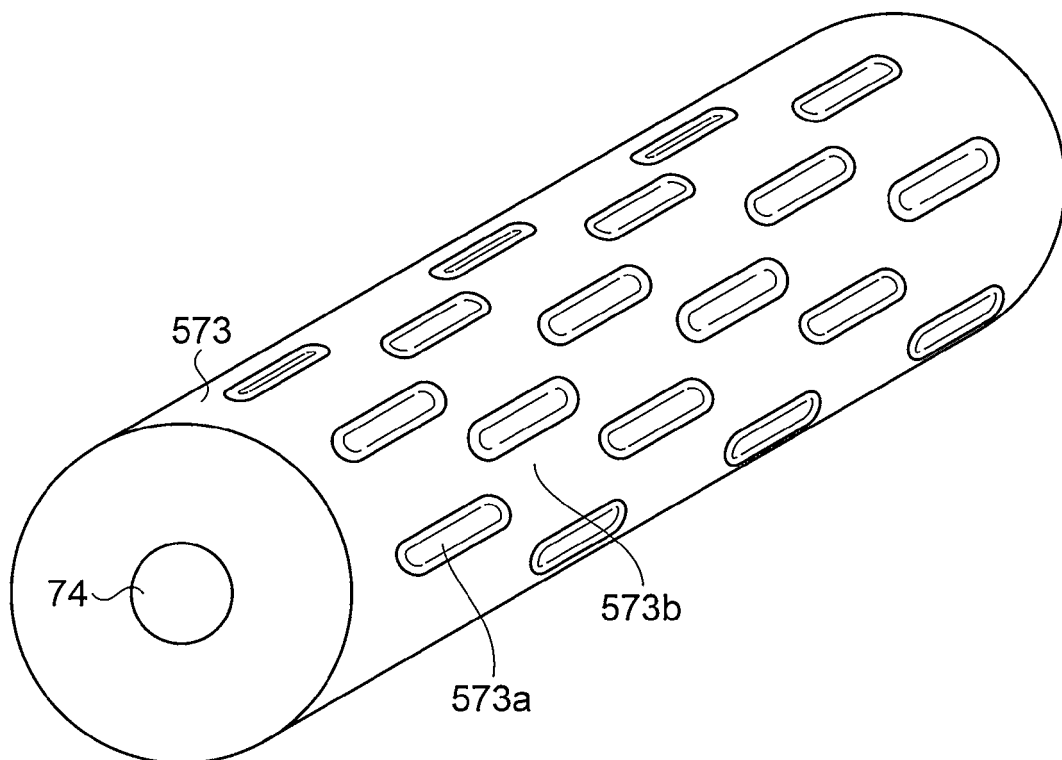
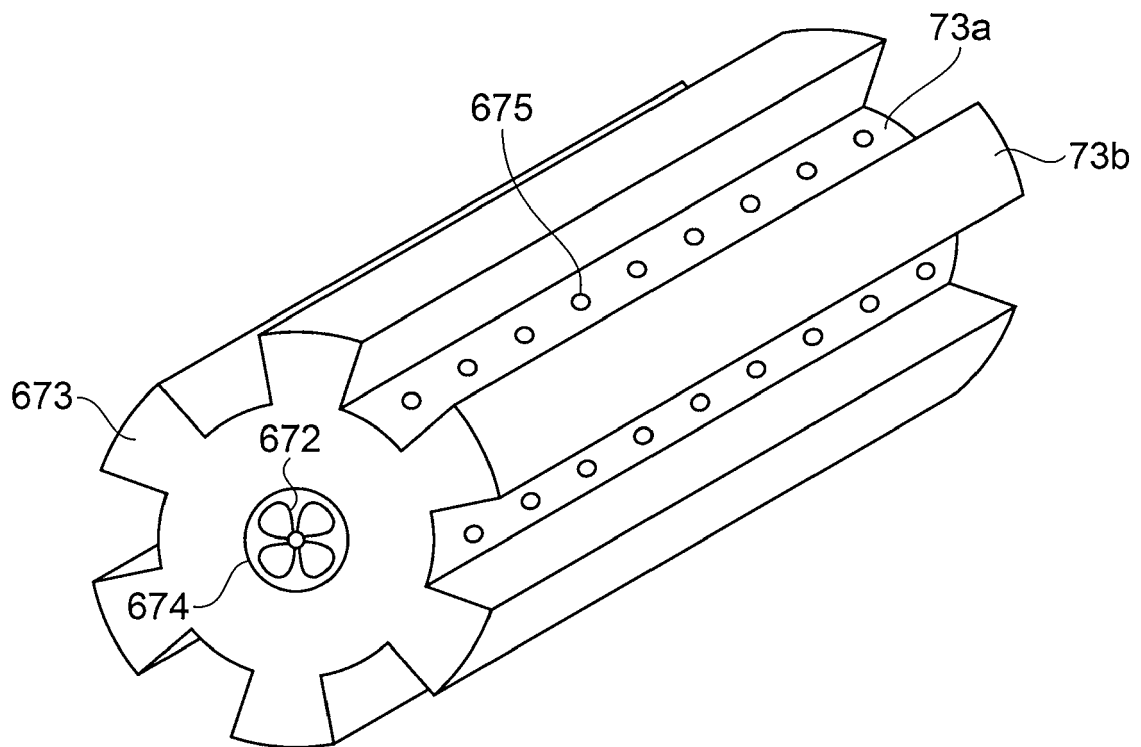


FIG. 23





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