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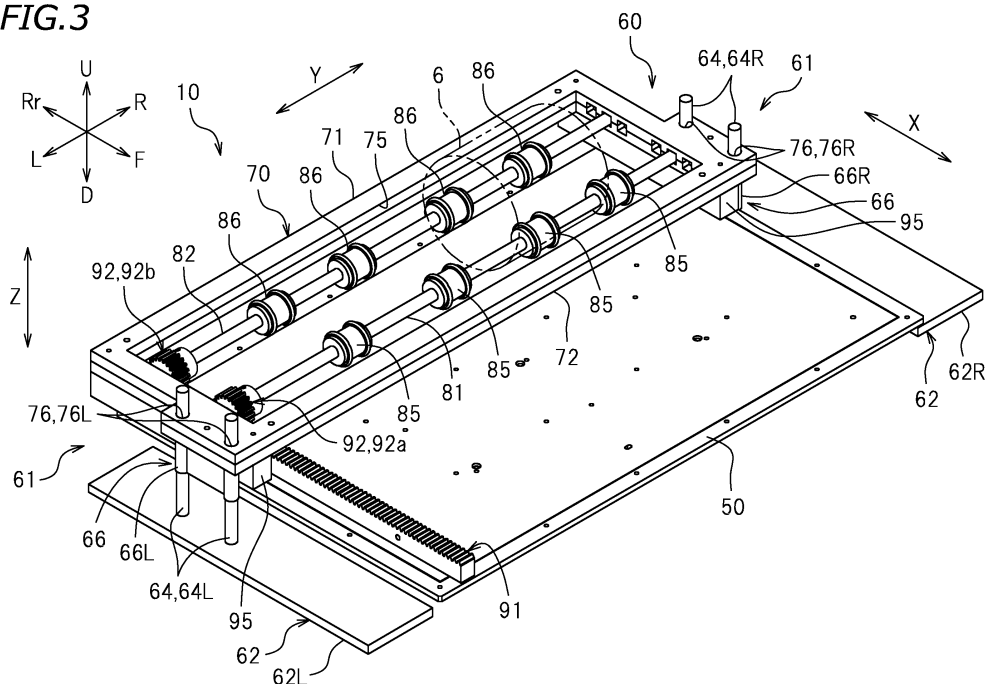
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(54) PRINTING TARGET ROTATION MECHANISM AND PRINTER

(57) A printing target (6) having an outer circumferential shape that is at least partially cylindrical is rotated smoothly. A rotation mechanism (60) includes a first rotation shaft (81), a second rotation shaft (82), a frame (70), a rack (91) and a pinion (92). The first rotation shaft (81) extends in a first direction. The second rotation shaft (82) is aligned with the first rotation shaft (81) in a second direction crossing the first direction. The second rotation shaft (82) supports, together with the first rotation shaft (81), a printing target (6) having an outer circumferential

shape that is partially cylindrical. The frame (70) supports at least one of the first rotation shaft (81) and the second rotation shaft (82) such that the at least one rotation shaft is rotatable. The rack (91) is provided on a support table (50) movable in the second direction with respect to the frame (70), and extends in the second direction. The pinion (92) is provided around the at least one rotation shaft, is rotatable together with the at least one rotation shaft, and is in mesh with the rack (91).

FIG.3**EP 4 067 094 A1**

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a printing target rotation mechanism and a printer, and more specifically, to a rotation mechanism rotating a printing target having an outer circumferential shape that is at least partially cylindrical, and a printer including the rotation mechanism.

2. Description of the Related Art

[0002] For example, Japanese Patent No. 6351872 discloses a printing device including a printing head and a movable table. The table supports a printing target having a flat surface, and the table is moved in an X axis direction to perform printing on the printing target.

[0003] The printing device is capable of performing printing on a cylindrical printing target in addition to a printing target having a flat surface. For performing printing on such a cylindrical printing target, a cylindrical printing jig is used. The cylindrical printing jig includes a first rotation shaft and a second rotation shaft both extending in a Y axis direction, and a movable portion supporting the first rotation shaft and the second rotation shaft such that the first rotation shaft and the second rotation shaft are rotatable. The movable portion is movable in an up-down direction. The first rotation shaft and the second rotation shaft are aligned in the X axis direction. The cylindrical printing target is located between the first rotation shaft and the second rotation shaft such that a central axis thereof extends in the Y axis direction, and is supported by the first rotation shaft and the second rotation shaft. The first rotation shaft is configured to be in contact with the table because of the weight of the movable portion.

[0004] The above-described printing device operates as follows. When the table is moved in the X axis direction in a state where the first rotation shaft is in contact with the table, the first rotation shaft rotates along with the movement of the table. The rotation of the first rotation shaft causes the cylindrical printing target supported between the first rotation shaft and the second rotation shaft to rotate. Ink is injected from the printing head while the cylindrical printing target is rotated, so that printing is performed on a circumferential surface of the cylindrical printing target. As can be seen, the above-described printing device rotates the cylindrical printing target by use of a force moving the table in the X axis direction.

[0005] As described above, the above-described printing device causes the first rotation shaft and the table to be in contact with each other because of the weight of the movable portion. Namely, the movable portion uses the weight thereof to press the first rotation shaft onto the table. In the case of such a configuration in which the

first rotation shaft is pressed onto the table because of the weight of the movable portion, the entirety of the first rotation shaft may undesirably not be pressed onto the table uniformly. Namely, a part of the first rotation shaft may undesirably not contact the table. As a result, there is an undesirable possibility that the force moving the table in the X axis direction is not properly converted into a force pivoting the cylindrical printing target and thus the cylindrical printing target is not rotated smoothly.

SUMMARY OF THE INVENTION

[0006] The present invention made in light of such a point has an object of providing a printing target rotation mechanism capable of smoothly rotating a printing target having an outer circumferential shape that is at least partially cylindrical, and a printer including such a printing target rotation mechanism.

[0007] This object is solved by the subject matter of the independent claims. Embodiments are defined by the dependent claims. A printing target rotation mechanism according to the present invention includes a first rotation shaft, a second rotation shaft, a frame, a rack and a pinion. The first rotation shaft extends in a first direction. The second rotation shaft is aligned with the first rotation shaft in a second direction crossing the first direction, and supports, together with the first rotation shaft, a printing target having an outer circumferential shape that is at least partially cylindrical. The frame supports at least one of the first rotation shaft and the second rotation shaft such that the at least one rotation shaft is rotatable. The rack is provided on a support table movable in the second direction with respect to the frame, and extends in the second direction. The pinion is provided around the at least one rotation shaft, is rotatable together with the at least one rotation shaft, and is in mesh with the rack.

[0008] With the above-described printing target rotation mechanism, while the support table is moved in the second direction, the rack is moved. Since the rack is in mesh with the pinion, the pinion is rotated along with the movement of the rack. The pinion is rotated along with at least one of the first rotation shaft and the second rotation shaft. Therefore, along with the rotation of the pinion, the printing target supported between the first rotation shaft and the second rotation shaft rotates. In this manner, the so-called rack and pinion mechanism may be used to properly convert a force moving the support table into a force rotating the printing target. Therefore, the printing target rotates smoothly.

[0009] The present invention provides a printing target rotation mechanism capable of smoothly rotating a printing target having an outer circumferential shape that is at least partially cylindrical, and a printer including such a printing target rotation mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a perspective view of a printer according to embodiment 1.

FIG. 2 is a perspective view showing an internal configuration of the printer according to embodiment 1, and shows a state where a rotation mechanism is detached.

FIG. 3 is a perspective view of the rotation mechanism and a support table according to embodiment 1.

FIG. 4 is a plan view of the rotation mechanism and the support table according to embodiment 1.

FIG. 5 is a front view of the rotation mechanism and the support table according to embodiment 1.

FIG. 6 is a right side view showing a state where a rack and pinions are in mesh with each other.

FIG. 7 is a plan view of a rotation mechanism and a support table of a printer according to embodiment 2.

FIG. 8 is a front view of the rotation mechanism and the support table of the printer according to embodiment 2.

FIG. 9 is a right side view showing a state where a toothed belt and pulleys are in mesh with each other in embodiment 2.

FIG. 10 is a conceptual view showing a distance by which a frame is movable in embodiment 2, and is a plan view of the rotation mechanism and the support table.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] Hereinafter, preferred embodiments of a printer including a printing target rotation mechanism according to the present invention will be described with reference to the drawings. The embodiments described herein are not intended to specifically limit the present invention, needless to say. Components and portions having the same functions will bear the same reference signs, and overlapping descriptions will be omitted or simplified when necessary.

<Embodiment 1>

[0012] First, a printer 10 according to embodiment 1 will be described. FIG. 1 is a perspective view of the printer 10 according to this embodiment. FIG. 2 is a perspective view showing an internal configuration of the printer 10 according to this embodiment. In the drawings, letters F, Rr, L, R, U and D respectively refer to front, rear, left, right, up and down of the printer 10. Letters X, Y and Z respectively refer to a sub scanning direction, a main scanning direction, and a height direction. For example, the main scanning direction Y is a left-right direction. The sub scanning direction X crosses the main scanning direction Y, and is perpendicular to the main scanning direction Y in this embodiment, as seen in a plan view. The sub scanning direction X is, for example, a front-rear direction. The height direction Z is an up-down direction. In this embodiment, the main scanning direction Y is an

example of a first direction, and the sub scanning direction X is an example of a second direction. It should be noted that these directions are merely defined for the sake of description, and do not limit the manner of installation of the printer 10 in any way.

[0013] The printer 10 is an inkjet printer. It should be noted that there is no specific limitation on the method by which the printer 10 performs printing. The printer 10 may be, for example, a dot-impact printer, a laser printer, a thermal printer or the like.

[0014] The printer 10 according to this embodiment is capable of performing printing on a first printing target 5 (see FIG. 2) supported by a support table 50 (see FIG. 2) described below. The printer 10 is also capable of performing printing on a second printing target 6 (see FIG. 3) by use of a rotation mechanism 60 (see FIG. 3) described below. The first printing target 5 shown in FIG. 2 is at least partially planar. The first printing target 5 is, for example, recording paper. It should be noted that the first printing target 5 is not limited to recording paper. The first printing target 5 encompasses, for example, a relatively thick printing target such as a sheet formed of a resin material, for example, PVC, polyester or the like, a metal plate, a glass plate, a wooden plate and the like. The first printing target 5 may be, for example, a three-dimensional object such as a smartphone case or the like.

[0015] The second printing target 6 shown in FIG. 3 is a three-dimensional object having an outer circumferential shape that is at least partially cylindrical. The part of the second printing target 6 that is referred to by "partially cylindrical" is a part to be in contact with the rotation mechanism 60 (in more detail, first rollers 85 and second rollers 86 (see FIG. 6) described below). The second printing target 6 encompasses a three-dimensional object accommodating a space therein, for example, a cylindrical three-dimensional object and the like. There is no specific limitation on the type of the second printing target 6. The second printing target 6 is, for example, a bottle, a glass or the like. There is no specific limitation on the material that forms the second printing target 6. The second printing target 6 may be formed of glass, a resin material, wood or the like. In this embodiment, the second printing target 6 is an example of a "printing target having an outer circumferential shape that is at least partially cylindrical".

[0016] As shown in FIG. 1, the printer 10 includes a printer main body 20. The printer main body 20 includes a base portion 21 (see FIG. 2), a case 22 and a cover 24. As shown in FIG. 2, the base portion 21 is a plate-like member, and is a bottom portion of the printer main body 20. There is no specific limitation on the shape of the base portion 21. In this embodiment, the base portion 21 has a hexagonal shape formed as a result of a front left corner and a front right corner of a rectangular member being cut away as seen in a plan view. The base portion 21 is provided with an inner wall 26. The inner wall 26 extends upward from the base portion 21, and extends in the main scanning direction Y. The inner wall

26 has an opening (not shown) formed therein running therethrough in the sub scanning direction X. The support table 50 is configured to pass through the opening of the inner wall 26.

[0017] The case 22 is located on the base portion 21, and is supported by the base portion 21. In this embodiment, there is a space enclosed by the case 22 and the base portion 21, and printing is performed in the space. As shown in FIG. 1, the case 22 has an opening 28 formed in a front portion thereof. The cover 24 is supported by the case 22 so as to be capable of opening or closing the opening 28. The cover 24 is rotatable about a rear end thereof as a rotation axis. The cover 24 has a window 29 formed in a top portion thereof. The window 29 is formed of a transparent or semi-transparent member, for example, an acrylic plate. A user may visually recognize the inner space enclosed by the case 22 and the base portion 21 through the window 29.

[0018] Now, the internal configuration of the printer 10 will be described. As shown in FIG. 2, the printer 10 includes a guide rail 30, a carriage 42, ink heads 44, a head moving mechanism 45, the support table 50, and a support table moving mechanism 55. The guide rail 30 extends in the main scanning direction Y. In this embodiment, the guide rail 30 is supported by a front surface of the inner wall 26, and is located above the support table 50.

[0019] The carriage 42 is slidably in engagement with the guide rail 30. The carriage 42 is movable in the main scanning direction Y along the guide rail 30. The ink heads 44 are provided in the carriage 42 such that bottom surfaces thereof are exposed downward. There is no specific limitation on the number of the ink heads 44. In this embodiment, the number of the ink heads 44 is three. The three ink heads 44 are aligned in the main scanning direction Y. Although not shown, a plurality of nozzles, from which ink is to be injected, are formed in the bottom surfaces of the ink heads 44. The ink to be injected from the ink heads 44 is so-called ultraviolet-curable ink. The ultraviolet-curable ink is progressively cured when being irradiated with ultraviolet rays. Although not shown, the carriage 42 may include an ultraviolet radiation device that radiates ultraviolet rays toward the ink injected from the ink heads 44 and landing on the first printing target 5 or the second printing target 6. This causes the ink injected from the ink heads 44 to be cured more progressively.

[0020] The head moving mechanism 45 moves the carriage 42 and the ink heads 44 in the main scanning direction Y. There is no specific limitation on the configuration of the head moving mechanism 45. In this embodiment, the head moving mechanism 45 includes left and right pulleys 46 and 47, an endless belt 48, and a head motor 49. The left pulley 46 is provided to the left of the guide rail 30, and the right pulley 47 is provided to the right of the guide rail 30. The belt 48 is wound along the left and right pulleys 46 and 47. The carriage 42 is secured to the belt 48. The head motor 49 is connected

with the right pulley 47. In this embodiment, the head motor 49 is driven to rotate the right pulley 47, and as a result, the belt 48 runs between the left and right pulleys 46 and 47. Along with the running of the belt 48, the carriage 42 and the ink heads 44 move in the main scanning direction Y.

[0021] The support table 50 supports the first printing target 5. In this embodiment, the first printing target 5 is placed on the support table 50, and printing on the first printing target 5 is performed on the support table 50. The support table 50 is located below the guide rail 30, the carriage 42 and the ink heads 44. A top surface of the support table 50 extends in the main scanning direction Y and in the sub scanning direction X. The support table 50 is movable in the sub scanning direction X by the support table moving mechanism 55.

[0022] As described above, the support table moving mechanism 55 moves the support table 50 in the sub scanning direction X. There is no specific limitation on the configuration of the support table moving mechanism 55. In this embodiment, the support table moving mechanism 55 includes a support table carriage 56 supporting the support table 50 and a pair of (i.e., left and right) slide rails (not shown) supporting the support table carriage 56 such that the support table carriage 56 is slidable. The slide rails extend in the sub scanning direction X. Although not shown, the support table moving mechanism 55 further includes a pair of (i.e., front and rear) pulleys provided to the front of, and to the rear of, the slide rails, and a belt wound along the front and rear pulleys. The support table carriage 56 is secured to the belt. One of the front and rear pulleys is connected with a feed motor. In this embodiment, the feed motor is driven to run the belt, and as a result, the support table 50 moves in the sub scanning direction X along with the support table carriage 56. Although not described in detail, the support table 50 is provided with an elevation mechanism moving the support table 50 in the height direction Z. Namely, the support table 50 is movable in the up-down direction.

[0023] In this embodiment, printing is performed on the first printing target 5 as follows. As shown in FIG. 2, the first printing target 5 is caused to be supported by the support table 50. The head moving mechanism 45 is actuated, so that while the ink heads 44 are moved in the main scanning direction Y, ink is injected from the ink heads 44 toward the first printing target 5. In this manner, one line of printing is performed. After the one line of printing, the support table 50 supporting the first printing target 5 is moved in the sub scanning direction X by the support table moving mechanism 55. Then, the ink heads 44 are moved in the main scanning direction Y to perform the next one line of printing. In this manner, one line of printing and the movement of the support table 50 in the sub scanning direction X are performed alternately. As a result, printing is performed on the first printing target 5.

[0024] As described above, the printer 10 according to this embodiment is capable of performing printing on the second printing target 6 having an outer circumferential

shape that is at least partially cylindrical, in addition to the first printing target 5 supported by the support table 50.

[0025] FIG. 3, FIG. 4 and FIG. 5 are respectively a perspective view, a plan view and a front view of the rotation mechanism 60 and the support table 50. FIG. 6 is a right side view showing a state where a rack 91 and pinions 92 of the rotation mechanism 60 are in mesh with each other. As shown in FIG. 3, in this embodiment, the printer 10 includes the rotation mechanism 60. The rotation mechanism 60 rotates the second printing target 6 about a central axis thereof. Printing is performed on the second printing target 6 while the second printing target 6 is rotated by use of the rotation mechanism 60. FIG. 2 does not show the rotation mechanism 60 because the rotation mechanism 60 is detached.

[0026] In this embodiment, the rotation mechanism 60 converts a force moving the support table 50 in the sub scanning direction X straight into a force rotating the second printing target 6, and thus rotates the second printing target 6. In this embodiment, the second printing target 6 is rotated by use of a driving force of the support table moving mechanism 55 (see FIG. 2) moving the support table 50 in the sub scanning direction X. In this embodiment, the rotation mechanism 60 adopts a so-called rack and pinion mechanism.

[0027] As shown in FIG. 3, the rotation mechanism 60 includes a base unit 61, a frame 70, a first rotation shaft 81, a second rotation shaft 82, the rack 91 and the pinions 92.

[0028] As shown in FIG. 5, the base unit 61 is attached and secured to the printer main body 20. FIG. 4 does not show the base unit 61. As shown in FIG. 5, the base unit 61 includes base plates 62, base shafts 64, and slidable bodies 66. The base plates 62 are secured to the base portion 21 of the printer main body 20. In this embodiment, the base plates 62 include a left base plate 62L and a right base plate 62R. As shown in FIG. 3, the left base plate 62L is a plate-like member extending in the sub scanning direction X. The right base plate 62R is also a plate-like member extending in the sub scanning direction X. As shown in FIG. 5, the left base plate 62L is located to the left of the support table 50, and is secured to the base portion 21. The right base plate 62R is located to the right of the support table 50, and is secured to the base portion 21.

[0029] The base shafts 64 are connected to the base plates 62 and extend in the height direction Z. In this embodiment, the base shafts 64 include left shafts 64L and right shafts 64R. The left shafts 64L are located to the left of the support table 50, and are connected with the left base plate 62L. The left shafts 64L extend upward from the left base plate 62L. In this embodiment, as shown in FIG. 3, there are two left shafts 64L, which are aligned in the sub scanning direction X. The number of the left shafts 64L is not limited to two, and may be one, or three or more.

[0030] As shown in FIG. 5, the right shafts 64R are

located to the right of the support table 50, and are connected with the right base plate 62R. The right shafts 64R extend upward from the right base plate 62R. There is no specific limitation on the number of the right shafts 64R, either. In this embodiment, as shown in FIG. 3, the number of the right shafts 64R is equal to the number of the left shafts 64L, namely, two. The two right shafts 64R are aligned in the sub scanning direction X.

[0031] The slidable bodies 66 guide a sliding movement of the frame 70 along the base shafts 64. The slidable bodies 66 are slidably outsized over the base shafts 64. The slidable bodies 66 are secured to the frame 70. In this embodiment, the slidable bodies 66 are secured to a bottom surface of the frame 70. Alternatively, the slidable bodies 66 may be secured to a top surface of the frame 70. In this embodiment, the frame 70 has insertion holes 76 (see FIG. 3) described below formed therein. The base shafts 64 are to be inserted into the insertion holes 76. The slidable bodies 66 extend downward from portions of the frame 70 that are around the insertion holes 76. The slidable bodies 66 extend in the height direction Z. In the case where, for example, central axes of the base shafts 64 and central axes of the insertion holes 76 are shifted from each other, namely, in the case where the central axes of the insertion holes 76 are inclined with respect to the central axes of the base shafts 64, it becomes difficult for the frame 70 to slide along the base shafts 64. The slidable bodies 66 are provided to match the central axes of the base shafts 64 and the central axes of the insertion holes 76 to each other so as to allow the frame 70 to slide easily along the base shafts 64. In the case where, for example, the frame 70 is the only member slidable along the base shafts 64, the length in the height direction Z of a member slidable along the base shafts 64 (i.e., the length of the frame 70) is short. It is considered that this causes the central axes of the base shafts 64 and the central axes of the insertion holes 76 to be shifted from each other easily, and that it is made difficult for the frame 70 to slide. In this embodiment, the slidable bodies 66 are secured to the frame 70, so that the length in the height direction Z of the member slidable along the base shafts 64 (i.e., the total length of the frame 70 and each of the slidable bodies 66) is made longer. Therefore, the central axes of the base shafts 64 and the central axes of the insertion holes 76 are easily matched to each other, and thus the frame 70 is allowed to slide easily along the base shafts 64. In this embodiment, the slidable bodies 66 include a left slidable body 66L and a right slidable body 66R. As shown in FIG. 5, the left slidable body 66L is located to the left of the support table 50, and are slidably outsized over the left shafts 64L. The right slidable body 66R is located to the right of the support table 50, and are slidably outsized over the right shafts 64R.

[0032] As shown in FIG. 3, the frame 70 supports the first rotation shaft 81 and the second rotation shaft 82. In this embodiment, the frame 70 extends in the main scanning direction Y and in the sub scanning direction

X. As shown in FIG. 4, the frame 70 has a support opening 75 formed in a central portion thereof. The support opening 75 runs through the frame 70 in the height direction Z. As shown in FIG. 5, the frame 70 is located above the support table 50. Although not shown, the frame 70 is located below the guide rail 30, the carriage 42 and the ink heads 44.

[0033] The frame 70 is detachable from the printer main body 20. In this embodiment, the frame 70 is detachable from the base unit 61 secured to the printer main body 20, and is supported by the base unit 61. In this embodiment, as shown in FIG. 3, the frame 70 is outserted over the base shafts 64. The slidable bodies 66 are secured to the frame 70. This will be described in more detail. As shown in FIG. 4, the frame 70 has the insertion holes 76 formed therein, into which the base shafts 66 are to be inserted. The insertion holes 76 include left insertion holes 76L formed in a left portion of the frame 70 and right insertion holes 76R formed in a right portion of the frame 70. As shown in FIG. 3, the left shafts 64L are inserted into the left insertion holes 76L. The left slidable body 66L extending downward is secured to the portions of the frame 70 that are around the left insertion holes 76L. The number of the left insertion holes 76L is equal to the number of the left shafts 64L, namely, two. The right shafts 64R are inserted into the right insertion holes 76R. The right slidable body 66R extending downward is secured to the portions of the frame 70 that are around the right insertion holes 76R. The number of the right insertion holes 76R is equal to the number of the right shafts 64R, namely, two.

[0034] In this embodiment, the frame 70 includes two members stacked in the height direction Z, namely, a top frame member 71 and a bottom frame member 72 stacked below the top frame member 71. It should be noted that the number of members included in the frame 70 may be one, or three or more.

[0035] As shown in FIG. 3, the first rotation shaft 81 and the second rotation shaft 82 support the second printing target 6 such that the second printing target 6 is rotatable. In this embodiment, as shown in FIG. 6, the second printing target 6 is located between the first rotation shaft 81 and the second rotation shaft 82, and is located so as to bridge a gap between the first rotation shaft 81 and the second rotation shaft 82. The second printing target 6 is placed on the first rotation shaft 81 and the second rotation shaft 82. In this embodiment, the support table 50 is moved in the sub scanning direction X. As a result, the pinions 92, which are in mesh with the rack 91, are rotated. The rotation of the pinions 92 causes the first rotation shaft 81 and the second rotation shaft 82 to rotate. Therefore, the second printing target 6 rotates. As shown in FIG. 4, the first rotation shaft 81 and the second rotation shaft 82 extend in the main scanning direction Y. The first rotation shaft 81 and the second rotation shaft 82 are aligned in the sub scanning direction X with a predetermined gap being provided between the rotation shafts 81 and 82. In this embodiment, the first

rotation shaft 81 is located to the front of the second rotation shaft 82.

[0036] As shown in FIG. 3, the first rotation shaft 81 and the second rotation shaft 82 are located above the support table 50, and are rotatably supported by the frame 70. In this embodiment, the first rotation shaft 81 and the second rotation shaft 82 are located in the support opening 75 of the frame 70. The first rotation shaft 81 and the second rotation shaft 82 are supported with both ends thereof being held between the top frame member 71 and the bottom frame member 72. In this embodiment, the gap between the first rotation shaft 81 and the second rotation shaft 82 is changeable appropriately in accordance with, for example, the size of the second printing target 6. In this embodiment, the gap between the first rotation shaft 81 and the second rotation shaft 82 may be changed by changing the position in the front-rear direction of the first rotation shaft 81 with respect to the frame 70 and the position in the front-rear direction of the second rotation shaft 82 with respect to the frame 70.

[0037] In this embodiment, the first rollers 85 are slidably outserted over the first rotation shaft 81. The second rollers 86 are slidably outserted over the second rotation shaft 82. As shown in FIG. 6, the first rollers 85 and the second rollers 86 are to be in direct contact with the second printing target 6. Neither the first rollers 85 nor the second rollers 86 are in contact with the support table 50. There is no specific limitation on the number of the first rollers 85 or the second rollers 86. As shown in FIG. 3, there are four first rollers 85 and four second rollers 86 in this embodiment. The first rollers 85 and the second rollers 86 are detachable respectively from the first rotation shaft 81 and the second rotation shaft 82. The number of the first rollers 85 and the number of the second rollers 86 are appropriately changeable. Intervals between the first rollers 85 and intervals between the second rollers 86 are also appropriately changeable. There is no specific limitation on the material that forms the first rollers 85 or the second rollers 86. The first rollers 85 and the second rollers 86 are formed of an elastic material, for example, rubber. Such a material makes it difficult for the second printing target 6 to slip against the first rotation shaft 81 and the second rotation shaft 82.

[0038] As shown in FIG. 3, the rack 91 extends in the sub scanning direction X, and is provided on the top surface of the support table 50. In this embodiment, the rack 91 has a length equal to that of the support table 50 in the sub scanning direction X. The rack 91 is directly secured to the top surface of the support table 50. There is no specific limitation on the position(s) or the number of the rack(s) 91. In this embodiment, the rack 91 is provided at a left end portion of the support table 50. Alternatively, the rack 91 may be provided at a right end portion of the support table 50. Still alternatively, there may be two racks 91 and may be provided at both of the left end portion and the right end portion of the support table 50. There is no specific limitation on the number of the rack(s)

91.

[0039] As shown in FIG. 6, the rack 91 includes a base portion 97 and rack teeth 93. The base portion 97 extends in the sub scanning direction X, and is placed on the support table 50. The rack teeth 93 are formed on a top surface of the base portion 97, and are aligned in the sub scanning direction X. In this embodiment, the base portion 97 and the rack teeth 93 are integral with each other. Alternatively, the base portion 97 and the rack teeth 93 may be separate from each other. The base portion 97 and the rack teeth 93 are formed of, for example, a resin material. There is no specific limitation on the material that forms the base portion 97 or the rack teeth 93. In this embodiment, height H1 of the base portion 97 is higher than height H2 of the rack teeth 93. It should be noted that there is no specific limitation on the relationship between height H1 of the base portion 97 and height H2 of the rack teeth 93.

[0040] The pinions 92 are gears to be in mesh with the rack 91. The pinion 92 is provided around at least one of the first rotation shaft 81 and the second rotation shaft 82. In this embodiment, the pinion 92 is provided around each of the first rotation shaft 81 and the second rotation shaft 82. The pinion 92 may be provided around either one of the first rotation shaft 81 and the second rotation shaft 82. Hereinafter, the pinion 92 provided around the first rotation shaft 81 will be referred to as a "first pinion 92a", and the pinion 92 provided around the second rotation shaft 82 will be referred to as a "second pinion 92b".

[0041] The first pinion 92a is configured to rotate together with the first rotation shaft 81. The second pinion 92b is configured to rotate together with the second rotation shaft 82. In this embodiment, the pinions 92 are located above the rack 91. In this embodiment, as shown in FIG. 3, the pinions 92 are located around a left end portion of the first rotation shaft 81 and a left end portion of the second rotation shaft 82. As shown in FIG. 6, the pinions 92 each include a plurality of pinion teeth 94, which are to be in mesh with the rack teeth 93 of the rack 91. The plurality of pinion teeth 94 are formed at a circumferential surface of each of the pinions 92, and are aligned in a circumferential direction of the pinion 92.

[0042] In FIG. 6, the rack 91 and the pinions 92 are so-called spur gears, in which the teeth 93 and 94 are straight and parallel to shafts of the gears. Alternatively, the rack 91 and the pinions 92 may be so-called helical gears. The rack teeth 93 of the rack 91 and the pinion teeth 94 of the pinions 92 may be helical. In the case where the rack 91 and the pinions 92 are helical gears, the teeth 93 and 94 are inclined with respect to the shafts of the gears.

[0043] In this embodiment, as shown in FIG. 3, the rotation mechanism 60 includes support members 95. As shown in FIG. 5, the support members 95 are located between the frame 70 and the support table 50. The support members 95 receive the weight of the frame 70 and keep the frame 70 at a predetermined level, such that the weight of the frame 70 is not imposed on portions

where the rack 91 and the pinions 92 are in mesh with each other. The predetermined level is a level with which the rack 91 and the pinions 92 may be in mesh with each other properly.

[0044] In this embodiment, length D11 in the height direction Z of the support members 95 is longer than distance D12 from the top surface of the support table 50 to the bottom surface of the frame 70 in a state where the rack 91 and the pinions 92 are in mesh with each other. Namely, $D11 > D12$. Distance D12 is a distance in the height direction Z from the top surface of the support table 50 to the bottom surface of the frame 70 in a state where the frame 70 is not supported by the support members 95, namely, in a state where the support members 95 are not located between the support table 50 and the frame 70. In this embodiment, $D11 > D12$. Length D11 and distance D12 have a difference from each other with which the rack 91 and the pinions 92 may be in mesh with each other. In this embodiment, in a state where the support members 95 are located between the frame 70 and the support table 50 and support the frame 70, a gap is formed between the rack 91 and the pinions 92. The "gap between the rack 91 and the pinions 92" includes a gap between the rack teeth 93 of the rack 91 and troughs between the pinion teeth 94 of the pinions 92 and a gap between troughs between the rack teeth 93 and the pinion teeth 94.

[0045] The support members 95 support the frame 70. In this embodiment, the support members 95 are each secured to a bottom surface of a shorter side portion of the bottom frame member 72 of the frame 70 (in this embodiment, the portion extending in the sub scanning direction X). The support members 95 are slidably supported by the support table 50. When the support table 50 is moved in the sub scanning direction X, the support table 50 is slid against the support members 95. Namely, while the support table 50 is moved in the sub scanning direction X, the positions of the support members 95 in the sub scanning direction X are not changed.

[0046] In this embodiment, a surface of each of the support members 95 that is to be in contact with the support table 50 (in this embodiment, the bottom surface of each support member 95) is treated to have a decreased frictional force with respect to the support table 50, such that the support table 50 is easily slid against the support members 95. In this embodiment, the bottom surface of each support member 95 is provided with a sheet formed of Teflon (registered trademark). The sheet provided on the bottom surface of each support member 95 is formed of polytetrafluoroethylene.

[0047] There is no specific limitation on the shape of the support members 95. In this embodiment, the support members 95 are each a quadrangular prism having a length equal to that of the frame 70 in the sub scanning direction X. There is no specific limitation on the material that forms the support members 95. The support members 95 are formed of, for example, a metal material. There is no specific limitation on the number of the sup-

port members 95. In this embodiment, there are two support members 95. One of the support members 95 is located at a left end portion of the frame 70, and to the left of the rack 91 and the pinions 92. The other support member 95 is located at a right end portion of the frame 70, and to the right of the rack 91 and the pinions 92.

[0048] In this embodiment, as shown in FIG. 6, the second printing target 6 is located between the first rotation shaft 81 and the second rotation shaft 82 such that the second printing target 6 has an axis extending in the main scanning direction Y. The second printing target 6 is rotated about the central axis thereof as follows. First, the support table moving mechanism 55 (see FIG. 5) is actuated to move the support table 50 in the sub scanning direction X. At this point, the rack 91 is also moved in the sub scanning direction X together with the support table 50. The movement of the rack 91 in the sub scanning direction X causes the pinions 92 in mesh with the rack 91 to rotate. The rotation of the pinions 92 (in more detail, the first pinion 92a and the second pinion 92b) causes the first rotation shaft 81 and the second rotation shaft 82 to be rotated in the same direction as the pinions 92. Along with the rotation of the first rotation shaft 81 and the second rotation shaft 82, the first rollers 85 and the second rollers 86 rotate, and as a result, the second printing target 6 supported by the first rotation shaft 81 and the second rotation shaft 82 rotates.

[0049] In this embodiment, as shown in FIG. 6, when the support table 50 and the rack 91 are moved forward as represented by arrow A11, the pinions 92, the first rotation shaft 81 and the second rotation shaft 82 are rotated clockwise as represented by arrow A21 as seen in a right side view. At this point, the second printing target 6 rotates counterclockwise as represented by arrow A31 as seen in a right side view. By contrast, when the support table 50 and the rack 91 are moved rearward as represented by arrow A12, the pinions 92, the first rotation shaft 81 and the second rotation shaft 82 are rotated counterclockwise as represented by arrow A22 as seen in a right side view. At this point, the second printing target 6 rotates clockwise as represented by arrow A32 as seen in a right side view.

[0050] In this embodiment, printing is performed on the second printing target 6 as follows. First, while the ink heads 44 are moved in the main scanning direction Y by the head moving mechanism 45, ink is injected from the ink heads 44 toward the second printing target 6 to perform one line of printing. This one line of printing is performed on a top surface of the second printing target 6. After the one line of printing, the support table moving mechanism 55 is actuated to rotate the first rotation shaft 81 and the second rotation shaft 82, and as a result, the second printing target 6 rotates by a predetermined amount. Then, the ink heads 44 are moved in the main scanning direction Y to perform the next one line of printing on the top surface of the second printing target 6. In this manner, one line of printing and the rotation of the second printing target 6 are alternately repeated, and as

a result, printing is performed on the second printing target 6.

[0051] As described above, in this embodiment, as shown in FIG. 3, the rotation mechanism 60 includes the first rotation shaft 81 and the second rotation shaft 82 extending in the main scanning direction Y, the frame 70, the rack 91 and the pinions 92. The second rotation shaft 82 is aligned with the first rotation shaft 81 in the sub scanning direction X, and supports, together with the first rotation shaft 81, the second printing target 6, which has an outer circumferential shape that is at least partially cylindrical. The frame 70 supports the first rotation shaft 81 and the second rotation shaft 82 such that the first rotation shaft 81 and the second rotation shaft 82 are rotatable. The rack 91 is provided on the support table 50 movable in the sub scanning direction X with respect to the frame 70, and extends in the sub scanning direction X. As shown in FIG. 6, the pinion 92 is provided around at least one of the first rotation shaft 81 and the second rotation shaft 82, is rotated together with the at least one rotation shaft, and is in mesh with the rack 91.

[0052] In this embodiment, as described above, while the support table 50 is moved in the sub scanning direction X, the rack 91 is moved. Since the rack 91 is in mesh with the pinions 92, the pinions 92 are rotated along with the movement of the rack 91. Along with the rotation of the pinions 92, the first rotation shaft 81 and the second rotation shaft 82 are rotated, and thus the second printing target 6 supported between the first rotation shaft 81 and the second rotation shaft 82 rotates. In this embodiment, the so-called rack and pinion mechanism is used, so that the first rotation shaft 81 and the second rotation shaft 82 (or the first rollers 85 and the second rollers 86) are prevented from contacting the support table 50 and thus are rotated smoothly. In this manner, the so-called rack and pinion mechanism may be used to properly convert the force moving the support table 50 into a force rotating the second printing target 6. This makes it difficult for the first rotation shaft 81 and the second rotation shaft 82 (or the first rollers 85 and the second rollers 86) to slip against the second printing target 6. Therefore, the second printing target 6 rotates smoothly.

[0053] In this embodiment, the first rotation shaft 81 and the second rotation shaft 82 are both rotatable with respect to the frame 70. The pinions 92 are provided around both of the first rotation shaft 81 and the second rotation shaft 82. With such a configuration, both of the first rotation shaft 81 and the second rotation shaft 82 are rotated along with the movement of the rack 91 in the sub scanning direction X. Thus, the first rotation shaft 81 and the second rotation shaft 82 are usable as driving shafts. Since both of the first rotation shaft 81 and the second rotation shaft 82 are rotated, the second printing target 6 rotates more smoothly.

[0054] In this embodiment, the rack 91 and the pinions 92 may be helical gears. In other words, the rack teeth 93 of the rack 91 and the pinion teeth 94 of the pinions 92 may be helical. This makes it difficult for the rack 91

and the pinions 92 to be shifted from each other. Especially, it is made difficult for the rack 91 and the pinions 92 to be shifted from each other in the main scanning direction Y.

[0055] In this embodiment, as shown in FIG. 5, the rotation mechanism 60 includes the support members 95 located between the support table 50 and the frame 70. Length D11 in the height direction Z of the support members 95 is longer than distance D12 from the top surface of the support table 50 to the bottom surface of the frame 70 in a state where the rack 91 and the pinions 92 are in mesh with each other while the support members 95 are not provided between the support table 50 and the frame 70. This causes the weight of the frame 70 to be received by the support members 95, and thus the portions where the rack 91 and the pinions 92 are in mesh with each other does not receive the weight of the frame 70. Therefore, the weight of the frame 70 is not imposed on the portions where the rack 91 and the pinions 92 are in mesh with each other, and thus the pinions 92 are easily rotated smoothly with respect to the rack 91. Length D11 in the height direction Z of the support members 95 may be equal to distance D12 from the top surface of the support table 50 to the bottom surface of the frame 70. Thus, length D11 in the height direction Z of the support members 95 may be longer than, or equal to, distance D12 from the top surface of the support table 50 to the bottom surface of the frame 70.

[0056] In this embodiment, as shown in FIG. 2, the printer 10 includes the printer main body 20 supporting the support table 50 and the rotation mechanism 60 shown in FIG. 3. As shown in FIG. 5, the frame 70 of the rotation mechanism 60 is detachable from the printer main body 20. With such a configuration, printing may be performed on the first printing target 5 and the second printing target 6 as follows. For performing printing on the first printing target 5, the frame 70 and also the first rotation shaft 81 and the second rotation shaft 82 supported by the frame 70 are detached from the printer main body 20. As shown in FIG. 2, the printing is performed on the first printing target 5 while the first printing target 5 is supported by the support table 50. For performing printing on the second printing target 6, as shown in FIG. 5, the frame 70 is attached to the printer main body 20, and the second printing target 6 is supported between the first rotation shaft 81 and the second rotation shaft 82 supported by the frame 70. In this state, the printing is performed on the second printing target 6. In this manner, the frame 70 is attachable to, and detachable from, the printer main body 20, so that printing is performed both on the first printing target 5 and the second printing target 6 with one printer 10.

[0057] In this embodiment, the rotation mechanism 60 includes the base unit 61 secured to the printer main body 20. The frame 70 is detachable from the base unit 61. In this embodiment, the base unit 61, which is one component of the rotation mechanism 60, is secured to the printer main body 20. Therefore, the frame 70, when

needs to be attached, may be attached to the base unit 61 secured to the printer main body 20. Therefore, it is easy to see the position, in the printer main body 20, to which the frame 70 is to be attached.

[0058] In this embodiment, the support table 50 is movable in the height direction Z. The printer main body 20 includes the plate-like base portion 21. The base unit 61 includes the base plates 62, the base shafts 64 and the slidable bodies 66. The base plates 62 are secured to the base portion 21. The base shafts 64 extend upward from the base plates 62. The slidable bodies 66 are slidably outserted over the base shafts 64, and are secured to the frame 70. In the case where, for example, the slidable bodies 66 are not provided, the frame 70 is the only member that is slidable along the base shafts 64. In this case, the length in the height direction Z of a member slidable along the base shafts 64 (i.e., the length of the frame 70) is short. This may cause the central axes of the base shafts 64 and the central axes of the insertion holes 76 to be shifted from each other easily, and thus it may be made difficult for the frame 70 to slide. However, in this embodiment, the slidable bodies 66 are secured to the frame 70. With such a structure, the length in the height direction Z of the member slidable along the base shafts 64 (i.e., the total length of the frame 70 and each of the slidable bodies 66) is made longer. This allows the central axes of the base shafts 64 and the central axes of the insertion holes 76 to match each other easily. Therefore, the frame 70 is allowed to slide easily along the base shafts 64.

<Embodiment 2>

[0059] Now, a printer 10A according to embodiment 2 will be described. FIG. 7 and FIG. 8 are respectively a plan view and a front view of a rotation mechanism 60A and a support table 50 of the printer 10A according to this embodiment. FIG. 9 is a right side view showing a state where toothed belts 91A and pulleys 92A are in mesh with each other in this embodiment.

[0060] The printer 10A includes the support table 50 and the rotation mechanism 60A. The support table 50 according to this embodiment have substantially the same configuration as that of the support table 50 in embodiment 1. The rotation mechanism 60A includes a base unit 61, a frame 70, a first rotation shaft 81, a second rotation shaft 82, the toothed belts 91A, the pulleys 92A, and support members 95A. The base unit 61, the frame 70, the first rotation shaft 81 and the second rotation shaft 82 have the same configurations as those in embodiment 1, and will not be described again. Hereinafter, the toothed belts 91A, the pulleys 92A and the support members 95A according to this embodiment will be described in detail.

[0061] Each of the toothed belts 91A has substantially the same function as that of the rack 91 in embodiment 1, and is an example of the rack according to the present invention. As shown in FIG. 7, the toothed belts 91A ex-

tend in the sub scanning direction X, and are provided on the top surface of the support table 50. In this embodiment, like in embodiment 1, the toothed belt 91A is provided at either the left end portion or the right end portion of the support table 50 (e.g., at the left end portion of the support table 50). Alternatively, as shown in FIG. 7, the toothed belt 91A may be provided at each of the left end portion and the right end portion of the support table 50.

[0062] As shown in FIG. 9, the toothed belts 91A each include a base portion 97A and teeth 93A. The base portion 97A extends in the sub scanning direction X. The teeth 93A are formed on a top surface of the base portion 97A, and are aligned in the sub scanning direction X. In this embodiment, the base portion 97A and the teeth 93A are separate from each other. Alternatively, the base portion 97A and the teeth 93A may be integral with each other. In this embodiment, the base portion 97A is, for example, belt-like and is relatively thin. The base portion 97A is formed of, for example, a flexible material, for example, a resin material. The teeth 93A are attached to the top surface of the base portion 97A. There is no specific limitation on the material that forms the teeth 93A. The teeth 93A are formed of, for example, a resin material. In this embodiment, the teeth 93A are relatively thin, and are thinner than the rack teeth 93 (see FIG. 6) in embodiment 1.

[0063] In this embodiment, each of the pulleys 92A has substantially the same function as that of the pinion 92 in embodiment 1, and is an example of the pinion according to the present invention. The pulleys 92A are to be in mesh with the toothed belts 91A. In this embodiment, the pulleys 92A are provided on the support table 50, at ends of the first rotation shaft 81 and the second rotation shaft 82 on the side on which the toothed belt 91A is provided. In the case where, for example, the toothed belt 91A is provided at the left end portion of the support table 50, the pulleys 92A are provided around the left end portion of the first rotation shaft 81 and around the left end portion of the second rotation shaft 82. In the case where, as shown in FIG. 7, the toothed belts 91A are provided at both of the left end portion and the right end portion of the support table 50, the pulleys 92A are also provided around both of the left end portion and the right end portion of the first rotation shaft 81 and around both of the left end portion and the right end portion of the second rotation shaft 82. As shown in FIG. 9, the pulleys 92A each include a plurality of teeth 94A, which are to be in mesh with the teeth 93A of the toothed belt 91A. The plurality of teeth 94A are formed at a circumferential surface of each of the pulleys 92A, and are aligned in a circumferential direction of the pulley 92A. In this embodiment, the teeth 94A are relatively thin, and are thinner than the pinion teeth 94 (see FIG. 6) in embodiment 1.

[0064] In this embodiment, length L1 in the sub scanning direction X of the toothed belts 91A is longer than length L2 in the sub scanning direction X of the support table 50. Length L1 in the sub scanning direction X of the toothed belts 91A is, for example, 1.1 to 2.0 times, pref-

erably 1.1 to 1.5 times, and more preferably 1.1 to 1.3 times of length L2 in the sub scanning direction X of the support table 50. "Length L2 in the sub scanning direction X of the support table 50" refers to the length in the sub scanning direction X of a surface of the support table 50 on which the toothed belt 91 is provided (in this embodiment, the top surface of the support table 50). In this embodiment, the tooth belts 91A protrude forward and rearward from the support table 50. Alternatively, the toothed belts 91A may protrude either forward or rearward from the support table 50.

[0065] FIG. 10 is a conceptual view showing distance L4 by which the frame 70 is movable, and is a plan view of the rotation mechanism 60A and the support table 50. In this embodiment, as shown in FIG. 10, a rearmost position of the frame 70 with respect to the toothed belts 91A is the position represented by the solid line, and is a position with which the second rotation shaft 82 is located at rear ends of the toothed belts 91A (such a position of the frame 70 is position P1 in FIG. 10). A frontmost position of the frame 70 with respect to the toothed belts 91A is the position represented by the two-dot chain line, and is a position with which the first rotation shaft 81 is located at front ends of the toothed belts 91A (such a position of the frame 70 is position P2 in FIG. 10). In this embodiment, the frame 70 is movable between position P1 and position P2 as represented by the arrow in FIG. 10 in a state where the toothed belts 91A and the pulleys 92A are in mesh with each other.

[0066] In this embodiment, the distance between the first rotation shaft 81 (in more detail, a central axis A81 of the first rotation shaft 81) and the second rotation shaft 82 (in more detail, a central axis A82 of the second rotation shaft 82) is set as inter-shaft distance L3. A maximum distance by which the frame 70 is movable in the sub scanning direction X in a state where the toothed belts 91A and the pulleys 92A are in mesh with each other is set as movable distance L4. Movable distance L4 is also a distance by which the support table 50 is movable in the sub scanning direction X in a state where the toothed belts 91A and the pulleys 92A are in mesh with each other.

[0067] Movable distance L4 of the frame 70 is obtained as a result of inter-shaft distance L3 being subtracted from length L1 in the sub scanning direction X of the toothed belts 91A, and $L4 = L1 - L3$. In this embodiment, length L1 of the toothed belts 91A and the length of the pulleys 92A (e.g., circumferential length thereof) are set to be longer by inter-shaft distance L3.

[0068] If, as in embodiment 1, length L1 of the toothed belts 91A is equal to length L2 of the support table 50, movable distance L4 of the frame 70 is obtained as a result of inter-shaft distance L3 being subtracted from length L2 of the support table 50, and $L4 = L2 - L3$. In this case, the range in which the support table 50 is movable while the printing is performed on the second printing target 6 is narrower by inter-shaft distance L3 than during normal printing (in this example, in the case where print-

ing is performed on the first printing target 5 with the first printing target 5 being directly supported by the support table 50). However, in this embodiment, length L1 of the toothed belts 91A and the length of the pulleys 92A (e.g., the circumferential length thereof) are set to be longer by inter-shaft length L3. Therefore, the support table 50 is guaranteed to be movable in substantially the same range as in the case of the normal printing.

[0069] As described above, length L1 in the sub scanning direction X of the toothed belts 91A may be made longer than length L2 in the sub scanning direction X of the support table 50, so that movable distance L4 in the sub scanning direction X of the support table 50 in a state where the pulleys 92A are in mesh with the toothed belts 91A is made longer. As can be seen, movable distance L4 in the sub scanning direction X of the support table 50 may be made longer, so that the maximum rotation amount of each of the pulleys 92A is made larger. When the maximum rotation amount of each of the pulleys 92A is made larger, the second printing target 6, even having a relatively long outer diameter, is rotated 360 degrees. Therefore, the printing is performed on the entirety of the outer circumferential surface of the second printing target 6 even in the case where the second printing target 6 has a relatively long outer diameter.

[0070] In this embodiment, as shown in FIG. 8, the support members 95A are attached to the support table 50. The support members 95A support the frame 70 such that the frame 70 is slidable. In this embodiment, while the support table 50 is moved in the sub scanning direction X, the support members 95A also move in the sub scanning direction X, and the frame 70 is slid against the support members 95A. As shown in FIG. 7, the support members 95A extend in the sub scanning direction X, and are rod-like members each having a quadrangular cross-section. In this embodiment, length L5 in the sub scanning direction X of the support members 95A is longer than length L2 in the sub scanning direction X of the support table 50. Length L5 of the support members 95A is equal to length L1 of the toothed belts 91A.

[0071] In this embodiment, as shown in FIG. 8, the support members 95A are each provided with a stay 96A. The stay 96A is aligned with the support member 95A in the main scanning direction Y, and as shown in FIG. 7, extends in the sub scanning direction X. The stay 96A is integrally formed with the support member 95A. Alternatively, the stay 96A and the support member 95A may be separate from each other. The stay 96A has a thickness smaller than that of the support member 95A. In this embodiment, the "thickness" of the stay 96A is a length thereof in the height direction Z.

[0072] In this embodiment, the toothed belt 91A is provided on a top surface of the stay 96A. Namely, the toothed belt 91A is attached to the support table 50 via the stay 96. In the case where the toothed belt 91A is provided at either the left end portion or the right end portion of the support table 50, the stay 96A is not provided at the end where the toothed belt 91A is not pro-

vided.

[0073] Even in the case where the support member 95A is attached to the support table 50 as in this embodiment, the weight of the frame 70 is received by the support member 95A, and thus is not received by portions where the toothed belts 91A and the pulleys 92A are in mesh with each other. Therefore, the weight of the frame 70 is not imposed on the portions where the toothed belts 91A and the pulleys 92A are in mesh with each other. As a result, the pulleys 92A are easily rotated smoothly with respect to the toothed belts 91A.

[0074] In each of the above embodiments, the frame 70 supports both of the first rotation shaft 81 and the second rotation shaft 82 such that the first rotation shaft 81 and the second rotation shaft 82 are rotatable. It is sufficient that the frame 70 supports at least one of the first rotation shaft 81 and the second rotation shaft 82 such that the at least one rotation shaft is rotatable. For example, the frame 70 may support one of the first rotation shaft 81 and the second rotation shaft 82 such that the one rotation shaft is rotatable while supporting and securing the other of the first rotation shaft 81 and the second rotation shaft 82 such that the other rotation shaft is not rotatable. It is now assumed that, for example, the first rotation shaft 81 is rotatably supported by the frame 70 and that the second rotation shaft 82 is non-rotatably supported by the frame 70. In this case, no pinion 92 needs to be provided around the second rotation shaft 82. In this case, the second rollers 86 may be rotatably provided around the second rotation shaft 82. With such a configuration, when the second printing target 6 is rotated by the rotation of the first rotation shaft 81, the second rollers 86 follow the rotation of the second printing target 6 to rotate with respect to the second rotation shaft 82. Therefore, the second printing target 6 rotates smoothly.

Claims

1. A printing target rotation mechanism (60), comprising:
 - a first rotation shaft (81) extending in a first direction;
 - a second rotation shaft (82) aligned with the first rotation shaft (81) in a second direction crossing the first direction, the second rotation shaft (82) supporting, together with the first rotation shaft (81), a printing target (6) having an outer circumferential shape that is at least partially cylindrical;
 - a frame (70) supporting at least one of the first rotation shaft (81) and the second rotation shaft (82) such that the at least one rotation shaft (81, 82) is rotatable;
 - a rack (91) provided on a support table (50) movable in the second direction with respect to the

- frame (70), the rack (91) extending in the second direction; and
 a pinion (92) provided around the at least one rotation shaft and rotatable together with the at least one rotation shaft (81, 82), the pinion (92) being in mesh with the rack (91). 5
2. The printing target rotation mechanism (60) according to claim 1, wherein: 10
- the first rotation shaft (81) and the second rotation shaft (82) are both rotatable with respect to the frame (70), and
 the pinion (92) is provided around each of the first rotation shaft (81) and the second rotation shaft (82). 15
3. The printing target rotation mechanism (60) according to claim 1 or 2, wherein the rack (91) and the pinion (92) are each formed of a helical gear. 20
4. The printing target rotation mechanism (60) according to any one of claims 1 through 3, further comprising a support member (95) located between the support table (50) and the frame (70), 25
- wherein the support member (95) has a length in an up-down direction longer than, or equal to, a distance from a top surface of the support table (50) to a bottom surface of the frame (70) in a state where the rack (91) and the pinion (92) are in mesh with each other while the support member (95) is not provided between the support table (50) and the frame (70). 30
5. A printer (10), comprising: 35
- a printer main body (20) supporting the support table (50); and
 the rotation mechanism (60) according to any one of claims 1 through 4,
 wherein the frame (70) of the rotation mechanism is detachable from the printer main body (20). 40
6. The printer (10) according to claim 5, wherein: 45
- the rotation mechanism (60) includes a base unit (61) secured to the printer main body (20), and the frame (70) is detachable from the base unit (61). 50
7. The printer (10) according to claim 6, wherein: 55
- the support table (50) is movable in the up-down direction,
 the printer main body (20) includes a plate-like base portion (21), and
 the base unit (61) includes:
- a base plate (62) secured to the base portion (21),
 a base shaft (64) extending upward from the base plate (62), and
 a slidable body (66) slidably outsized over the base shaft (64) and secured to the frame (70).
8. The printer (10) according to any one of claims 5 through 7, wherein the rack (91) is longer than the support table (50) in the second direction.

FIG. 1

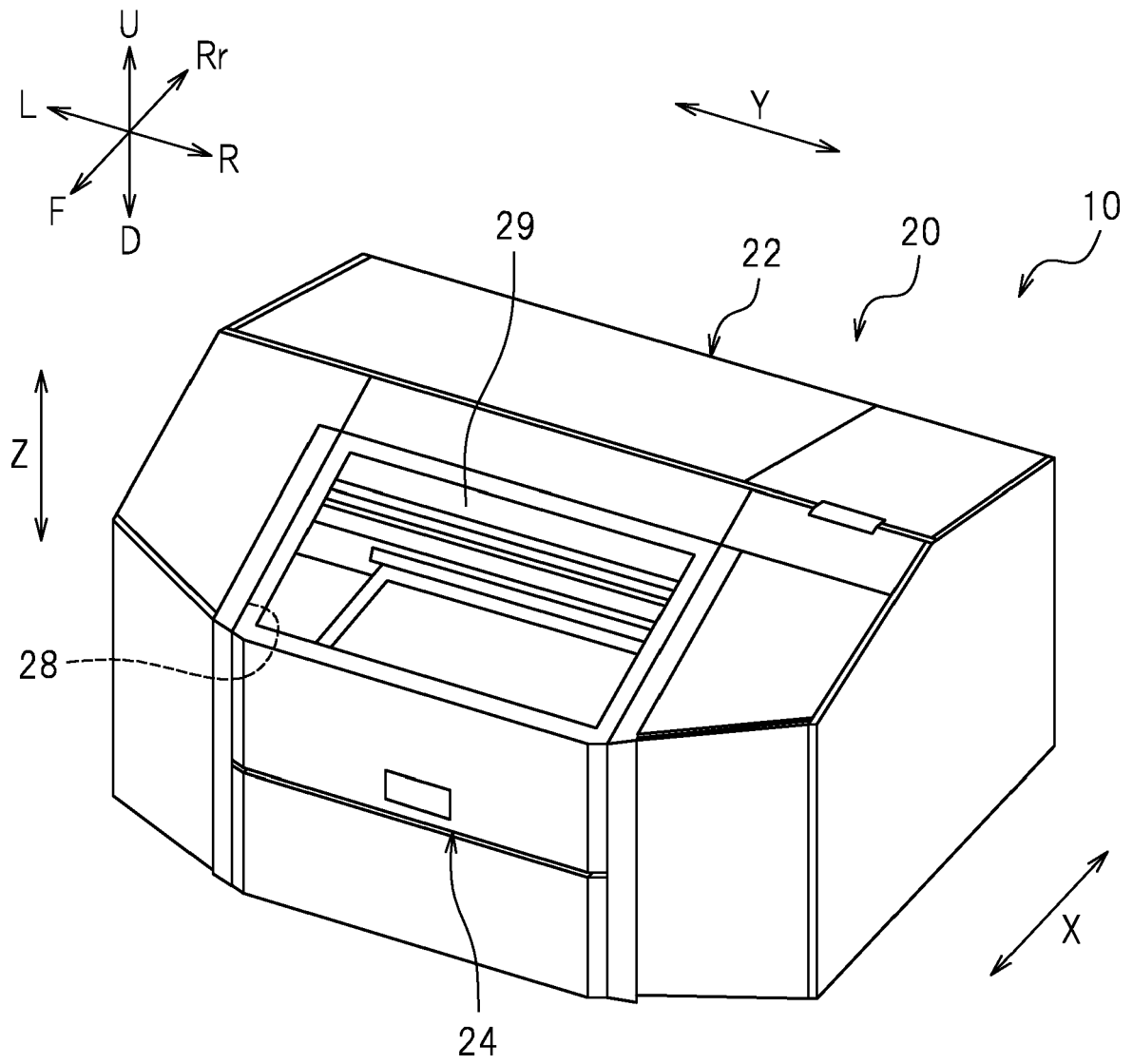
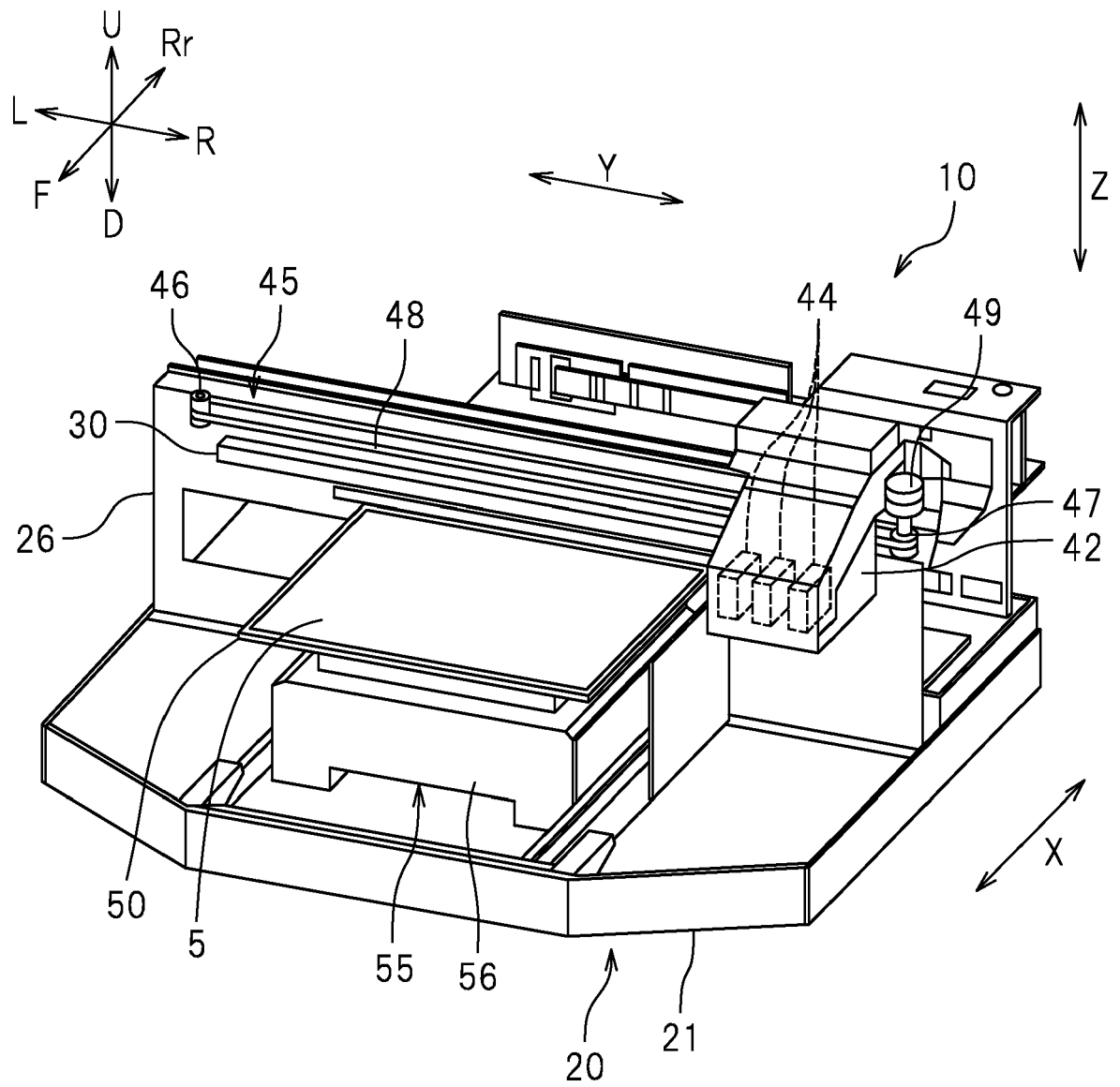


FIG.2



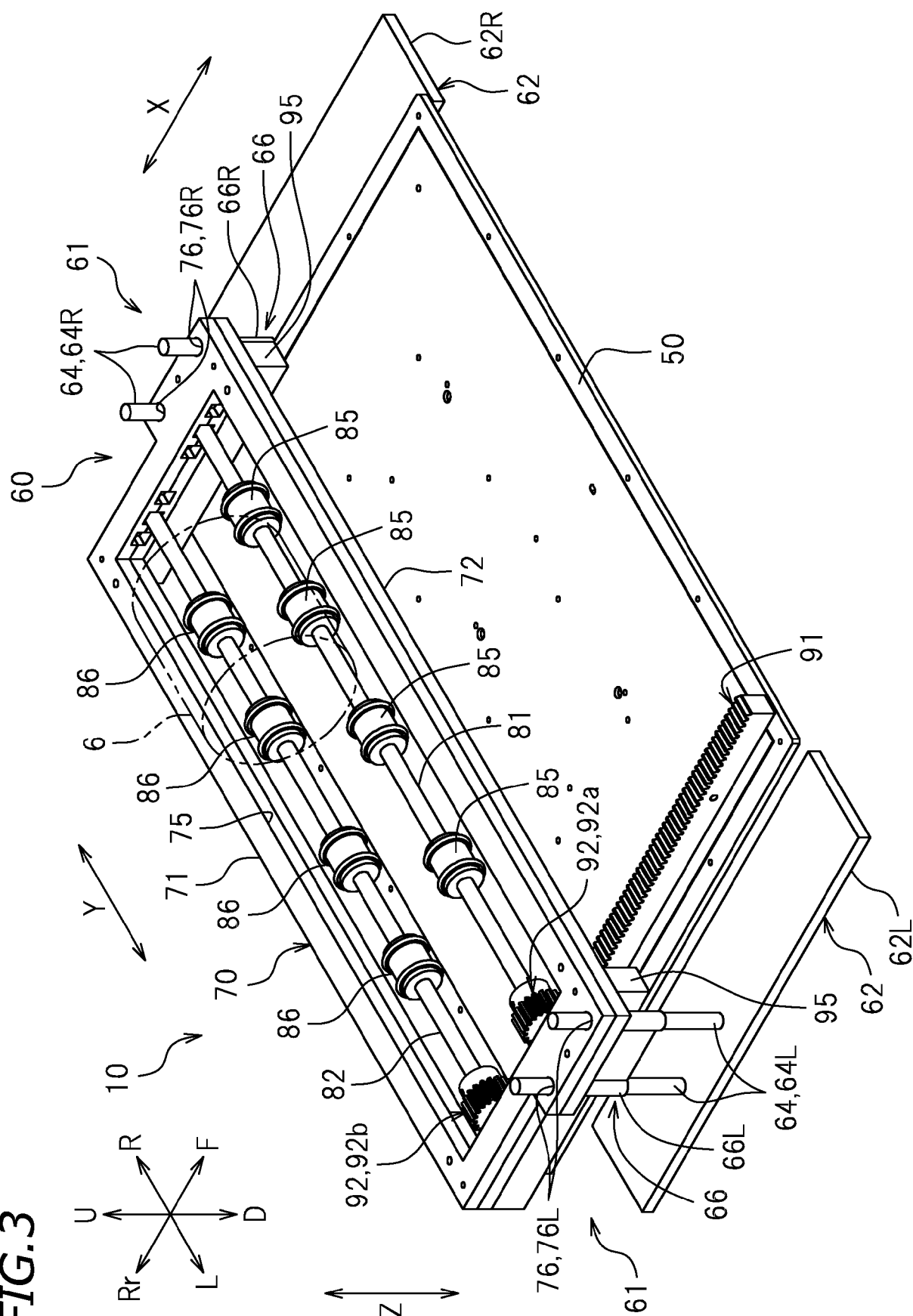


FIG. 4

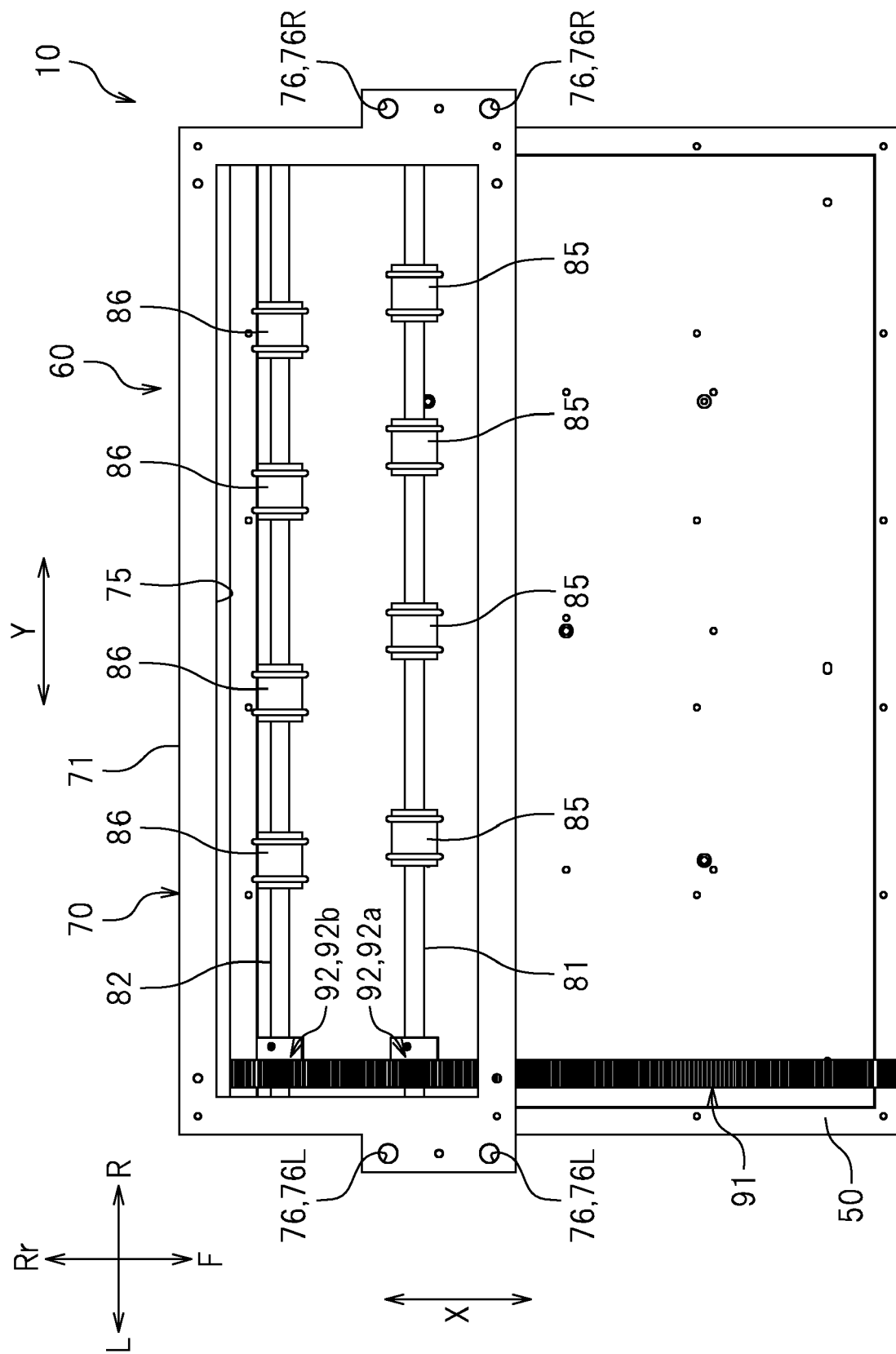


FIG.5

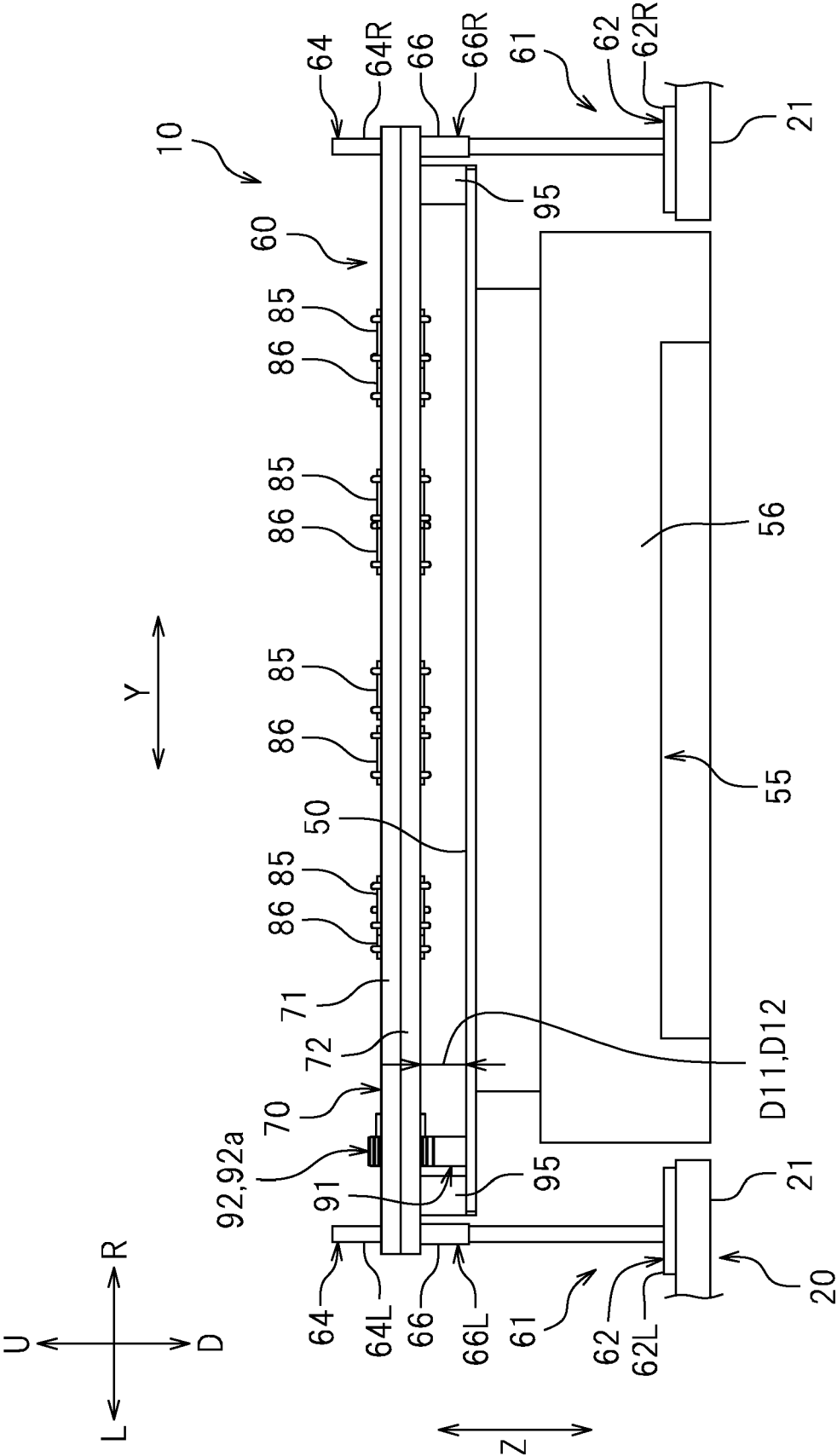


FIG. 6

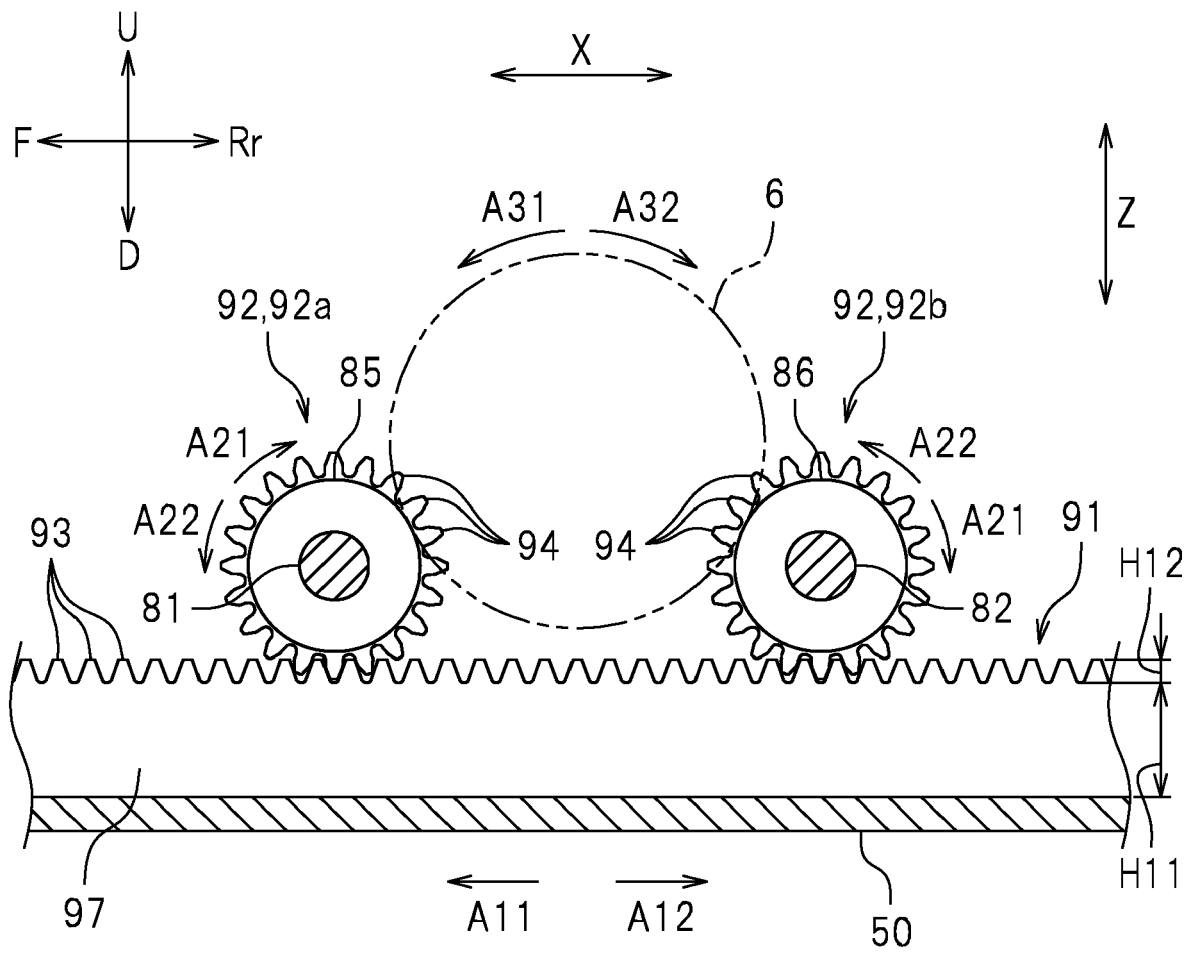


FIG. 7

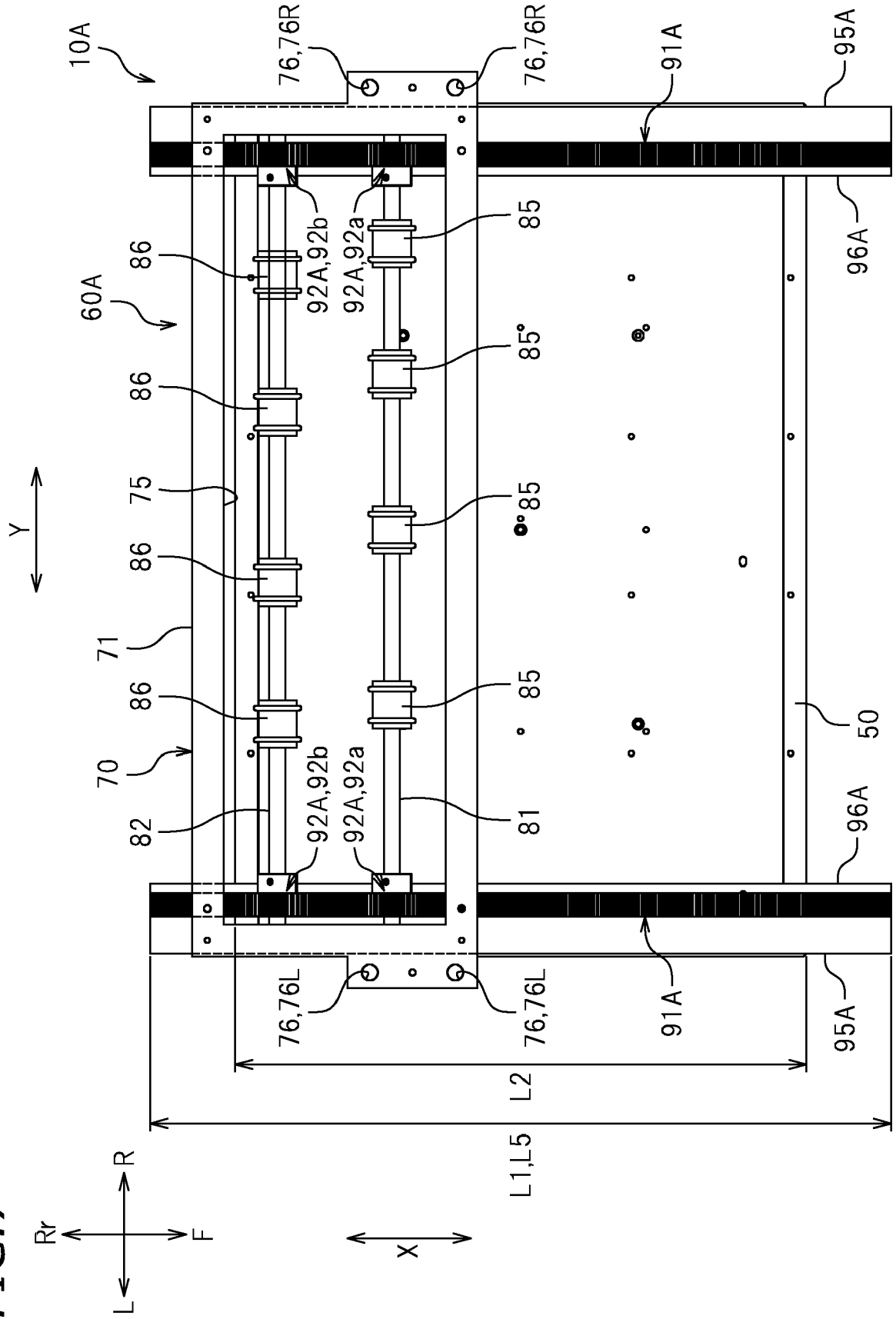


FIG. 8

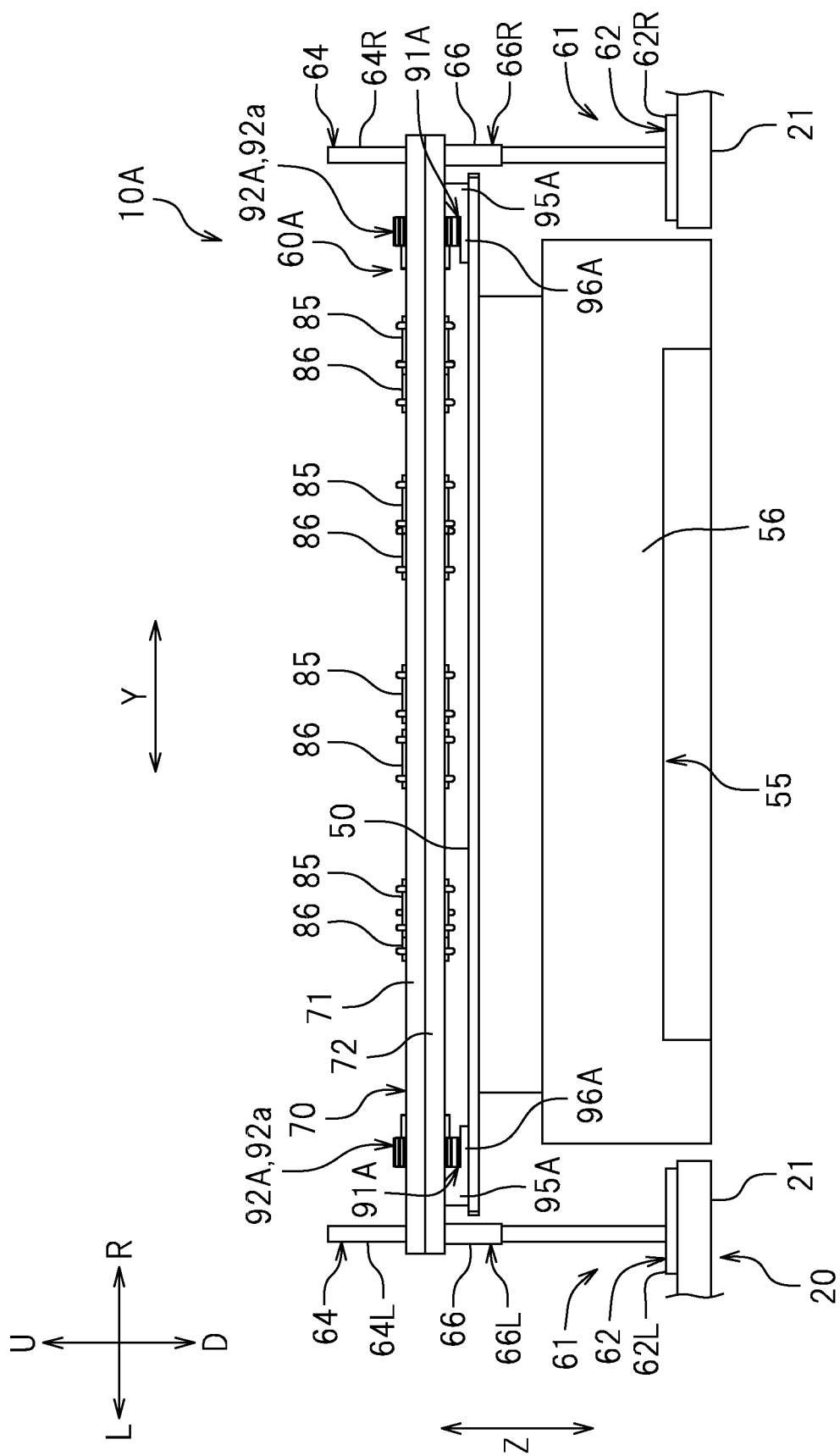


FIG. 9

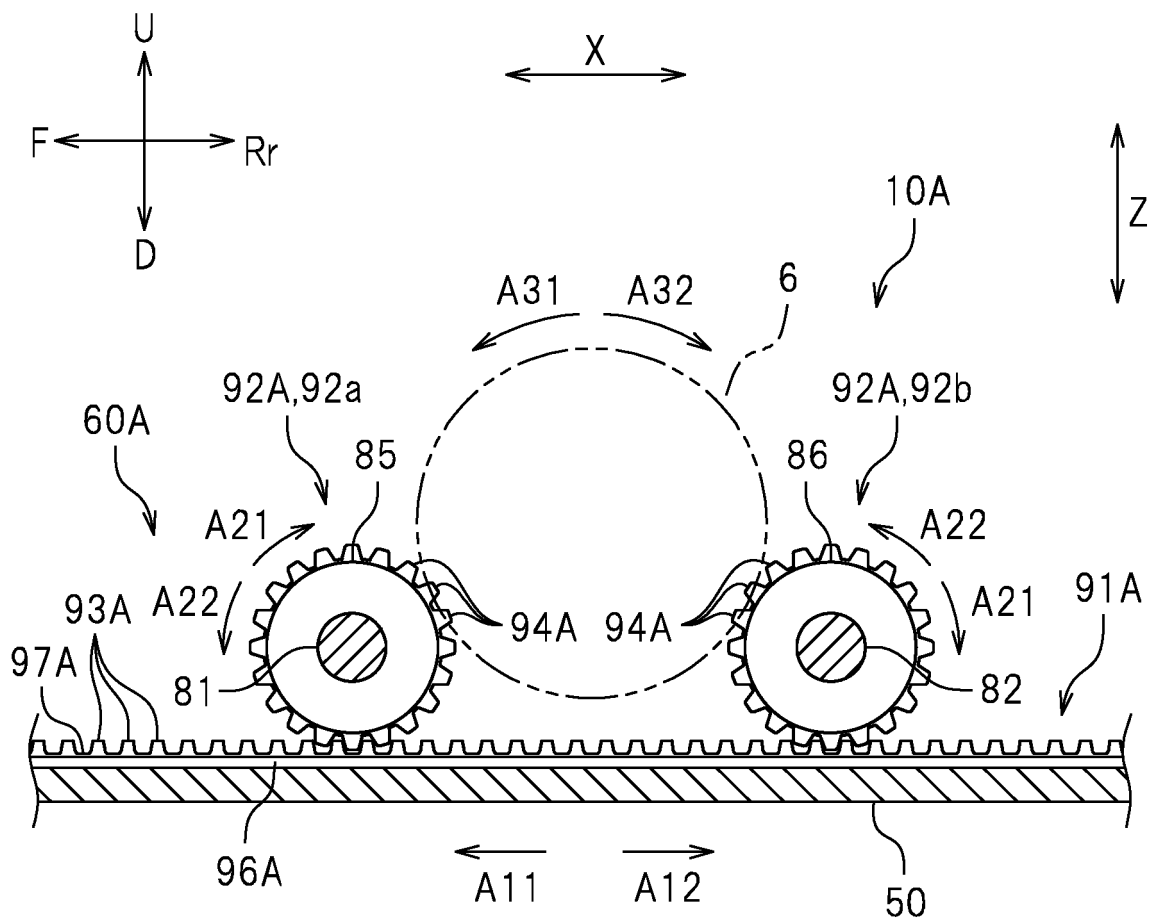
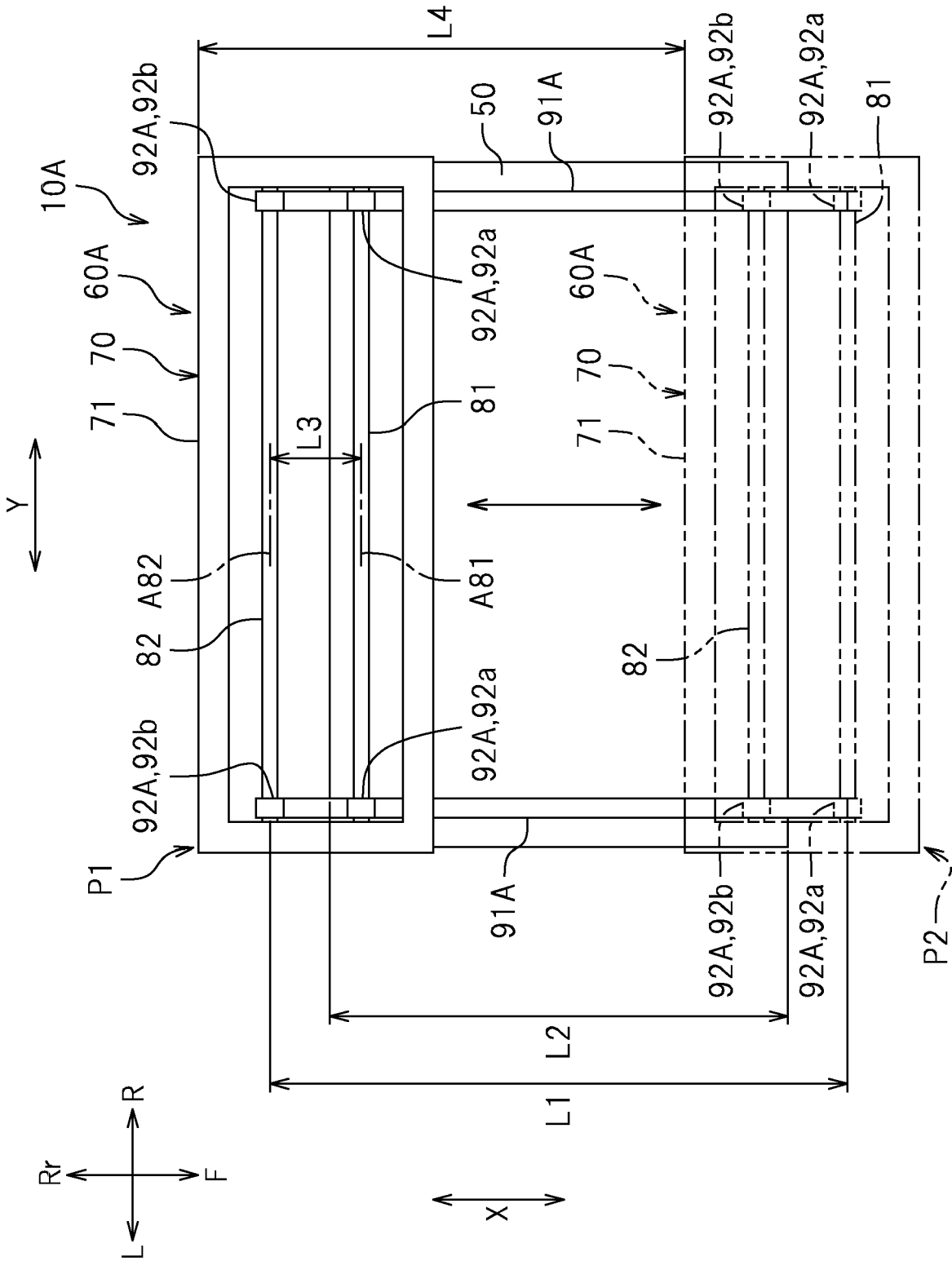


FIG.10





EUROPEAN SEARCH REPORT

Application Number

EP 22 16 5567

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A, D	US 2018/304645 A1 (NAKANISHI KENTO [JP]) 25 October 2018 (2018-10-25) * paragraphs [0001], [0023] - [0084]; figures 1-3, 4a, 4b * -----	1-8	INV. B41J3/407
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 August 2022	Examiner Bacon, Alan
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