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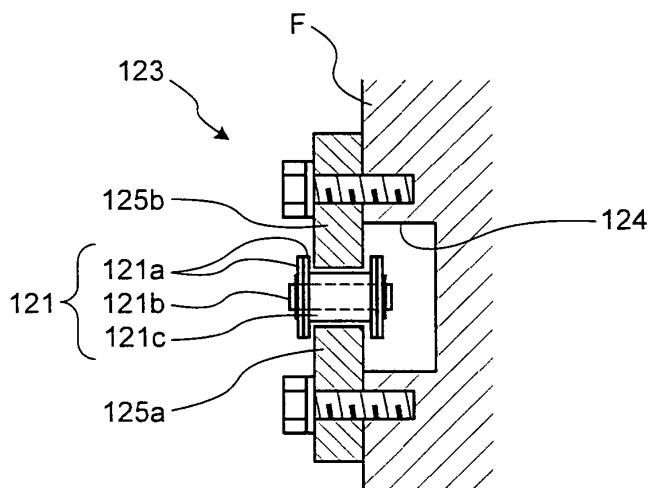
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(54) **SHEET CONVEYOR AND PRINTING MACHINE**

(57) To reduce noise by suppressing oscillation occurring when an endless chain is rotated. In a chain gripper 12 that includes a sandwiching mechanism that sandwiches or releases a sheet, an endless chain 121 with no ends that supports the sandwiching mechanism, and a chain guide 123 that guides the endless chain 121 along a predetermined rotational orbit, the chain guide 123 includes a groove 124 that is provided to a fixed frame F

as a depression and forms a rotational orbit, an inner guiding member 125a that is attached to the frame F while housing part of the endless chain 121 in the groove 124, and supports the inner side of the rotational orbit of the endless chain 121, and an outer guiding member 125b that is attached to the frame F while housing part of the endless chain 121 in the groove 124, and supports the outer side of the rotational orbit of the endless chain 121.

FIG.4



Description

TECHNICAL FIELD

[0001] The present invention relates to a sheet conveying apparatus that conveys a sheet for example, and a printer using the sheet conveying apparatus.

BACKGROUND ART

[0002] For example, a sheet-fed printer that prints images on sheets such as films, art paper sheets, and coated paper sheets as well as on ordinary paper includes a paper-feeding unit that sends out and feeds printing sheets one by one, a printing unit that prints images on a sheet fed and conveyed, and a paper discharging unit that discharges the sheet on which images are printed. To convey a sheet, the paper-discharging unit of the sheet-fed printer includes a sheet conveying apparatus in which both ends of a sandwiching mechanism that sandwiches a sheet are attached to left and right endless chains with no ends that are arranged oppositely, and the sandwiching mechanism is moved along the endless orbits of the endless chains by rotating the endless chains in synchronization. The sheet conveying apparatus includes a chain guide that guides the endless chains along a predetermined orbit for conveying a sheet.

[0003] In a chain guide of a conventional sheet conveying apparatus, a clamp forming a depression is fixed to a left frame and a right frame of a paper-discharging unit, and a guiding member is attached above and below an opening part of the depression of the clamp. The endless chains are supported by being housed in the depression at its one side, and sandwiched by the upper and the lower guiding members (see for example Patent Document 1).

[0004] [Patent Document 1] Japanese Patent Application Laid-open No. 11-199085

DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] In the chain guide in the conventional sheet conveying apparatus explained above, the clamp is provided protruding from the frame to form the depression that houses one side of the endless chains, and the guiding member that sandwiches and supports the endless chains is attached to the clamp. Accordingly, noise occurs when the endless chains are rotated along the chain guide because the clamp amplifies oscillation of the endless chains.

[0006] The present invention has been made in view of the above problem, and has an object to provide a sheet conveying apparatus and a printer that can reduce noise by suppressing oscillation occurring when an endless chain is rotated.

MEANS FOR SOLVING PROBLEM

[0007] According to an aspect of the present invention, a sheet conveying apparatus includes: a sandwiching mechanism that sandwiches or releases a sheet; an endless chain with no ends that supports the sandwiching mechanism; and a chain guide that guides the endless chain along a predetermined rotational orbit. The chain guide includes: a groove that is provided to a fixed frame as a depression and forms the rotational orbit; an inner guiding member that is attached to the frame while housing part of the endless chain in the groove, and supports an inner side of the rotational orbit of the endless chain; and an outer guiding member that is attached to the frame while housing part of the endless chain in the groove, and supports an outer side of the rotational orbit of the endless chain.

[0008] Advantageously, the sheet conveying apparatus further includes a sprocket that engages with the endless chain and drives rotation of the endless chain. An overlapping part at which a tooth of the sprocket and an edge of the inner guiding member overlap with each other is provided, notches are provided to both the edge of the inner guiding member and the tooth of the sprocket at the overlapping part, and a thickness of the overlapping part engaged with the endless chain and a thickness of the inner guiding member engaged with the endless chain are adjusted to be same by overlapping of the notches.

[0009] Advantageously, in the sheet conveying apparatus, the inner guiding member and the outer guiding member each include a fixed part fixed to the frame, and a moving part provided movably to the frame to expand and shrink the rotational orbit, an overlapping part at which an edge of the fixed part and an edge of the moving part overlap with each other is provided, notches are provided to both the edge of the fixed part and the edge of the moving part at the overlapping part, and a thickness of the overlapping part engaged with the endless chain, a thickness of the moving part engaged with the endless chain, and a thickness of the fixed part engaged with the endless chain are adjusted to be same by overlapping of the notches.

[0010] According to another aspect of the present invention, a printer includes: a paper-feeding unit that sends out and feeds sheets one by one; a printing unit that prints images on the sheets fed from the paper-feeding unit; and a paper-discharging unit that discharges the sheets on which images are printed by the printing unit, the paper-discharging unit including a sheet conveying apparatus including a sandwiching mechanism that sandwiches or releases the sheets, an endless chain with no ends that supports the sandwiching mechanism, and a chain guide that guides the endless chain along a predetermined rotational orbit. The chain guide of the sheet conveying apparatus includes: a groove that is provided to a fixed frame as a depression and forms the rotational orbit; an inner guiding member that is attached to the

frame while housing part of the endless chain in the groove, and supports an inner side of the rotational orbit of the endless chain; and an outer guiding member that is attached to the frame while housing part of the endless chain in the groove, and supports an outer side of the rotational orbit of the endless chain.

[0011] Advantageously, in the printer, the sheet conveying apparatus includes a sprocket that engages with the endless chain and drives rotation of the endless chain, an overlapping part at which a tooth of the sprocket and an edge of the inner guiding member overlap with each other is provided, notches are provided to both the edge of the inner guiding member and the tooth of the sprocket at the overlapping part, and a thickness of the overlapping part engaged with the endless chain and a thickness of the inner guiding member engaged with the endless chain are adjusted to be same by overlapping of the notches.

[0012] Advantageously, in the printer, the inner guiding member and the outer guiding member each include a fixed part fixed to the frame, and a moving part provided movably to the frame to expand and shrink the rotational orbit, an overlapping part at which an edge of the fixed part and an edge of the moving part overlap with each other is provided, notches are provided to both the edge of the fixed part and the edge of the moving part at the overlapping part, and a thickness of the overlapping part engaged with the endless chain, a thickness of the moving part engaged with the endless chain, and a thickness of the fixed part engaged with the endless chain are adjusted to be same by overlapping of the notches.

EFFECT OF THE INVENTION

[0013] In the sheet conveying apparatus of claim 1, because the endless chain is supported by the inner guiding member and the outer guiding member attached directly on the side of the frame, oscillation occurring when the endless chain is rotated is suppressed by the rigid structure, and thus noise can be reduced.

[0014] In the sheet conveying apparatus of claim 2, because contacts between the inner guiding member and the sprocket are prevented, and the thickness of the overlapping part engaged with the endless chain and the thickness of the inner guiding member engaged with the endless chain are adjusted to be the same by the overlapping of the notches, the endless chain is delivered smoothly between the inner guiding member and the sprocket.

[0015] In the sheet conveying apparatus of claim 3, because the entire length of the rotational orbit of the endless chain changes by moving the moving part, the tension of the endless chain supported by the inner guiding member and the outer guiding member can be adjusted. Furthermore, because the thickness of the overlapping part engaged with the endless chain, the thickness of the moving part engaged with the endless chain, and the thickness of the fixed part engaged with the end-

less chain are adjusted to be the same by the overlapping of the notches of the fixed part and the moving part, the endless chain can be rotated smoothly at the part at which the tension of the endless chain is adjusted.

[0016] In the printer of claim 4, because the endless chain is supported by the inner guiding member and the outer guiding member attached directly on the side of the frame, oscillation occurring when the endless chain is rotated is suppressed by the rigid structure, and thus noise can be reduced.

[0017] In the printer of claim 5, because contacts between the inner guiding member and the sprocket are prevented, and the thickness of the overlapping part engaged with the endless chain and the thickness of the inner guiding member engaged with the endless chain are adjusted to be the same by the overlapping of the notches, the endless chain is delivered smoothly between the inner guiding member and the sprocket, and paper can be smoothly discharged by the paper-discharging unit.

[0018] In the printer of claim 6, the tension of the endless chain supported by the inner guiding member and the outer guiding member can be adjusted by moving the moving part. Furthermore, because the thickness of the overlapping part engaged with the endless chain, the thickness of the moving part engaged with the endless chain, and the thickness of the fixed part engaged with the endless chain are adjusted to be the same by the overlapping of the notches of the fixed part and the moving part, the endless chain can be rotated smoothly at the part at which the tension of the endless chain is adjusted, and paper can be discharged smoothly by the paper-discharging unit.

BRIEF DESCRIPTION OF DRAWINGS

[0019]

[Fig. 1] Fig. 1 is a schematic of a configuration of a printer according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a schematic perspective view of a sheet conveying apparatus according to the embodiment of the present invention.

[Fig. 3] Fig. 3 is a schematic of a chain guide of the sheet conveying apparatus shown in Fig. 2.

[Fig. 4] Fig. 4 is a sectional schematic of A-A in Fig. 3.

[Fig. 5] Fig. 5 is a sectional schematic of B-B in Fig. 3.

[Fig. 6] Fig. 6 is a sectional schematic of C-C in Fig. 3.

[Fig. 7] Fig. 7 is a sectional schematic of D-D in Fig. 3.

EXPLANATIONS OF LETTERS OR NUMERALS

[0020]

- | | |
|---|-----------------------------|
| 1 | sheet-fed printer (printer) |
| 2 | paper-feeding unit |
| 3 | printing unit |

4	paper-discharging unit
12	chain gripper
13	discharged paper pile
121	endless chain
121a	link
121b	pin
121c	roller
122	gripper
122a	gripper bar
122b	gripper nail
123	chain guide
124	groove
125a	inner guiding member
125b	outer guiding member
125c	notch
125d	seam
125e	long hole
126	sprocket
126a	tooth
126b	notch
127	pin
128	sliding member
128a	long hole
128b	screw
F	frame
F1	depression
P	sheet
W1	first turning part
W2	second turning part
W3	arc part
W4	arc part
W5	tilting part
θ	tilting angle

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0021] Embodiments of a sheet conveying apparatus and a printer according to the present invention are explained in detail with reference to the drawings. The present invention is not limited by the embodiments. The components in the embodiments include those that can be easily replaced by a person skilled in the art, and those that are substantially the same.

[0022] Fig. 1 is a schematic of a configuration of a printer according to an embodiment of the present invention. Fig. 2 is a schematic perspective view of a sheet conveying apparatus according to the embodiment of the present invention. Fig. 3 is a schematic of a chain guide of the sheet conveying apparatus shown in Fig. 2. Fig. 4 is a sectional schematic of A-A in Fig. 3. Fig. 5 is a sectional schematic of B-B in Fig. 3. Fig. 6 is a sectional schematic of C-C in Fig. 3. Fig. 7 is a sectional schematic of D-D in Fig. 3.

[Printer]

[0023] The printer according to an embodiment of the

present invention is, as shown in Fig. 1, a sheet-fed printer 1 that prints images on sheets P such as films, art paper sheets, and coated paper sheets as well as on ordinary paper, and is a so-called offset sheet-fed printer including a plate cylinder 8, a blanket cylinder 9, and an impression cylinder 10.

[0024] The sheet-fed printer 1 includes a paper-feeding unit 2 that sends out and feeds the printing sheets P one by one, a printing unit 3 that prints images on the sheets P conveyed in an advance direction R, and a paper-discharging unit 4 that discharges the sheets P on which images are printed.

[0025] The paper-feeding unit 2 includes a feed paper cassette 5, and a paper-feeding mechanism 6. The sheets P are stacked and placed on the feed paper cassette 5. The paper-feeding mechanism 6 takes up the sheets P stacked on the feed paper cassette 5 from the top, and supplies the sheets one by one, and is configured by a separator (a paper suction), a cam, a swing gripper and the like that are not shown in the figures. The feed paper cassette 5 is controlled to move vertically upward corresponding to the supply of the sheets P to maintain a substantially constant positional relationship between the paper-feeding mechanism 6 and the sheets P.

[0026] The printing unit 3 includes a plurality of printing units 7 that realizes color printing by printing various colors. The printing units 7 of colors to be printed are aligned in the advance direction R of the sheets P. In the sheet-fed printer 1, for example, the four printing units 7 corresponding to four different colors of cyan (C), magenta (M), yellow (Y), and black (BL) are aligned.

[0027] The printer unit 7 includes the plate cylinder 8, the blanket cylinder 9, and the impression cylinder 10. The plate cylinder 8, the blanket cylinder 9, and the impression cylinder 10 are formed cylindrically, and their central axes are horizontal, and cross the advance direction R. The plate cylinder 8, the blanket cylinder 9, and the impression cylinder 10 are arranged in this order from the vertically upper side to the bottom side. The circumferential surface of the plate cylinder 8 contacts with that of the blanket cylinder 9, and the circumferential surface of the blanket cylinder 9 contacts with that of the impression cylinder 10. The plate cylinder 8, the blanket cylinder 9, and the impression cylinder 10 are rotatable about their central axes.

[0028] A press plate to form a printing image on the peripheral surface of the plate cylinder 8 is mounted on the plate cylinder 8. Each of the printing units 7 includes, in the periphery of the plate cylinder 8, an ink supply device (not shown) including a group of rollers for supplying ink to an image-making part of the press plate, and a dampening device (not shown) including a group of water rollers for supplying dampening water to a non-image making part of the press plate. A blanket formed with an elastic material is mounted on the peripheral surface of the blanket cylinder 9. Ink supplied to an image-making part of the plate cylinder 8 is transcribed to the blanket. The blanket cylinder 9 transcribes the ink to the

sheets P with a printing image of the press plate as the pattern. The impression cylinder 10 applies a predetermined printing pressure to the sheets P in cooperation with the blanket cylinder 9. The impression cylinder 10 is a so-called double cylinder having a diameter twice that of the plate cylinder 8 and that of the blanket cylinder 9, and a sandwiching mechanism (not shown) that holds the leading end of each sheet P is provided on its periphery at two parts of the peripheral surface at symmetrical positions with the central axis of the impression cylinder 10 as the reference.

[0029] The printer unit 7 further includes an intermediate cylinder 11. The intermediate cylinder 11 is formed cylindrically similarly to the plate cylinder 8, the blanket cylinder 9, and the impression cylinder 10, and the central axis is horizontal, and crosses the advance direction R. The intermediate cylinder 11 is rotatable about the central axis. The intermediate cylinder 11 is arranged upstream of the impression cylinder 10 in the advance direction R of the sheets P, and contacts the circumferential surface of the impression cylinder 10. The intermediate cylinder 11 is a double cylinder having a diameter twice that of the plate cylinder 8 and that of the blanket cylinder 9 similarly to the impression cylinder 10, and a sandwiching mechanism (not shown) that holds the leading end of each sheet P is provided on its periphery at two parts of the peripheral surface at symmetrical positions with the central axis of the intermediate cylinder 11 as the reference.

[0030] In each of the printing units 7, the intermediate cylinder 11 is arranged to contact the impression cylinder 10 of the printer unit 7 that is adjacent thereto and provided upstream in the advance direction R of the sheets P. In the present embodiment, as shown in Fig. 1, only the printer unit 7 positioned most upstream in the advance direction R does not have the intermediate cylinder 11 of a double-cylinder size on the side of the upstream of paper conveyance, and paper is conveyed to the impression cylinder 10 from the paper-feeding unit 2 through an intermediate cylinder of a single-cylinder type. The sheets P supplied from the paper-feeding unit 2 are first supplied to between the blanket 9 and the impression cylinder 10 of the printer unit 7 positioned most upstream, and thereafter gripped one after another by the sandwiching mechanism of the intermediate cylinder 11 and then of the impression cylinder 10 of the downstream printer unit 7. The sheets P are conveyed through each of the printing units 7 in this manner, and ink is transcribed thereon one after another on their way. The type and the arrangement of the impression cylinder 10 and the intermediate cylinder 11 are not limited to those explained above, but may be modified appropriately in accordance with a demanded conveyance path design.

[0031] The paper-discharging unit 4 conveys the sheets P on which the printing unit 3 prints images, and line up and stack the sheets P. The paper-discharging unit 4 includes a chain gripper 12 that conveys the sheets P, a discharged paper pile 13 on which the sheets P with

images printed thereon are stacked, a fan device 14 that forms downdraft near the discharged paper pile 13, a paper pad 16, a vacuum suction vehicle device 17, a rear paper aligning device 18, and a width direction paper aligning device 19.

[0032] The chain gripper 12 configures the sheet conveying apparatus of the present invention that receives the sheets P from the impression cylinder 10 of the most downstream printer unit 7 and conveys the sheets to a predetermined position above the discharged paper pile 13. The chain gripper 12 includes endless chains 121 with no ends that are arranged oppositely and move between an adjacent position of the impression cylinder 10 of the most downstream printer unit 7 and the upper position of the discharged paper pile 13 in an rotational orbit, and supports a gripper (sandwiching mechanism) 122 including a gripper bar 122a (see Fig. 2), and a gripper nail 122b that sandwiches and releases the sheets P with the gripper bar 122a (see Fig. 2) between each of the endless chains 121.

[0033] The discharged paper pile 13 is suspended by a chain, and is movable vertically. The sheets P discharged from the chain gripper 12 are stacked and placed on the discharged paper pile 13. When the top surface height of the top stage of the discharged paper pile 13 rises by the sheets P being stacked, the discharged paper pile 13 is controlled to move vertically downward gradually continuously or at steps so that the fall distance of the sheets P is substantially constant.

[0034] The fan device 14 includes a plurality of fans arranged substantially rectangularly, and moves the sheets P discharged from the chain gripper 12 vertically downward by flow control above the discharged paper pile 13. The vacuum suction vehicle device 17 is for decreasing the advance speed of the falling sheets P and at the same time controlling the falling position. The vacuum suction vehicle device 17 brakes the sheets P by applying suction on the edge of each sheet P upstream (posterior) in the advance direction R.

[0035] The paper pad 16, the rear paper aligning device 18, and the width direction paper aligning device 19 are provided at positions below the chain gripper 12 and above the discharged paper pile 13, that is, between the chain gripper 12 and the discharged paper pile 13. The paper pad 16 is for regulating the position of the sheets P downstream (anterior) in the advance direction R, and the paper pad 16 is provided in plurality in the width direction of the sheets P. The rear paper aligning device 18 is for regulating the position of the sheets P upstream (posterior) in the advance direction R, is configured by a plurality of plates extending vertically, and is attached to the vacuum suction vehicle device 17. The width direction paper aligning device 19 is for aligning the position of the sheets P in the width direction.

[0036] In the sheet-fed printer 1, the sheets P loaded on the feed paper cassette 5 of the paper-feeding unit 2 are taken out from the top one by one by the paper-feeding mechanism 6, and are supplied to the printer unit 7

of the printing unit 3. The sheets P supplied to the printer unit 7 are gripped sequentially by the sandwiching mechanism of the impression cylinder 10 and the intermediate cylinder 11 of each of the downstream printing units 7. The sheets P are conveyed through each of the printing units 7, and ink is transcribed thereon one after another on its way. In the printer unit 7, water is supplied from the dampening device to a non-image making part of a press plate attached to the peripheral surface of the plate cylinder 8, and then ink is supplied from the ink supplying device to an image-making part of the press plate. A printing image on the press plate thus obtained is transcribed onto the blanket cylinder 9. The printing image transcribed onto the blanket cylinder 9 is transcribed onto the sheets P carried by the impression cylinder 10, and an image of a single color is printed. This process is repeated with each of the printing units 7, and thereby a color image is printed. The sheets P on which the color image is printed are gripped by the impression cylinder 10 of the last printer unit 7 (most downstream) and then by the gripper 122 of the chain gripper 12. The gripping of the sheets P conveyed by the chain gripper 12 is released above the discharged paper pile 13, and the sheets P fall and are stacked on the discharged paper pile 13. At this time, powder is sprayed in advance on the sheets P while conveyed by the chain gripper 12 to prevent undried ink from being transferred on the back of the sheets P above. The sheets P to be stacked on the discharged paper pile 13 are lined up by the fan device 14, the vacuum suction vehicle device 17, the paper pad 16, the rear paper aligning device 18, and the width direction paper aligning device 19, and then is stacked on the discharged paper pile 13.

[Sheet conveying apparatus]

[0037] The sheet conveying apparatus is configured as the chain gripper 12 of the paper-discharging unit 4. The sheet conveying apparatus includes a chain guide 123 as shown in Figs. 2 to 7. The chain guide 123 forms a rotational orbit of the endless chain 121 shown in Fig. 1, and is arranged to be opposite to guide the endless chain 121 arranged oppositely. The chain guide 123 includes a groove 124, an inner guiding member 125a and an outer guiding member 125b.

[0038] The groove 124 is provided as a depression on the opposing surface of the fixed frame F (see Fig. 4) arranged oppositely to follow the rotational orbit of the endless chain 121 shown in Fig. 3. The groove 124 has opening and groove depth that can house one side of the endless chain 121.

[0039] The inner guiding member 125a is formed into a plate as shown in Fig. 3, and is attached to the frame F with a bolt or the like along the inner side of the rotational orbit of the endless chain 121 and partially along the inner side of the rotational orbit of the opening of the groove 124 as shown in Fig. 4. The outer guiding member 125b is formed into a plate as shown in Fig. 3, and is attached

to the frame F with a bolt or the like along the outer side of the rotational orbit of the endless chain 121 and partially along the inner side of the rotational orbit of the opening of the groove 124 as shown in Fig. 4. The inner guiding member 125a and the outer guiding member 125b are provided with the opening part of the groove 124 therebetween as a gap. A roller 121c of the endless chain 121 is fit and inserted to the gap between inner guiding member 125a and the outer guiding member 125b. The endless chain 121 fit and inserted to the gap between the inner guiding member 125a and the outer guiding member 125b is housed in the groove 124 at its one end and arranged on the frame F, and is guided along a predetermined rotational orbit.

[0040] Steel SS400 is used for the inner guiding member 125a and the outer guiding member 125b, and its hardness is enhanced by surface polishing followed by tufftriding. Steel S45C may be used for the inner guiding member 125a and the outer guiding member 125b.

[0041] The roller 121c of the endless chain 121 includes in its inside a pin 121b that connects a link 121a of the endless chain 121, and is rotatable about the shaft of the pin 121b. The roller 121c fits with a tooth 126a of the sprocket 126 (see Figs. 2 and 3) that drives rotation of the endless chain 121 at a first turning part W1 (the part at which the gripping is switched from the impression cylinder 10 of the most downstream printer unit 7 to the gripper 122) of the rotational orbit shown in Fig. 3.

[0042] The inner guiding member 125a passes the endless chain 121 to the tooth 126a of the sprocket 126 at the first turning part W1 of the rotational orbit, and receives the endless chain 121 from the tooth 126a of the sprocket 126. The inner guiding member 125a is cut at a position of the sprocket 126, and is continuous along the rotational orbit at other parts. As shown in Figs. 3 and 5, there is a part at which one end and the other end formed by cutting the inner guiding member 125a, and the tooth 126a of the sprocket 126 overlap with each other. At the overlapping part, a notch 125c and a notch 126b are provided at the both ends parts of the inner guiding member 125a, and the tooth 126a of the sprocket 126 as shown in Fig. 5, and the notches 125c, 126b are overlapped over one another with no contact so that a thickness T1 of the inner guiding member 125a engaged with the endless chain 121 and a thickness T2 of the overlapping part engaged with the endless chain 121 are adjusted to be the same and continuous.

[0043] The outer guiding member 125b is endlessly continuous along the rotational orbit regardless of the position of the sprocket 126. In other words, the outer guiding member 125b is an arc disposed along the circumference of the tooth 126a of the sprocket 126 at the first turning part W1 of the rotational orbit.

[0044] The inner guiding member 125a and the outer guiding member 125b are disposed in U-shapes at a second turning part W2 (the part above the discharged paper pile 13 at which the gripper 122 releases its gripping) of the rotational orbit shown in Fig. 3, and the U-shaped

part is divided from the inner guiding member 125a and the outer guiding member 125b of the other rotational orbit. The inner guiding member 125a and the outer guiding member 125b at the second turning part W2 of the rotational orbit are formed arcuate at their closing parts of the U-shapes, and the open ends of the U-shapes are linear and parallel with each other. Long holes 125e are provided at the open ends of the U-shapes as shown in Figs. 3 and 6. The long hole 125e is provided parallel with the guiding members 125a, 125b along the parallel directions of extension of the inner guiding member 125a and the outer guiding member 125b. The linear edges of the guiding members 125a, 125b of the other rotational orbit are provided at the open ends of the U-shapes, and the ends are connected with each other.

[0045] Specifically, the ends of the guiding members 125a, 125b of the other rotational orbit form a fixed part attached to the frame F with a pin 127 fixed to the frame F as shown in Fig. 6. On the other hand, in the U-shaped, open-ended guiding members 125a, 125b, the pin 127 is inserted through the long holes 125e, and moving parts supported movably in the direction of extension of the long holes 125e are formed. The U-shaped, open-ended guiding members 125a, 125b, and the ends of guiding members 125a, 125b of the other rotational orbit overlap with each other. The notch 125c is provided at the ends of the overlapping parts, and by overlapping the notches 125c, 125c, the thickness of the overlapping part engaged with the endless chain 121, and the thickness T1 of the guiding members 125a, 125b engaged with the endless chain 121 are adjusted to be the same and continuous.

[0046] Furthermore, the U-shaped guiding members 125a, 125b at the second turning part W2 of the rotational orbit are attached to a sliding member 128 as shown in Figs. 3 and 6. The grooves 124 that configure the chafing guide 123 together with the U-shaped guiding members 125a, 125b at the second turning part W2 of the rotational orbit is provided as a depression in the sliding member 128, and long holes 128a are provided on the sliding member 128 along the direction of extension of the long holes 125e. The sliding member 128 is housed in a depression F1 formed on the frame F, and is attached to the frame F with a screw 128b inserted to the long hole 128a. The frame F is slidable in the direction of extension of the holes 128a (the arrow S direction in Figs. 3 and 6) by loosening the screw 128b. That is, the U-shaped guiding members 125a, 125b at the second turning part W2 of the rotational orbit slide in the direction of extension of the long holes 125e (the arrow S direction in Figs. 3 and 6) such that part of the rotational orbit expands and shrinks while being supported by the pin 127 in relation to the guiding members 125a, 125b of the other rotational orbit, along with sliding of the sliding member 128.

[0047] The inner guiding member 125a and the outer guiding member 125b form the rotational orbit with a plurality of parts through seams 125d as shown in Fig. 3. As shown in Fig. 7, overlapping parts at which the edges

of the inner guiding member 125a and the edges of the outer guiding members 125b overlap are provided at the seams 125d. The notches 125c are provided to the edges at the overlapping parts, and the thickness of the overlapping parts engaged with the endless chain 121 and the thickness T1 of the guiding members 125a, 125b engaged with the endless chain 121 are adjusted to be the same and continuous by overlapping the notches 125c, 125c. The inner guiding member 125a and the outer guiding member 125b are attached to the frame F with a bolt or the like at the parts where the notches 125c, 125c are overlapped. With this configuration, manufacturing and assembling of the rotational orbit become easy, the inner guiding member 125a and the outer guiding member 125b are surely attached to the frame F, and rotation of the endless chain 121 can be smoothly guided at the overlapping parts of the seams 125d.

[0048] In the sheet conveying apparatus (the chain gripper 12) applied to the sheet-fed printer 1, when the sheets P are conveyed, rotation of the sprocket 126 is driven clockwise in Fig. 3 (the arrow K direction in Fig. 3), and the endless chain 121 is rotated in the arrow J direction in Fig. 3 along the rotational orbit formed by the inner guiding member 125a and the outer guiding member 125b. The gripper 122 that moves along the rotational orbit along with the rotation of the endless chain 121 grips the leading end of each sheet P at the first turning part W1, passes through the lower range of the rotational orbit, and release the gripping at the second turning part W2. After releasing the gripping, the gripper 122 passes through the upper range of the rotational orbit, and returns from the second turning part W2 to the first turning part W1.

[0049] In the sheet conveying apparatus thus configured, the chain guide 123 that supports endless chain 121 at the rotational orbit is configured by the groove 124 formed on the side of the fixed frame F forming a rotational orbit, and the guiding members 125a, 125b that are attached on the side of the frame F with part of the endless chain 121 being housed in the groove 124, and support the inner side and the outer side of the rotational orbit of the endless chain 121. Accordingly, because the endless chain 121 is supported by the frame F with the guiding members 125a, 125b attached directly on the side of the frame F, oscillation occurring due to the rotation of the endless chain 121 is suppressed by the rigid structure, and noise can be reduced. In the sheet-fed printer 1 to which the sheet conveying apparatus is applied to the paper-discharging unit 4, noise at the paper-discharging unit 4 can be reduced.

[0050] Some chain guides of existing sheet conveying apparatuses have a guide rail that is configured by casting to have a substantially C-shaped section. Because the guide rail configured by casting requires a longer time for processing accurately a C-shaped opening that supports the endless chain, manufacturing cost of the guide rail increases, the C-shaped opening end may break down due to fatigue caused by load or oscillation made

due to the centrifugal force of the rotating endless chain. In this regard, because the guiding members 125a, 125b formed into plates are attached to the opening of the groove 124 in the chain guide 123 of the present embodiment, the manufacturing cost of the guiding members can be reduced as compared with casting, oscillation can be suppressed as explained above, and accordingly occurrence of fatigue breakdown can be reduced. Because the steel SS4400 subjected to tufftriding, or the steel S45c are used as the material of the guiding members 125a, 125b, strength can be improved.

[0051] The inner guiding member 125a that supports the inner side of the rotational orbit of the endless chain 121 is cut at the position of the sprocket 126, and the notches 125c, 126b are provided at the overlapping part of the edge, and the tooth 126a of the sprocket 126. By overlapping the notches 125c, 126b with no contact, the thickness T1 of the inner guiding member 125a engaged with the endless chain 121 and the thickness T2 of the overlapping part engaged with the endless chain 121 are adjusted to be the same and continuous. Accordingly, contact between the inner guiding member 125a and the sprocket 126 is prevented, and the endless chain 121 can be delivered smoothly between the inner guiding member 125a and the sprocket 126. Because the outer guiding member 125b is an arc disposed along the circumference of the tooth 126a of the sprocket 126, the fitting of the sprocket 126 and endless chain 121 can be held at the circumference part of the sprocket 126. In the sheet-fed printer 1 in which the sheet conveying apparatus is applied to the paper-discharging unit 4, paper can be smoothly discharged by the paper-discharging unit 4.

[0052] The guiding members 125a, 125b of the chain guide 123 include, at the second turning part W2 of the rotational orbit, fixed parts fixed to the frame F and moving parts provided movably to the frame F so as to expand and shrink part of the rotational orbit of the endless chain 121. Accordingly, by moving the moving part along the direction of extension of the long hole 125e, the entire length of the rotational orbit changes, and thereby tension of the endless chain 121 supported by the guiding members 125a, 125b can be adjusted. Because the notches 125c, 125c are provided at the overlapping parts of the edges of the fixed part and the moving part, and the thickness of the overlapping part engaged with the endless chain 121 and the thickness T1 of the guiding members 125a, 125b engaged with the endless chain 121 are adjusted to be the same and continuous by overlapping the notches 125c, 125c, the endless chain 121 can be smoothly rotated at the part where the tension of the endless chain 121 is adjusted. In the sheet-fed printer 1 in which the sheet conveying apparatus is applied to the paper-discharging unit 4, paper can be smoothly discharged by the paper-discharging unit 4.

[0053] In the present embodiment, the sliding member 128 to which the U-shaped guiding members 125a, 125b provided with the groove 124 as depressions are at-

tached is applied as a configuration of sliding the moving part. Other than this, as a configuration of sliding the moving part, although not shown, the U-shaped guiding members 125a, 125b may be provided slidably to the frame F without using the sliding member 128, and the groove 124 that houses one side of the endless chain 121 may be attached corresponding to the position to which the guiding members 125a, 125b slide.

[0054] In the rotational orbit of the endless chain 121 in the sheet conveying apparatus (the chain gripper 12) applied to the sheet-fed printer 1, as shown in Figs. 1 and 3, the second turning part W2 of the rotational orbit (the part at which the gripper 122 releases the gripping above the discharged paper pile 13) is positioned above the first turning part W1 of the rotational orbit to which the sprocket 126 is provided (the part at which the gripping is switched from the impression cylinder 10 of the most downstream printer unit 7 to the gripper 122).

[0055] The sheets P whose leading ends are gripped by the gripper 122 at a lower range of the rotational orbit are conveyed to the upper left of Fig. 3 while being accelerated by the rotational drive of the sprocket 126. In the chain gripper 12 in the present embodiment, the chain guide 123 (the groove 124, the inner guiding member 125a, and the outer guiding member 125b) is arranged forming an arc part W3 with the largest curvature in accordance with the arrangement of the impression cylinder 10 of the most downstream printer unit 7, the discharged paper pile 13, and other configurations involved in the conveyance of the sheets P so that the first turning part W1 continues smoothly to the second turning part W2 in the lower range of the rotational orbit.

[0056] Accordingly, even when the gripper 12 gripping the leading end of each sheet P moves from the first turning part W1 to the second turning part W2 and changes its direction to the upper left, the gripper 122 is guided along a smooth locus of the arc part W3; thus, the rear end of each sheet P that is not gripped and free does not flip-flop, and the conveyance position of the sheets P can be stabilized. Furthermore, because the gripper 122 is guided along a smooth locus of the arc part W3, the centrifugal force that the endless chain 121 receives can be reduced, and the abrasion resistance between the endless chain 121 and the guiding members 125a, 125b can be improved.

[0057] In the upper range of the rotational orbit, the gripper 122 moves to the lower right of the Fig. 3 while being accelerated by the rotational drive of the sprocket 126. In the chain gripper 12 of the present embodiment, in the upper range of the rotational orbit, the chain guide 123 (the groove 124, the inner guiding member 125a, and the outer guiding member 125b) is arranged forming an arc part W4 so that the second turning part W2 continues smoothly to the first turning part W1. In the rotational orbit of the present embodiment, the arc part W3 is formed to have the largest curvature, and the curvature of the arc part W4, the first turning part W1, and the second turning part W2 (the closing part of the U-shape) are

set in this order.

[0058] In the lower range of the U-shape of the second turning part W2, the open ends of the guiding members 125a, 125b that continue from the arc part W3 are formed substantially horizontally. From the open ends to the left part of Fig. 3 up to the arc of the blocking part of the U-shape, the chain guide 123 (the groove 124, the inner guiding member 125a, and the outer guiding member 125b) is arranged forming a tilting part W5 tilting to the lower left. The tilting angle θ of the tilting part W5 is set to be equal to or more than 2° and equal to or less than 5° , and preferably 3.5° .

[0059] Accordingly, because the gripper 122 gripping the leading end of each sheet P moves along the tilting part W5 tilting to the lower left, each sheet P takes a position with its leading end directed slightly to the lower left, and the gripping of the gripper 122 is released; as a result, the fall position of the sheets P to the discharged paper pile 13 can be stabilized.

INDUSTRIAL APPLICABILITY

[0060] As can be seen, the sheet conveying apparatus and the printer according to the present invention are useful for a configuration including, for conveying a sheet, an endless chain with no ends that supports a sandwiching mechanism that sandwiches the sheet, and a chain guide that guides the endless chain along a predetermined rotational orbit, and especially is suited for reducing noise by suppressing oscillation occurring when the endless chain is rotated.

Claims

1. A sheet conveying apparatus comprising:

a sandwiching mechanism that sandwiches or releases a sheet;
an endless chain with no ends that supports the sandwiching mechanism; and
a chain guide that guides the endless chain along a predetermined rotational orbit, wherein the chain guide includes:

a groove that is provided to a fixed frame as a depression and forms the rotational orbit;
an inner guiding member that is attached to the frame while housing part of the endless chain in the groove, and supports an inner side of the rotational orbit of the endless chain; and
an outer guiding member that is attached to the frame while housing part of the endless chain in the groove, and supports an outer side of the rotational orbit of the endless chain.

2. The sheet conveying apparatus according to claim 1, further comprising a sprocket that engages with the endless chain and drives rotation of the endless chain, wherein

an overlapping part at which a tooth of the sprocket and an edge of the inner guiding member overlap with each other is provided,
notches are provided to both the edge of the inner guiding member and the tooth of the sprocket at the overlapping part, and
a thickness of the overlapping part engaged with the endless chain and a thickness of the inner guiding member engaged with the endless chain are adjusted to be same by overlapping of the notches.

3. The sheet conveying apparatus according to claim 1, wherein

the inner guiding member and the outer guiding member each include a fixed part fixed to the frame, and a moving part provided movably to the frame to expand and shrink the rotational orbit,
an overlapping part at which an edge of the fixed part and an edge of the moving part overlap with each other is provided,
notches are provided to both the edge of the fixed part and the edge of the moving part at the overlapping part, and
a thickness of the overlapping part engaged with the endless chain, a thickness of the moving part engaged with the endless chain, and a thickness of the fixed part engaged with the endless chain are adjusted to be same by overlapping of the notches.

4. A printer comprising:

a paper-feeding unit that sends out and feeds sheets one by one;
a printing unit that prints images on the sheets fed from the paper-feeding unit; and
a paper-discharging unit that discharges the sheets on which images are printed by the printing unit, the paper-discharging unit including a sheet conveying apparatus including a sandwiching mechanism that sandwiches or releases the sheets, an endless chain with no ends that supports the sandwiching mechanism, and a chain guide that guides the endless chain along a predetermined rotational orbit, wherein the chain guide of the sheet conveying apparatus includes:

a groove that is provided to a fixed frame as a depression and forms the rotational orbit;
an inner guiding member that is attached to the frame while housing part of the endless chain in the groove, and supports an inner side of the rotational orbit of the endless

chain; and
 an outer guiding member that is attached to
 the frame while housing part of the endless
 chain in the groove, and supports an outer
 side of the rotational orbit of the endless
 chain. 5

5. The printer according to claim 4, wherein
 the sheet conveying apparatus includes a sprocket
 that engages with the endless chain and drives ro- 10
 tation of the endless chain,
 an overlapping part at which a tooth of the sprocket
 and an edge of the inner guiding member overlap
 with each other is provided,
 notches are provided to both the edge of the inner 15
 guiding member and the tooth of the sprocket at the
 overlapping part, and
 a thickness of the overlapping part engaged with the
 endless chain and a thickness of the inner guiding
 member engaged with the endless chain are adjust- 20
 ed to be same by overlapping of the notches.

6. The printer according to claim 4, wherein
 the inner guiding member and the outer guiding 25
 member each include a fixed part fixed to the frame,
 and a moving part provided movably to the frame to
 expand and shrink the rotational orbit,
 an overlapping part at which an edge of the fixed
 part and an edge of the moving part overlap with 30
 each other is provided,
 notches are provided to both the edge of the fixed
 part and the edge of the moving part at the overlap-
 ping part, and
 a thickness of the overlapping part engaged with the 35
 endless chain, a thickness of the moving part en-
 gaged with the endless chain, and a thickness of the
 fixed part engaged with the endless chain are ad-
 justed to be same by overlapping of the notches.

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FIG.1

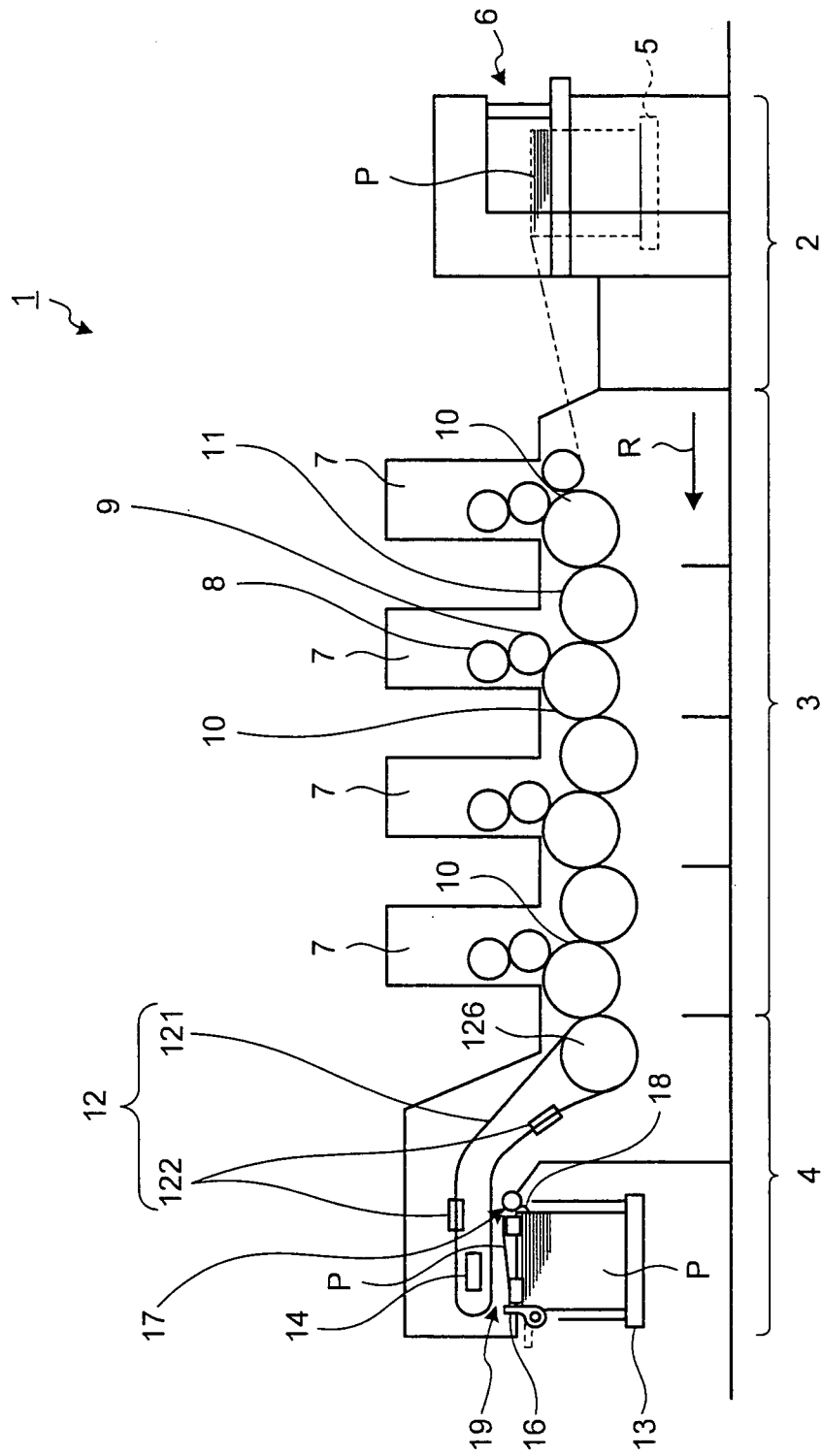


FIG.2

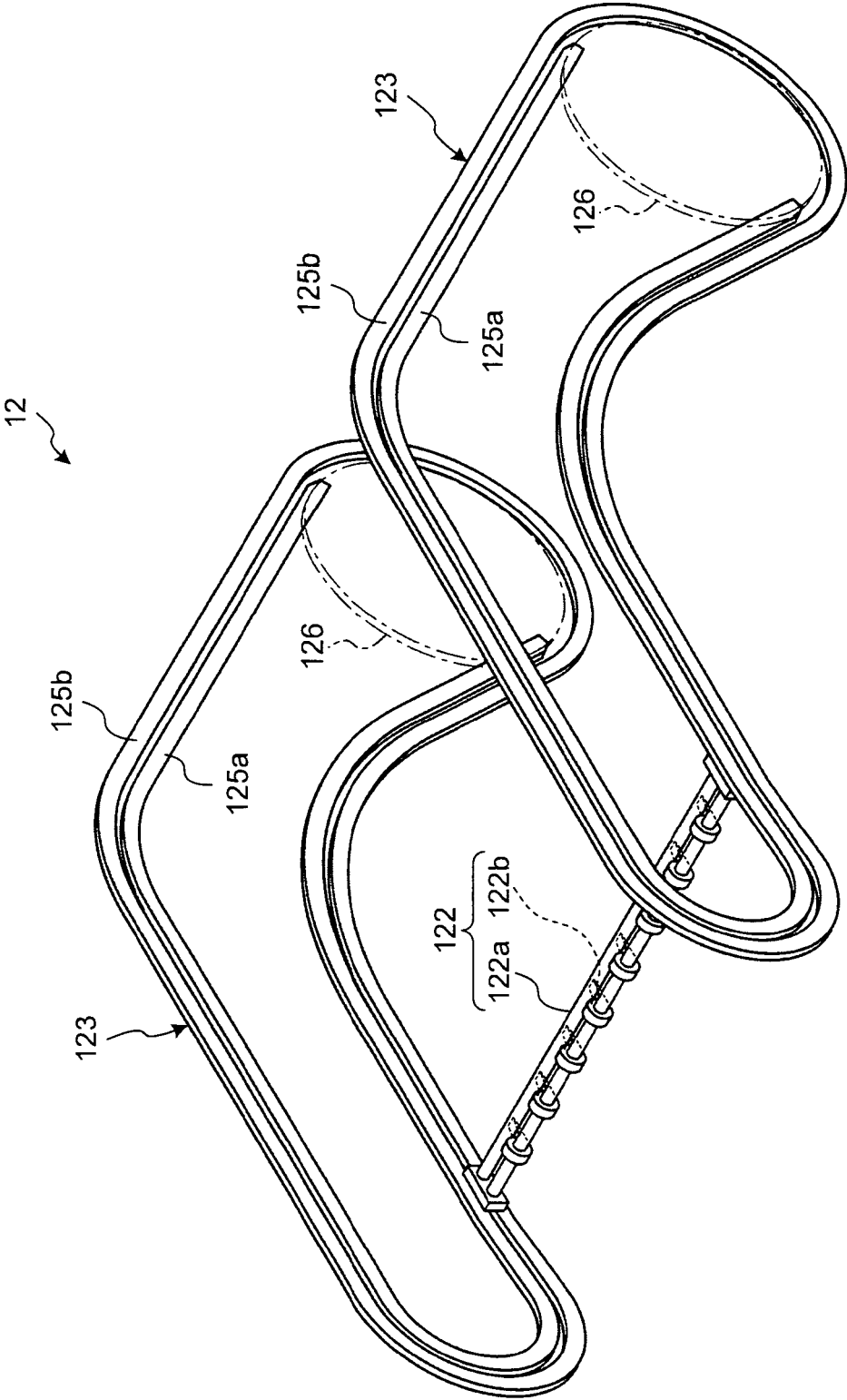


FIG.3

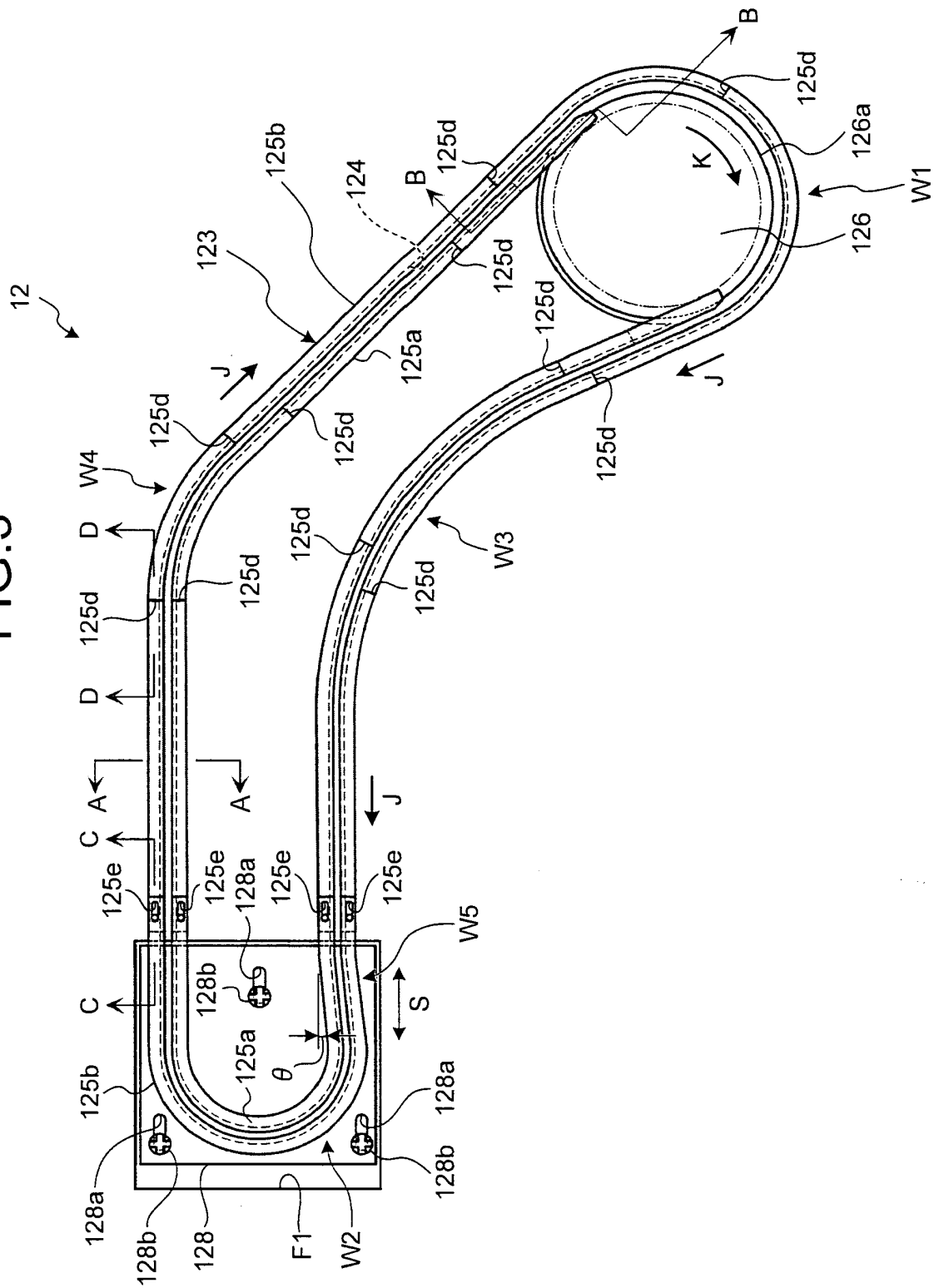


FIG.4

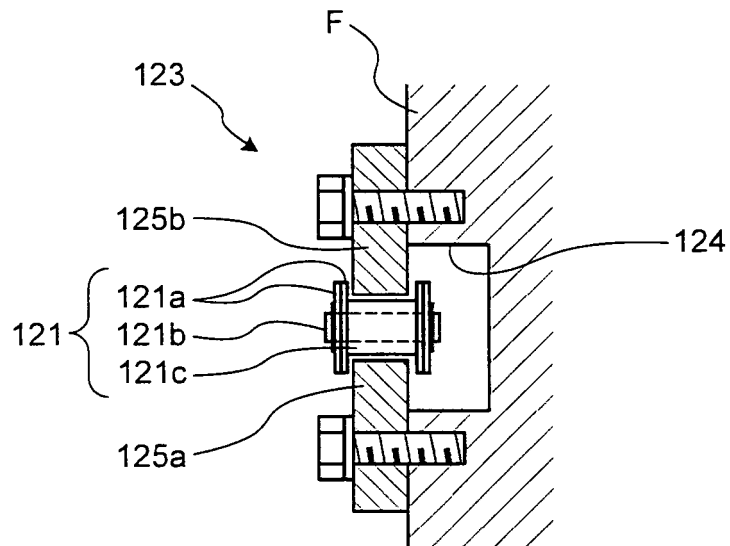


FIG.5

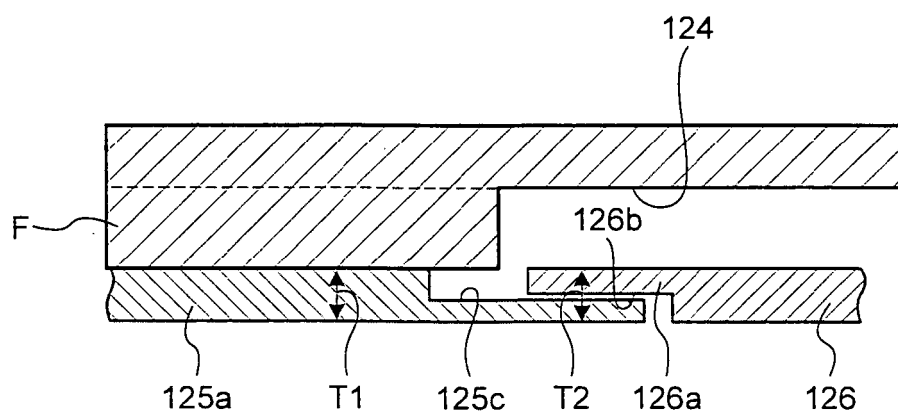


FIG.6

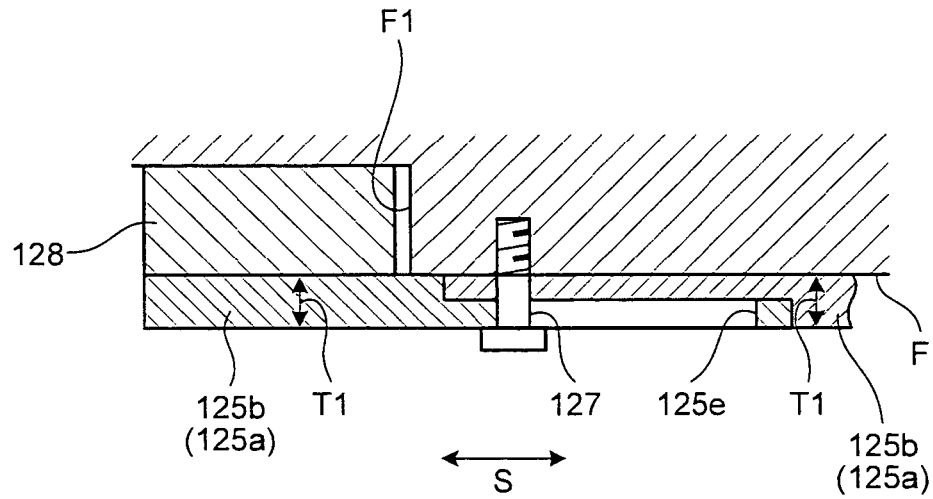
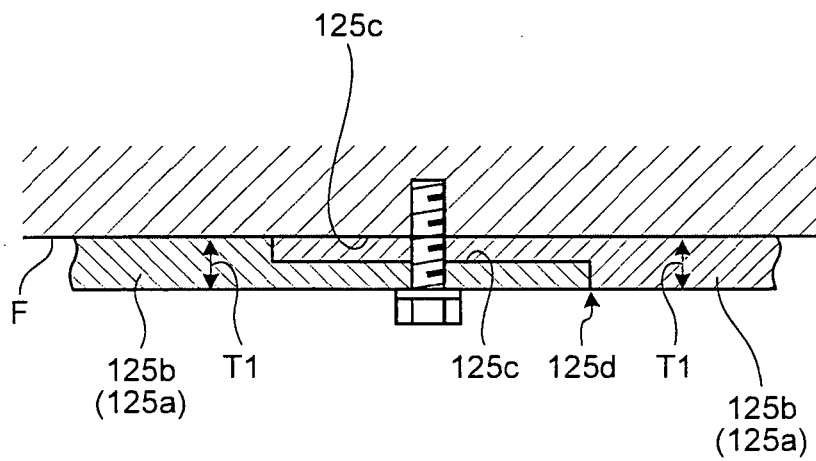


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/050055

A. CLASSIFICATION OF SUBJECT MATTER

B65H29/04 (2006.01) i, B41F21/08 (2006.01) i, B65H5/08 (2006.01) i, B65H5/02 (2006.01) n

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65H29/04, B41F21/08, B65H5/08, B65H5/02

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	JP 09-040254 A (Heidelberger Druckmaschinen AG.), 10 February, 1997 (10.02.97), Par. No. [0014]; Fig. 5 & US 5823526 A & EP 753477 A2 & DE 19525635 A & AT 208348 T & CN 1140689 A	1, 4

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

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Date of the actual completion of the international search
04 April, 2008 (04.04.08)

Date of mailing of the international search report
15 April, 2008 (15.04.08)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/050055

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	JP 2002-302317 A (Heidelberger Druckmaschinen AG.), 18 October, 2002 (18.10.02), Par. No. [0040]; Fig. 2 & US 2002/0109286 A1 & EP 1231174 A2 & DE 10105374 A & CZ 20020270 A & AT 314996 T & HK 1050176 A & CN 1369421 A	3, 6
A	JP 03-172268 A (MAN Miller Druckmaschinen GmbH), 25 July, 1991 (25.07.91), Full text; all drawings & US 5056773 A & EP 429743 A2 & DE 3939250 C & ES 2047718 T & CS 9001002 A & DD 298760 A & AT 98199 T & CA 2018402 A	1, 4

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REFERENCES CITED IN THE DESCRIPTION

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