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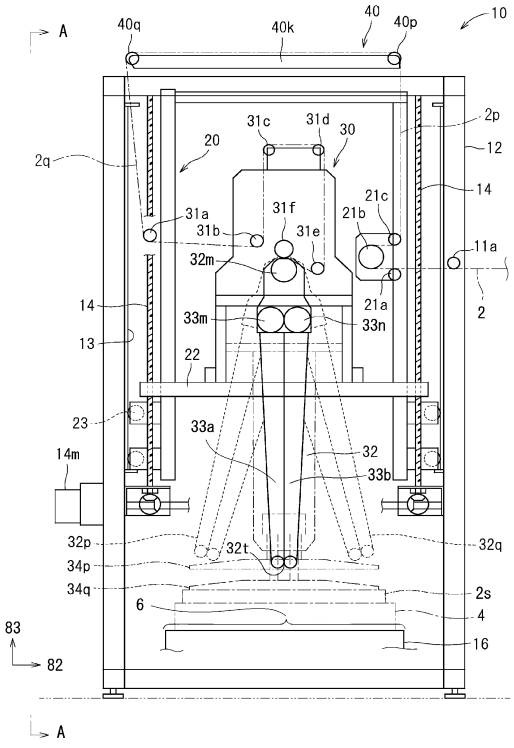
# (54) SHEET FOLDING DEVICE

(57) Provided is a sheet folding device which can reduce the frequency at which pallets are exchanged and shorten an operation stop time accompanying a pallet exchange.

The sheet folding device comprises: (a) first movement unit (20) disposed to be able to be raised/lowered above a placement region (6); (b) a second movement unit (30) which is supported by the first movement unit (20) and reciprocates along the placement region (6) in a first direction (81); and (c) a sheet discharge device (32) which is supported by the second movement unit (30) and has a sheet discharge port (32t) facing the placement region (6), the sheet discharge port (32t) reciprocating along the placement region (6) in a second direction (82) crossing the first direction (81). Sheets (2, 2s) continuous in the longitudinal direction are discharged from the sheet discharge port (32t) of the sheet discharge device (32) so that the width direction of the sheets (2, 2s) crosses the second direction (82).

Fig. 1

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a sheet folding device, and more specifically, relates to a sheet folding device that folds and stacks a sheet on top of a pallet.

### BACKGROUND ART

**[0002]** Fig. 10 is a schematic diagram of a sheet folding device 101. As shown in Fig. 10, in this device 101, an elongated rubber sheet 111 conveyed by a conveyor 110 passes through a swinging device 121 swung by a crank mechanism, is discharged from between a pair of rolls 121a at the exit side end of the swinging device 121, and is folded to a predetermined length and stacked on top of a pallet 131. The pallet 131 is disposed on a raising/lowering device 132, and is lowered when the rubber sheet 111 is stacked. A folding flap 133 holds down the rubber sheet to assist in folding the rubber sheet (for example, see Patent Literature 1).

### CITATION LIST

### PATENT LITERATURE

**[0003]** [Patent Literature 1] JP 2012-236704

### SUMMARY OF INVENTION

### PROBLEM TO BE SOLVED BY THE INVENTION

**[0004]** In a case where a sheet continuous in the longitudinal direction and conveyed in the longitudinal direction is folded and stacked on top of a pallet as described above, stacking the sheet higher increases the material length on the pallet, enabling the placement of an elongated sheet on the pallet. In addition, the increase in the load capacity on the pallet reduces the frequency of pallet exchange, which increases the efficiency.

**[0005]** However, since the height to which a sheet can be stacked without collapsing depends on, for example, the width dimension of the sheet, it is difficult to reduce the frequency of pallet exchange to increase the efficiency.

**[0006]** In addition, after the sheet stacking is completed, it is necessary to take out the pallet, place another pallet and then, raise the pallet to a predetermined height. The operation stop time accompanying this pallet exchange contributes to a decrease in efficiency.

**[0007]** In view of such circumstances, a problem to be solved by the present invention is to provide a sheet folding device capable of reducing the frequency of pallet exchange and shortening the operation stop time accompanying the pallet exchange.

### MEANS FOR SOLVING THE PROBLEM

**[0008]** To solve the above-mentioned problem, the present invention provides a sheet folding device structured as follows:

**[0009]** A sheet folding device is provided with: (a) a first movement unit disposed to be able to be raised/lowered above a placement region; (b) a second movement unit supported by the first movement unit and reciprocating along the placement region in a first direction; and (c) a sheet discharge device supported by the second movement unit and having a sheet discharge port facing the placement region, the sheet discharge port reciprocating along the placement region in a second direction crossing the first direction. A sheet continuous in a longitudinal direction is discharged from the sheet discharge port of the sheet discharge device so that a width direction of the sheet crosses the second direction.

**[0010]** With the above-described structure, the sheet discharged from the sheet discharge port of the sheet discharge device can be folded and stacked while being shifted in the width direction of the sheet on top of a pallet placed in the placement region. The first movement unit is raised as appropriate so that the sheet discharge port of the sheet discharge device is away at an appropriate distance from the sheet folded and stacked on top of the pallet.

**[0011]** In the above-described structure, since the sheet can be stacked while being shifted along the width of the sheet by the second movement unit reciprocating in the first direction, the overall length of the folded and stacked sheet can be increased to thereby reduce the frequency of pallet exchange.

**[0012]** When the stacking of the sheet is completed, it is necessary only to take out the pallet and place another pallet in the placement region and it is unnecessary to raise the another pallet to a predetermined height, so that the operation stop time accompanying the pallet exchange can be shortened.

**[0013]** Preferably, the second movement unit stops at a plurality of positions at a distance of not less than a width dimension of the sheet in the first direction. The sheet discharge port of the sheet discharge device reciprocates along the placement region in the second direction orthogonal to the first direction, and the sheet is discharged from the sheet discharge port so that the width direction of the sheet coincides with the first direction.

**[0014]** In this case, since the second movement unit stops at a plurality of positions at a distance of equal to or greater than the width of the sheet, sheet stacked parts formed while the second movement unit is stopping are formed at a plurality of positions so as to be adjacent to each other without overlapping. These stacked parts can be formed higher because they are connected together by the sheet of the part discharged while the second movement unit is moving and do not readily collapse. By this, the overall length of the folded and stacked sheet

can be further increased to thereby further reduce the frequency of pallet exchange.

**[0015]** Preferably, the sheet folding device is further provided with (d) a pressing member that returnably moves toward the placement region, on each side of the sheet discharge device in the first direction.

**[0016]** In this case, for example, when the folded sheet is undulating, the folded sheet can be smoothed out by pressing the folded sheet by the pressing member. By doing this, the sheet can be stacked higher to thereby further increase the overall length of the sheet that can be folded and stacked, so that the frequency of pallet exchange can be further reduced.

**[0017]** The pressing member may be provided either in the first movement unit or in the second movement unit. Since it is necessary for the pressing member not to interfere with the sheet discharge device, providing the pressing member in the second movement unit simplifies the structure.

**[0018]** Preferably, the sheet folding device is further provided with: (e) a track shifter disposed above the second movement unit, supported to be swingable by the first movement unit and having a reception roll that receives the sheet and a discharge roll that discharges the received sheet, the discharge roll reciprocating in the first direction in conjunction with the reciprocation of the second movement unit in the first direction; (f) a plurality of first rolls supported by the first movement unit and defining a first conveyance path where the sheet is conveyed to the reception roll of the track shifter; and (g) a plurality of second rolls supported by the second movement unit and defining a second conveyance path where the sheet is conveyed from the discharge roll of the track shifter to the sheet discharge device.

**[0019]** In this case, the position where the sheet is fed to the sheet folding device can be fixed while the increase in the dimensions of the sheet folding device is suppressed. That is, even if the sheet conveyance direction shifts in the width direction of the sheet in response to the movement of the second movement unit, the sheet can be stably conveyed by absorbing the twist of the sheet due to the swinging of the track shifter by making the first and second conveyance paths sufficiently long. Moreover, by arranging the first and second rolls so as to bend the first and second conveyance paths, the first and second conveyance paths can be made sufficiently long while the increase in dimensions such as the height and width of the sheet folding device is suppressed.

## EFFECTS OF THE INVENTION

**[0020]** According to the present invention, the frequency of pallet exchange can be reduced to thereby shorten the operation stop time accompanying the pallet exchange.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0021]**

[Fig. 1] Fig. 1 is a schematic front view of a sheet folding device (first embodiment).

[Fig. 2] Fig. 2 is a schematic side view along the line A-A of Fig. 1 (first embodiment).

[Fig. 3] Fig. 3 is a schematic view along the line B-B of Fig. 2 (first embodiment.

[Fig. 4] Fig. 4 is a schematic top view along the line C-C of Fig. 2 (first embodiment).

[Fig. 5] Fig. 5 is a schematic partial cross-sectional view along the line D-D of Fig. 4 (first embodiment).

[Fig. 6] Fig. 6 is a schematic relevant part view of the sheet folding device (first embodiment).

[Fig. 7] Fig. 7 is a schematic relevant part view of the sheet folding device (first embodiment).

[Fig. 8] Fig. 8 is a timing chart showing the operation of the sheet folding device (first embodiment).

[Fig. 9] Fig. 9 is schematic views along the line X-X of Fig. 7 (first embodiment).

[Fig. 10] Fig. 10 is a schematic view of the sheet folding device (first conventional example).

## MODE FOR CARRYING OUT THE INVENTION

**[0022]** Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

**[0023]** [First embodiment] A sheet folding device 10 of a first embodiment will be described with reference to Figs. 1 to 9.

**[0024]** Fig. 1 is a schematic front view of the sheet folding device 10. Fig. 2 is a schematic side view along the line A-A of Fig. 1. Fig. 3 is a schematic view along the line B-B of Fig. 2. Fig. 4 is a schematic top view along the line C-C of Fig. 2, and shows a track shifter 40 in perspective view. Fig. 5 is a schematic partial cross-sectional view along the line D-D of Fig. 4. Fig. 6 is a schematic relevant part view of the sheet folding device 10.

**[0025]** As shown in Figs. 1 to 6, the sheet folding device 10 is provided with a first movement unit 20, a second movement unit 30 and a sheet discharge device 32. A pallet placement device 16 for disposing a pallet 4 in a placement region 6, the first movement unit 20, the second movement unit 30, the sheet discharge device 32 and the like are disposed inside a main body frame 12 of the sheet folding device 10.

**[0026]** While details will be provided later, the sheet folding device 10 folds the sheet discharged from the sheet discharge device 32 and stacks it on top of the pallet 4 disposed in the placement region 6. The pallet placement device 16 conveys the pallet 4 with the sheet stacked thereon from the placement region 6 to a non-illustrated taking-out position. The placement region 6 is a predetermined region where the pallet 4 is placed when the sheet discharged from the sheet discharge device 32 is folded and stacked on top of the pallet 4.

**[0027]** The sheet folding device 10 conveys a sheet 2 continuous in the longitudinal direction, and folds and stacks the sheet 2 on top of the pallet 4. The sheet 2 is a single or multiple layer sheet, for example, a multiple layer sheet where a resin sheet having stretchability is sandwiched between two nonwoven fabric sheets and the resin sheet and the nonwoven fabric sheets are bonded together.

**[0028]** The first movement unit 20 is disposed above the placement region 6, and is raised/lowered along the main body frame 12 in a third direction 83 facing the placement region 6 as indicated by the arrow 83. Specifically, a first screw shaft 14 extending in the third direction 83 is rotatably supported by the main body frame 12, and a movement member 22 of the first movement unit 20 engages with the first screw shaft 14. The first screw shaft 14 is rotated by a first motor 14m, whereby the movement member 22 of the first movement unit 20 moves parallel in the third direction 83. A wheel 23 rotatably supported by the first movement unit 20 engages with a first rail 13 fixed to the main body frame 12 and extending in the third direction 83, and moves along the first rail 13.

**[0029]** The track shifter 40 is disposed to be swingable above the first movement unit 20. The track shifter 40 is disposed above the second movement unit 30. A reception roll 40p that receives the sheet 2 is rotatably supported by one end of a frame 40k of the track shifter 40 which frame 40k is U-shaped in cross section, and a discharge roll 40q that discharges the received sheet 2 is rotatably supported by the other end of the frame 40k.

**[0030]** The first movement unit 20 supports a plurality of first rolls 21a to 21c. These first rolls 21a to 21c define a first conveyance path 2p where the sheet 2 guided by a guide roll 11a supported by the main body frame 12 is conveyed to the reception roll 40p of the track shifter 40.

**[0031]** The second movement unit 30 is supported by the first movement unit 20, and reciprocates along the placement region 6 in a first direction 81 indicated by the arrow 81. Specifically, as shown in Figs. 2 and 3, a pair of second rails 25 are fixed to an upper surface 22a of the horizontally extending movement member 22 of the first movement unit 20, and a pair of second screw shafts 26 are rotatably supported by the movement member 22. The second rails 25 and the second screw shafts 26 extend in the first direction 81. A second wheel 37 of the second movement unit 30 engages with the second rails 25, and an engagement part 36 of the second movement unit 30 engages with the second screw shafts 26. A second motor 26m rotates the second screw shafts 26 to thereby move the second movement unit 30 in the first direction 81.

**[0032]** The second movement unit 30 supports an upper part of the sheet discharge device 32 to be swingable. The sheet discharge device 32 swings between a first and second positions 32p and 32q indicated by broken lines 32p and 32q in Fig. 1 by a third motor 32m. The swinging of the sheet discharge device 32 reciprocates a sheet discharge port 32t provided in a lower part of the sheet discharge device 32, along the placement region 6 in a second direction 82 orthogonal to the first direction 81. The sheet discharge port 32t discharges the sheet 2 toward the placement region 6 in such a manner that the width direction of the sheet 2 is parallel to the first direction 81.

**[0033]** As shown in Fig. 6, the sheet discharge device 32 has two conveyors 33a and 33b arranged in mirror symmetry to each other. The conveyors 33a and 33b each have an endless belt 33v circulating in a direction indicated by the arrow 33x along guide rollers 33p and 33q and a drive roller 33d. The sheet 2 is conveyed while being sandwiched between the endless belts 33v of the conveyors 33a and 33b, and is discharged in a direction indicated by the arrow 2x from the sheet discharge port 32t between end parts, on the downstream side in the conveyance direction, of facing parts of the endless belts 33v of the conveyors 33a and 33b. The drive rollers 33d of the conveyors 33a and 33b are rotated by conveyor motors 33m and 33n shown in Fig. 1.

**[0034]** The second movement unit 30 supports a plurality of second rolls 31a to 31g that define a second conveyance path 2p where the sheet 2 is conveyed from the discharge roll 40q of the track shifter 40 to the sheet discharge device 32.

**[0035]** As shown in Fig. 2, the second movement unit 30 has, on each side of the sheet discharge device 32 in the first direction 81, a pressing member 34 that returnably moves toward the placement region 6. For example, the pressing member 34 which is a plate-like member moves from a standby position 34p to a pressing position 34q as indicated by the chain lines 34p and 34q in Fig. 1 by the extension and contraction of an air cylinder 35 fixed to the second movement unit 30, and presses a sheet 2s folded on top of the pallet 4.

**[0036]** While the pressing members 34 may be provided in the first movement unit 20, providing them in the second movement unit 30 makes it easy to prevent the pressing member 34 from interfering with the sheet discharge device 32. Pressing members 34 can be omitted.

**[0037]** When the second movement unit 30 moves in the first direction 81, the conveyance direction of the sheet 2 shifts in the width direction of the sheet 2. The track shifter 40 swings in response to this shift.

**[0038]** Specifically, as shown in Figs. 4 and 5, a guide member 42 curved in an arc shape is fixed to an upper surface 24a of an upper member 24 of the first movement unit 20 through a support member 41, and a third screw shaft 46 is rotatably supported by the upper member 24. The third screw shaft 46 extends in the first direction 81. As shown in Fig. 2, an engagement member 47 engages with the third screw shaft 46, and a protrusion 47a protruding upward is formed on the engagement member 47.

**[0039]** As shown in Figs. 4 and 5, two pairs of holding rollers 44a and 44b, and 44p and 44q that hold the arc-shaped guide member 42 from inside and outside in a radial direction are rotatably supported by a lower part

on one end side of the frame 40k of the track shifter 40. As shown in Figs. 2 and 4, block-shaped holding members 48a and 48b that hold the protrusion 47a of the engagement member 47 from both sides in the first direction 81 are fixed to a lower part on the other end side of the frame 40k of the track shifter 40.

**[0040]** When the third screw shaft 46 is rotated by the third motor 46m, the engagement member 47 moves along the third screw shaft 46. In response thereto, the track shifter 40 swings as shown by the oblique lines 40a and 40b in Fig. 4, and the discharge roll 40q of the track shifter 40 moves in the first direction 81. At this time, the track shifter 40 swings about a predetermined position 40x at the center in the width direction of the reception roll 40p in such a manner that the center line of the sheet 2 that the reception roll 40p receives does not move, on the upstream side of the reception roll 40p.

**[0041]** In tandem with the movement of the second movement unit 30 in the first direction 81, the track shifter 40 swings in such a manner that the discharge roll 40q moves in the first direction 81. The swinging of the track shifter 40 twists the sheet 2. To absorb the twist of the sheet 2, the first conveyance path 2p upstream of the track shifter 40 is bent by use of the first rolls 21a to 21c supported by the first movement unit 20, thereby making the first conveyance path 2p sufficiently long. The second conveyance path 2q from the track shifter 40 to the sheet discharge device 32 is bent by use of the second rolls 31a to 31g supported by the second movement unit 30, thereby making the second conveyance path 2q sufficiently long. By doing this, the sheet 2 can be stably conveyed even though the second movement unit 30 moves.

**[0042]** Bending the first and second conveyance paths 2p and 2q makes it possible to make the first and second conveyance paths 2p and 2q sufficiently long while the increase in dimensions such as the height and width of the sheet folding device 10 is suppressed.

**[0043]** Next, the operation of the sheet folding device 10 will be described with reference to Figs. 7 through Fig. 9.

**[0044]** Fig. 7 is a schematic relevant part view showing the operation of the sheet folding device 10. As shown in Fig. 7, when the operation is started, the sheet discharge device 32 repeatedly swigs between the position indicated by the solid line and the position indicated by the chain line. The sheet 2 which is conveyed in the direction indicated by the arrow 2i in the sheet folding device 10 passes through the sheet discharge device 32, and is discharged from the sheet discharge port 32t reciprocating in the second direction 82. By doing this, the sheet 2s is folded and stacked on top of the pallet 4 placed on the pallet placement device 16.

**[0045]** The first movement unit 20 is raised as appropriate so that the sheet discharge port 32t of the sheet discharge device 32 is away at an appropriate distance from the sheet 2s folded and stacked on top of the pallet 4. The pressing member 34 presses the sheet 2s folded and stacked on top of the pallet 4.

**[0046]** Fig. 8 is a timing chart showing an example of the operation of the sheet folding device 10. As shown by reference numeral 50 in Fig. 8, the sheet discharge device 32 repeats a regular cycle of swinging. As shown by reference numeral 51, the second motor 26m rotates in one direction, so that the second movement unit 30 moves in the first direction 81.

**[0047]** Then, as shown by reference numeral 52, the second motor 26m stops rotating in one direction, so that the second movement unit 30 stops at a first position. When the sheet discharge device 32 completes N1 cycles of swinging (N1=8 in Fig. 8) while the second movement unit 30 is stopping, as shown by reference numeral 54, the second motor 26m rotates in the reverse direction, so that the second movement unit 30 moves from the first position.

**[0048]** When the sheet discharge device 32 completes K1 cycles of swinging (K1=2 in Fig. 8) while the second movement unit 30 is moving, as shown by reference numeral 56, the second motor 26m stops rotating in the reverse direction, so that the second movement unit 30 stops at a second position. When the sheet discharge device 32 completes N2 cycles of swinging (N2=8 in Fig. 8) while the second movement unit 30 is stopping, as shown by reference numeral 58, the second motor 26m rotates in one direction, so that the second movement unit 30 moves from the second position.

**[0049]** Then, when the sheet discharge device 32 completes K2 cycles of swinging (K2=2 in Fig. 8) while the second movement unit 30 is moving, as shown by reference numeral 59, the second motor 26m stops rotating in one direction, so that the second movement unit 30 stops at the first position. Similar operations are repeated thereafter.

**[0050]** N1, N2, K1 and K2 may be either natural numbers or positive real numbers. N1 and N2 may be not equal to each other, and K1 and K2 may be not equal to each other.

**[0051]** It is preferable that N1 and N2 are large because the movement of the second movement unit 30 can be reduced. For example, when N1 is equal to or greater than 2 and N2 is equal to or greater than 2, the number of times of reciprocation of the sheet discharge port 32t of the sheet discharge device 32 in the second direction 82 along the placement region 6 while the second movement unit 30 is stopping at one position is two or more, so that the movement of the second movement unit 30 can be reduced.

**[0052]** In conjunction with the operation of the second movement unit 30, the first movement unit 20 is raised and the pressing member 34 operates as follows:

**[0053]** When the second movement unit 30 moves and stops at the first position, as shown by reference numeral 60, the air cylinder 35 is turned on, so that the pressing member 34 is lowered. Then, as shown by reference numeral 62, the air cylinder 35 is turned off, so that the pressing member 34 is raised to return to the original position.

**[0054]** Moreover, as shown by reference numeral 70, when the air cylinder 35 switches from on to off while the second movement unit 30 moves and stops at the first position, the first motor 14m is turned on, so that the first movement unit 20 is raised. Then, as shown by reference numeral 72, the first motor 14m is turned off, so that the first movement unit 20 stops.

**[0055]** When the second movement unit 30 moves and stops at the second position, as shown by reference numeral 64, the air cylinder 35 is turned on, so that the pressing member 34 is lowered. Then, as shown by reference numeral 66, the air cylinder is turned off, so that the pressing member 34 is raised.

**[0056]** Similarly, when the second movement unit 30 stops, the pressing member 34 is lowered. Moreover, each time the second movement unit 30 reciprocates between the first and second positions, the first movement unit 20 is raised.

**[0057]** Fig. 9 which is schematic view along the line X-X of Fig. 7 schematically shows a bent part 2v of the sheet 2s folded and stacked on top of the pallet 4, by the solid lines 2a to 2d.

**[0058]** As shown in Fig. 9(a), when the sheet discharge device 32 swings while the second movement unit 30 is stopping at the first position, a first folded part 2a where the sheet is newly folded is formed on one side of the pallet 4 in the first direction 81.

**[0059]** Then, as shown in Fig. 9(b), the sheet discharge device 32 swings while moving in the direction indicated by the arrow 32x while the second movement unit 30 is moving from the first position to the second position, whereby first intermediate folded parts 2b and 2c where the sheet is newly folded are formed.

**[0060]** Then, as shown in Fig. 9(c), when the second movement unit 30 stops at the second position, the pressing member 34 is lowered, so that the first folded part 2a is pressed to be compressed. For example, an undulating part 2k between opposing folded parts 2u and 2v of the sheet 2 shown in Fig. 7 is pressed to be flattened. Although not shown in Fig. 9(c), while this is being done, the sheet is newly folded on the other side of the pallet 4 in the first direction 81.

**[0061]** As shown in Fig. 9(d), the sheet discharge device 32 swings while the second movement unit 30 is stopping at the second position, whereby a second folded part 2d where the sheet is newly folded is formed on the other side of the pallet 4 in the first direction 81.

**[0062]** Although not shown, thereafter, second intermediate folded parts where the sheet is folded are similarly formed while the second movement unit 30 is moving from the second position to the first position. Then, when the second movement unit 30 stops at the first position, the pressing member 34 is lowered, so that the second folded part 2d is pressed to be compressed.

**[0063]** The second movement unit 30 stops at the first position and the second position in such a manner that the first folded part 2a and the second folded part 2d are adjacent to each other without overlapping. That is, the second movement unit 30 stops at a plurality of positions, that is, at the first position and the second position at a distance of not less than the width dimension W of the sheet 2 in the first direction 81.

**[0064]** When the width W of the sheet 2 is not more than half of the dimension T of the pallet 4 in the first direction 81, the parts 2a and 2d where the sheet is folded while the second movement unit 30 is stopping can be formed at a plurality of positions 4a and 4b on the pallet 4. The parts 2a and 2d where the sheet is folded while the second movement unit 30 is stopping are connected together through the parts 2b and 2c where the sheet is folded while the second movement unit 30 is moving, so that the sheet can be stacked higher than when the sheet is folded only at one position on the pallet 4. Therefore, by folding and stacking the sheet 2s at a plurality of positions 4a and 4b on the pallet 4, the frequency of exchanging the pallet 4 can be reduced more than when the sheet 2s is folded and stacked only at one position on the pallet 4.

**[0065]** For example, when the folded sheet 2s is undulating, the sheet 2s can be smoothed out by pressing the folded sheet 2s by the pressing member 34. By doing this, the sheet 2s can be stacked higher to thereby further increase the overall length of the sheet 2s that can be folded and stacked, so that the frequency of pallet exchange can be further reduced.

**[0066]** When the stacking of the sheet 2s is completed, the pallet 4 is taken out, and another pallet 4 is placed on the pallet placement device 16. Since it is unnecessary to raise the another pallet 4 placed on the pallet placement device 16 up to a predetermined height, the operation stop time accompanying the pallet exchange can be shortened.

**[0067]** When the width W of the sheet 2 is shorter, by stopping the second movement unit 30 at three or more positions, the part where the sheet is folded while the second movement unit 30 is stopping can be formed at three or more positions on the pallet 4. In this case, the second movement unit 30 also stops at a plurality of positions at a distance of not less than the width dimension W of the sheet in the first direction 81.

**[0068]** While in the first embodiment, a case is shown where the second direction 82 is orthogonal to the first direction 81, the sheet folding device 10 may have a structure where the second direction 82 is a direction crossing the first direction 81 which direction is other than a direction orthogonal to the first direction 81. While in the first embodiment, a case is shown where the sheet 2 is discharged from the sheet discharge port 32t of the sheet discharge device 32 in such a manner that the width direction of the sheet 2 coincides with the first direction 81, the sheet folding device 10 may have a structure where the sheet 2 is discharged from the sheet discharge port 32t in such a manner that the width direction of the sheet 2 crosses the second direction 82 without coinciding with the first direction 81.

**[0069]** Moreover, the sheet discharge port 32t of the

sheet discharge device 32 may be made to reciprocate in the second direction 82 without the sheet discharge device 32 swinging, for example, by the sheet discharge device 32 moving parallel in the second direction 82.

**[0070]** [Summary] As described above, the sheet folding device 10 reduces the frequency of exchanging the pallet 4 and shortens the operation stop time accompanying the pallet exchange.

**[0071]** The present invention is not limited to the above-described embodiment but may be carried out with various modifications being added.

**[0072]** For example, the sheet folding device may be operated in various modes. For example, the first movement unit may continuously move instead of repeating the cycle of moving and stopping. Moreover, the moving and stopping of the second movement unit and the reciprocation of the sheet discharge port may be linked together in various modes.

**[0073]** The pallet placement device 16 may be designed to guide the pallet 4 to an appropriate position by a non-illustrated device such as a position measurement device, a controller or a driver. Specifically, the position of the pallet placement device 16 may be automatically adjusted in each of the first direction 81 and the second direction 82 so that the region (not shown) where the sheet 2s is discharged by the sheet discharge device 32 is within the placement region 6 of the pallet placement device 16. Moreover, the position of the pallet 4 may be automatically adjusted in each of the first direction 81 and the second direction 82 so that the pallet 4 is disposed within the placement region 6.

**[0074]** Lastly, technical ideas grasped from the above-described embodiment and other examples (modifications) will be added in the following:

**[0075]** A sheet folding device according to a first aspect of the present invention is provided with: a first movement unit disposed to be able to be raised/lowered above a placement region; a second movement unit supported by the first movement unit and reciprocating along the placement region in a first direction; and a sheet discharge device supported by the second movement unit and having a sheet discharge port facing the placement region, the sheet discharge port reciprocating along the placement region in a second direction crossing the first direction. A sheet continuous in a longitudinal direction is discharged from the sheet discharge port of the sheet discharge device so that a width direction of the sheet crosses the second direction.

**[0076]** With the sheet folding device of the first aspect, the sheet discharged from the sheet discharge port of the sheet discharge device can be folded and stacked while being shifted in the width direction of the sheet on top of a pallet placed in the placement region. The first movement unit is raised as appropriate so that the sheet discharge port of the sheet discharge device is away at an appropriate distance from the sheet folded and stacked on top of the pallet.

**[0077]** In the sheet folding device of the first aspect, since the sheet can be stacked while being shifted along the width of the sheet by the second movement unit reciprocating in the first direction, the overall length of the folded and stacked sheet can be increased to thereby reduce the frequency of pallet exchange.

**[0078]** When the stacking of the sheet is completed, it is necessary only to take out the pallet and place another pallet in the placement region and it is unnecessary to raise the another pallet to a predetermined height, so that the operation stop time accompanying the pallet exchange can be shortened.

**[0079]** A sheet folding device according to a second aspect of the present invention is the sheet folding device of the first aspect in which the second movement unit stops at a plurality of positions at a distance of not less than a width dimension of the sheet in the first direction, the sheet discharge port of the sheet discharge device reciprocates along the placement region in the second direction orthogonal to the first direction and the sheet is discharged from the sheet discharge port so that the width direction of the sheet coincides with the first direction.

**[0080]** With the sheet folding device of the second aspect, since the second movement unit stops at a plurality of positions at a distance of equal to or greater than the width of the sheet, sheet stacked parts formed while the second movement unit is stopping are formed at a plurality of positions so as to be adjacent to each other without overlapping. These stacked parts can be formed higher because they are connected together by the sheet of the part discharged while the second movement unit is moving and do not readily collapse. By this, the overall length of the folded and stacked sheet can be further increased to thereby further reduce the frequency of pallet exchange.

**[0081]** A sheet folding device according to a third aspect of the present invention is the sheet folding device of the first or the second aspect, further provided with a pressing member that returnably moves toward the placement region, on each side of the sheet discharge device in the first direction.

**[0082]** With the sheet folding device of the third aspect, for example, when the folded sheet is undulating, the folded sheet can be smoothed out by pressing the folded sheet by the pressing member. By doing this, the sheet can be stacked higher to thereby further increase the overall length of the sheet that can be folded and stacked, so that the frequency of pallet exchange can be further reduced.

**[0083]** The pressing member may be provided either in the first movement unit or in the second movement unit. Since it is necessary for the pressing member not to interfere with the sheet discharge device, providing the pressing member in the second movement unit simplifies the structure.

**[0084]** A sheet folding device according to a fourth aspect of the present invention is the sheet folding device of any of the first to third aspects, further provided with:

a track shifter disposed above the second movement unit, supported to be swingable by the first movement unit and having a reception roll that receives the sheet and a discharge roll that discharges the received sheet, the discharge roll reciprocating in the first direction in conjunction with the reciprocation of the second movement unit in the first direction; a plurality of first rolls supported by the first movement unit and defining a first conveyance path where the sheet is conveyed to the reception roll of the track shifter; and a plurality of second rolls supported by the second movement unit and defining a second conveyance path where the sheet is conveyed from the discharge roll of the track shifter to the sheet discharge device.

**[0085]** With the sheet folding device of the fourth aspect, the position where the sheet is fed to the sheet folding device can be fixed while the increase in the dimensions of the sheet folding device is suppressed. That is, even if the sheet conveyance direction shifts in the width direction of the sheet in response to the movement of the second movement unit, the sheet can be stably conveyed by absorbing the twist of the sheet due to the swinging of the track shifter by making the first and second conveyance paths sufficiently long. Moreover, by arranging the first and second rolls so as to bend the first and second conveyance paths, the first and second conveyance paths can be made sufficiently long while the increase in dimensions such as the height and width of the sheet folding device is suppressed.

DESCRIPTION OF REFERENCE NUMERALS

**[0086]**

2, 2s Sheet
2p First conveyance path
2p Second conveyance path
4 Pallet
6 Placement region
10 Sheet folding device
20 First movement unit
21a to 21c First rolls
30 Second movement unit
31a to 31g Second rolls
32 Sheet discharge device
32t Sheet discharge port
34 Pressing member
40 Track shifter
40p Reception roll
40q Discharge roll
81 First direction
82 Second direction
W Width (width dimension)

## Claims

**1.** A sheet folding device comprising:

a first movement unit disposed to be able to be raised/lowered above a placement region;
a second movement unit supported by the first movement unit and reciprocating along the placement region in a first direction; and
a sheet discharge device supported by the second movement unit and having a sheet discharge port facing the placement region, the sheet discharge port reciprocating along the placement region in a second direction crossing the first direction,
wherein a sheet continuous in a longitudinal direction is discharged from the sheet discharge port of the sheet discharge device so that a width direction of the sheet crosses the second direction.

**2.** The sheet folding device according to claim 1, wherein the second movement unit stops at a plurality of positions at a distance of not less than a width dimension of the sheet in the first direction, and
the sheet discharge port of the sheet discharge device reciprocates along the placement region in the second direction orthogonal to the first direction and the sheet is discharged from the sheet discharge port so that the width direction of the sheet coincides with the first direction.

**3.** The sheet folding device according to claim 1, further comprising a pressing member that returnably moves toward the placement region, on each side of the sheet discharge device in the first direction.

**4.** The sheet folding device according to claim 2, further comprising a pressing member that returnably moves toward the placement region, on each side of the sheet discharge device in the first direction.

**5.** The sheet folding device according to any one of claims 1 to 3, further comprising:

a track shifter disposed above the second movement unit, supported to be swingable by the first movement unit and having a reception roll that receives the sheet and a discharge roll that discharges the received sheet, the discharge roll reciprocating in the first direction in conjunction with the reciprocation of the second movement unit in the first direction;
a plurality of first rolls supported by the first movement unit and defining a first conveyance path where the sheet is conveyed to the reception roll of the track shifter; and
a plurality of second rolls supported by the second movement unit and defining a second conveyance path where the sheet is conveyed from the discharge roll of the track shifter to the sheet discharge device.

Fig. 1

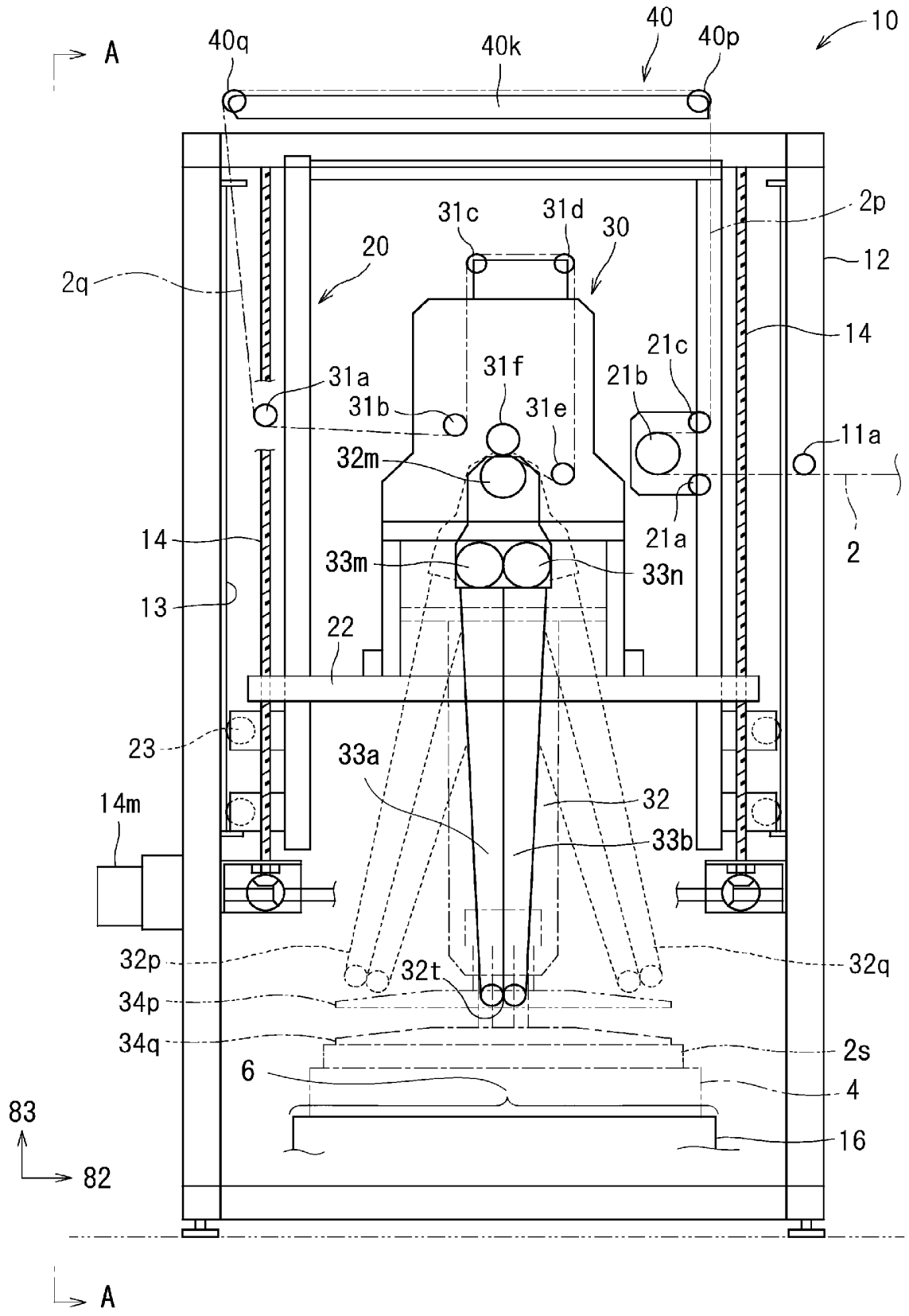
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Fig. 2

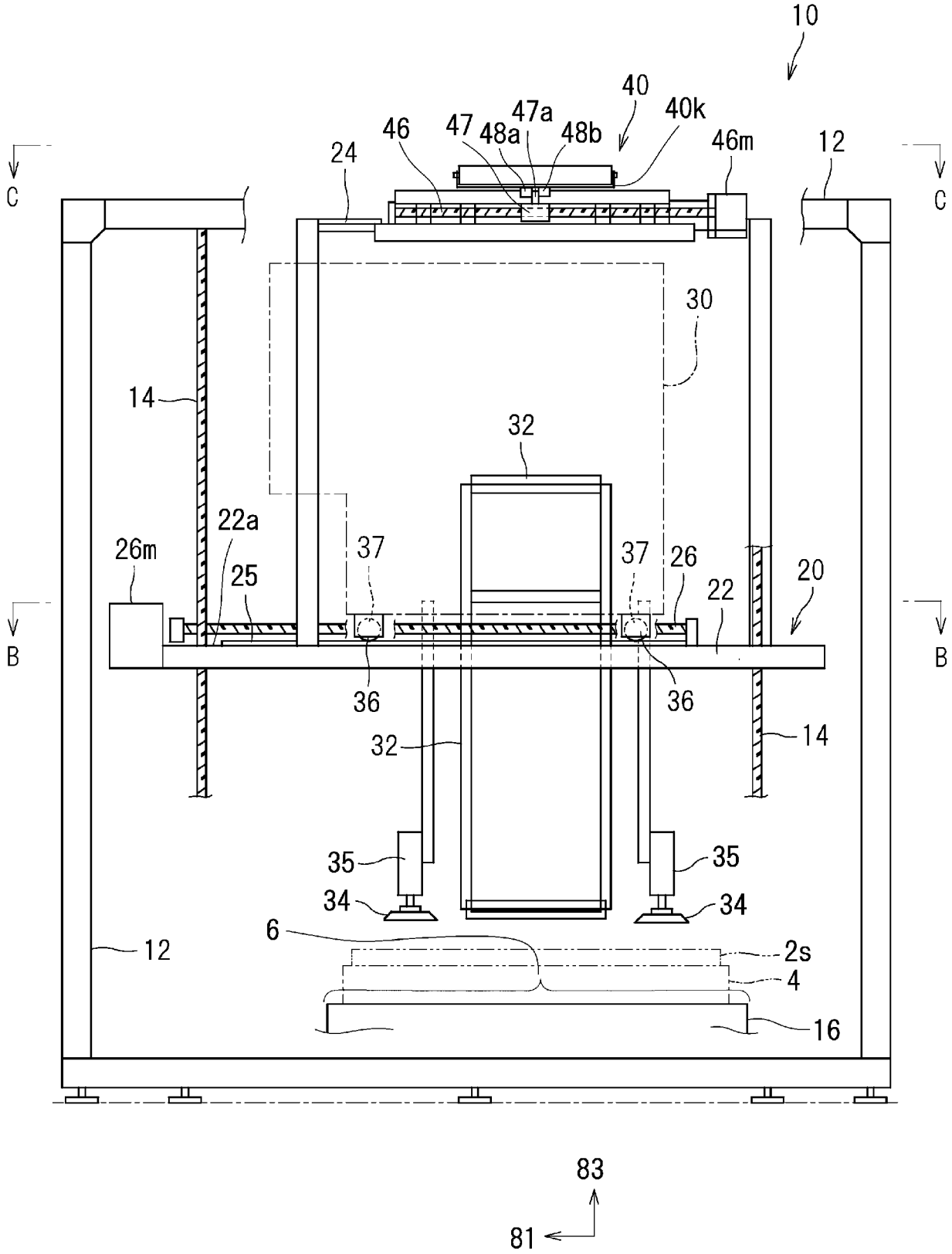
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Fig. 3

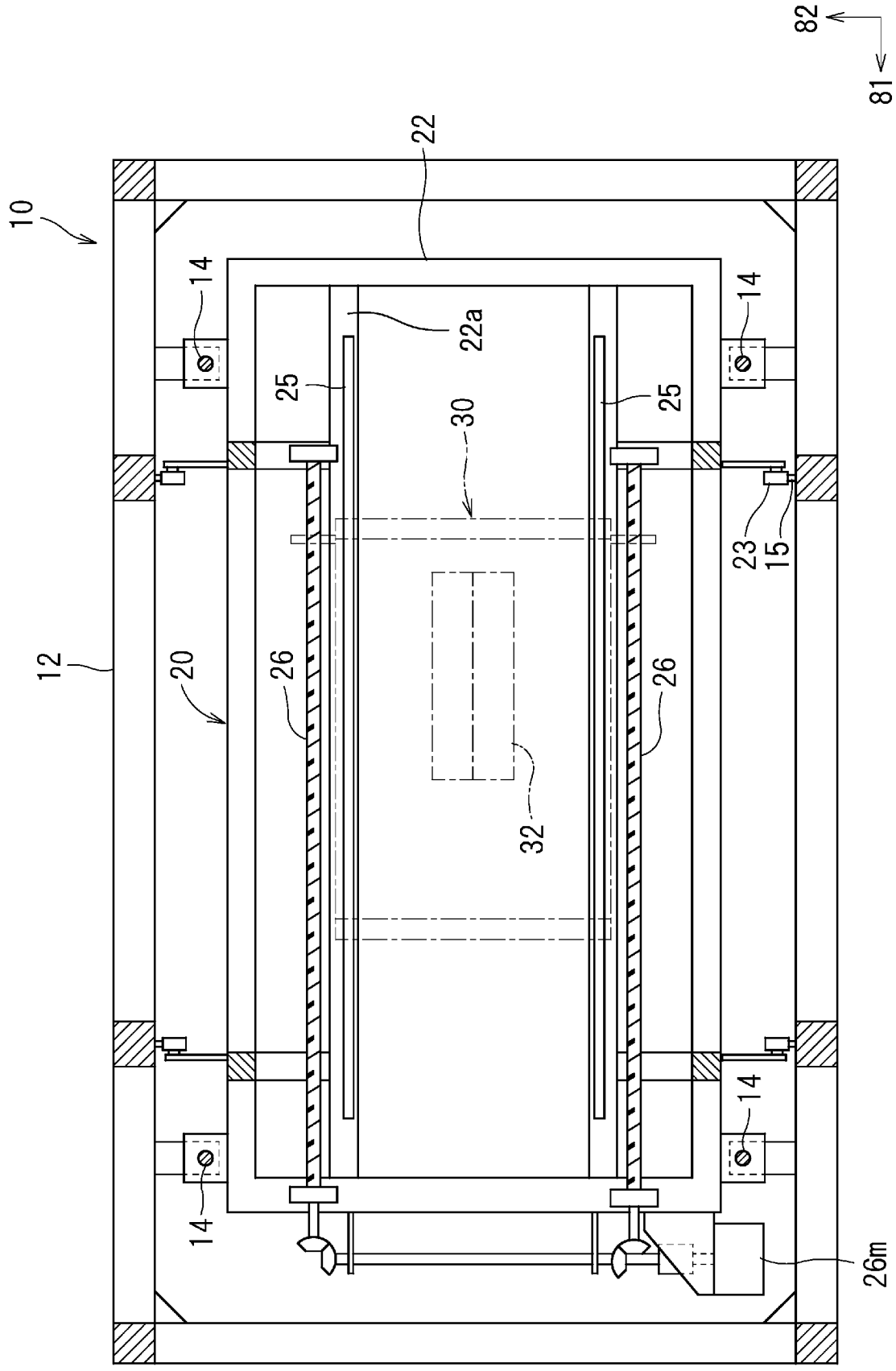
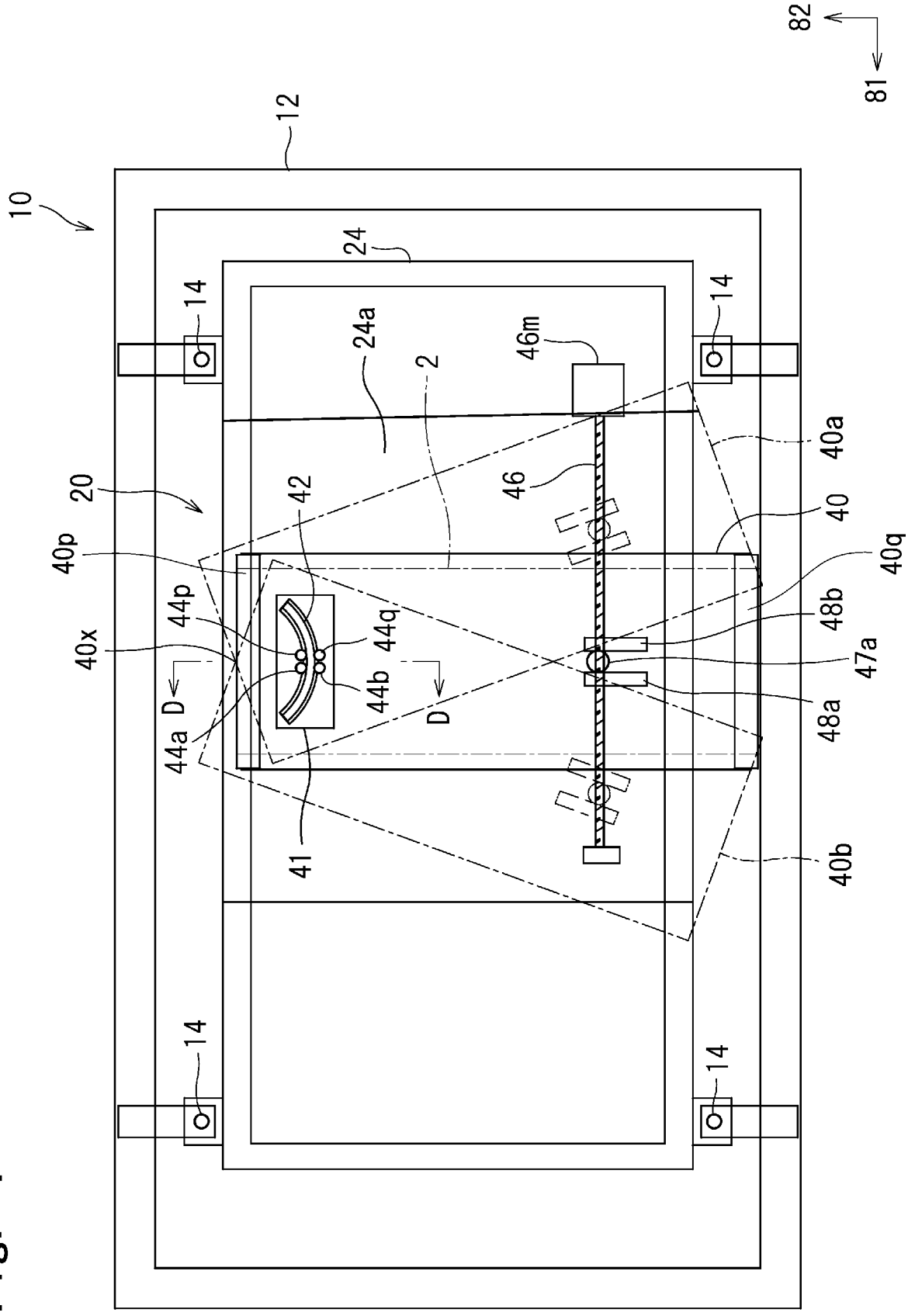


Fig. 4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44a
41
40b

Fig. 5

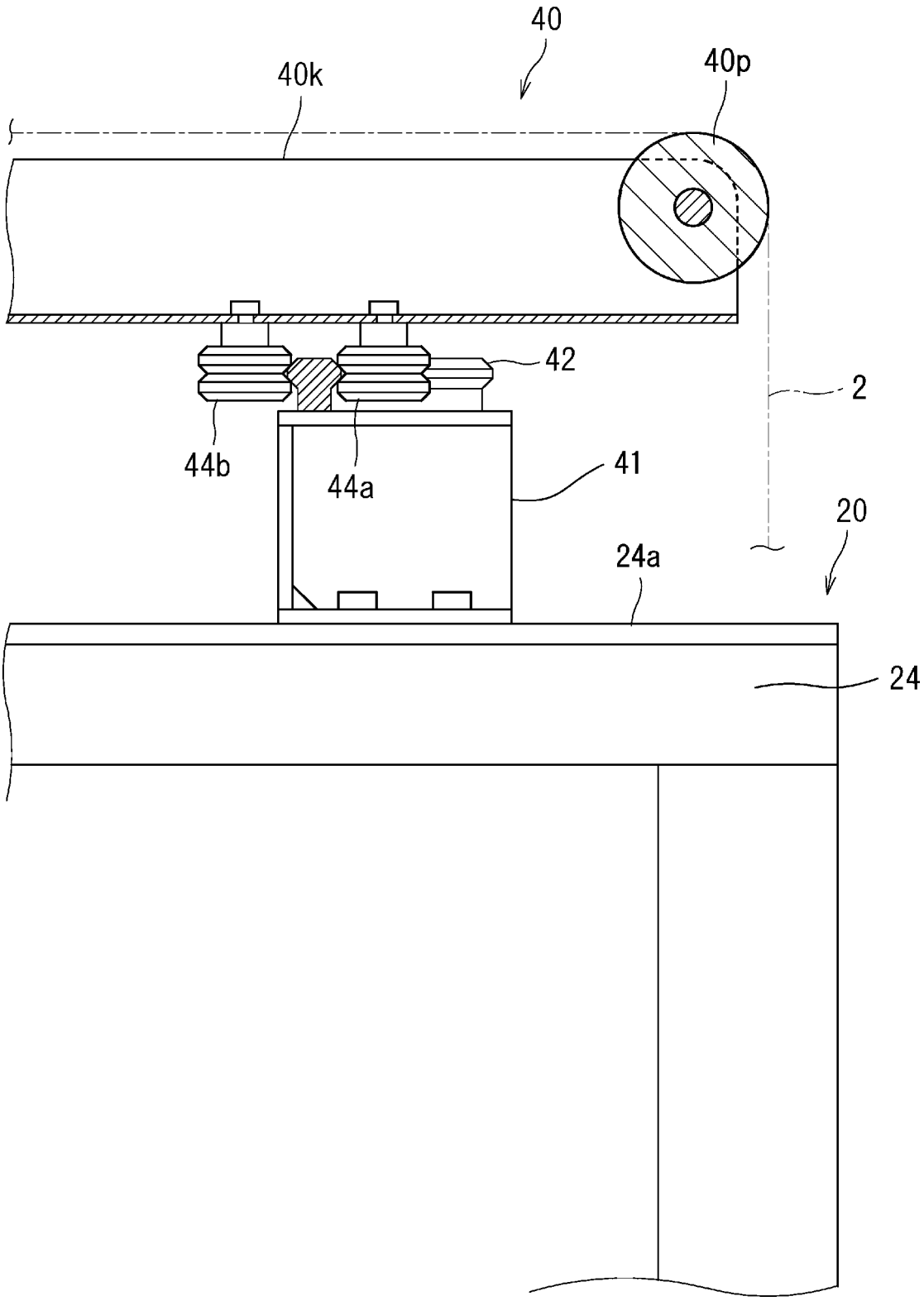

Fig. 6

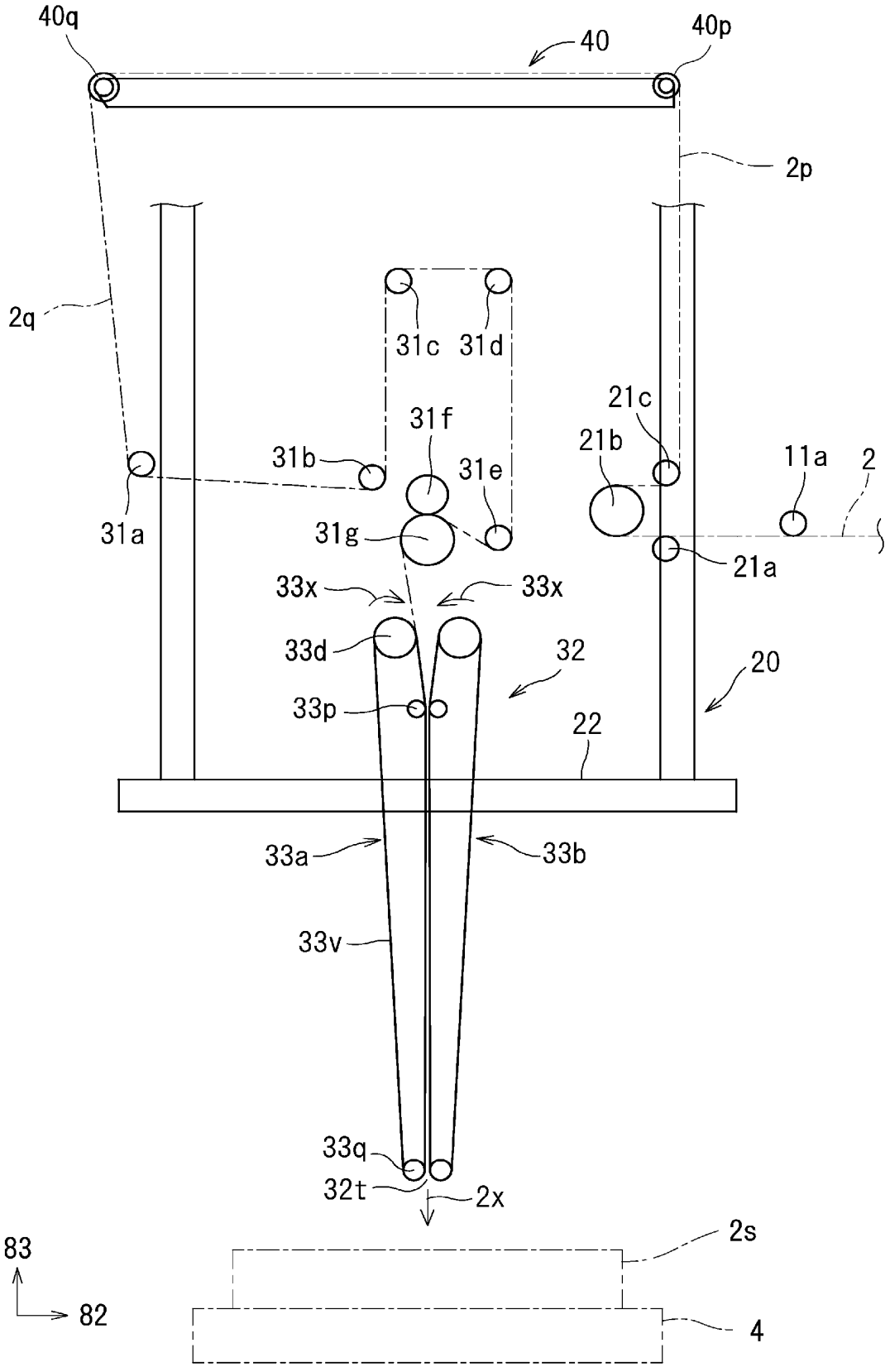
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Fig. 7

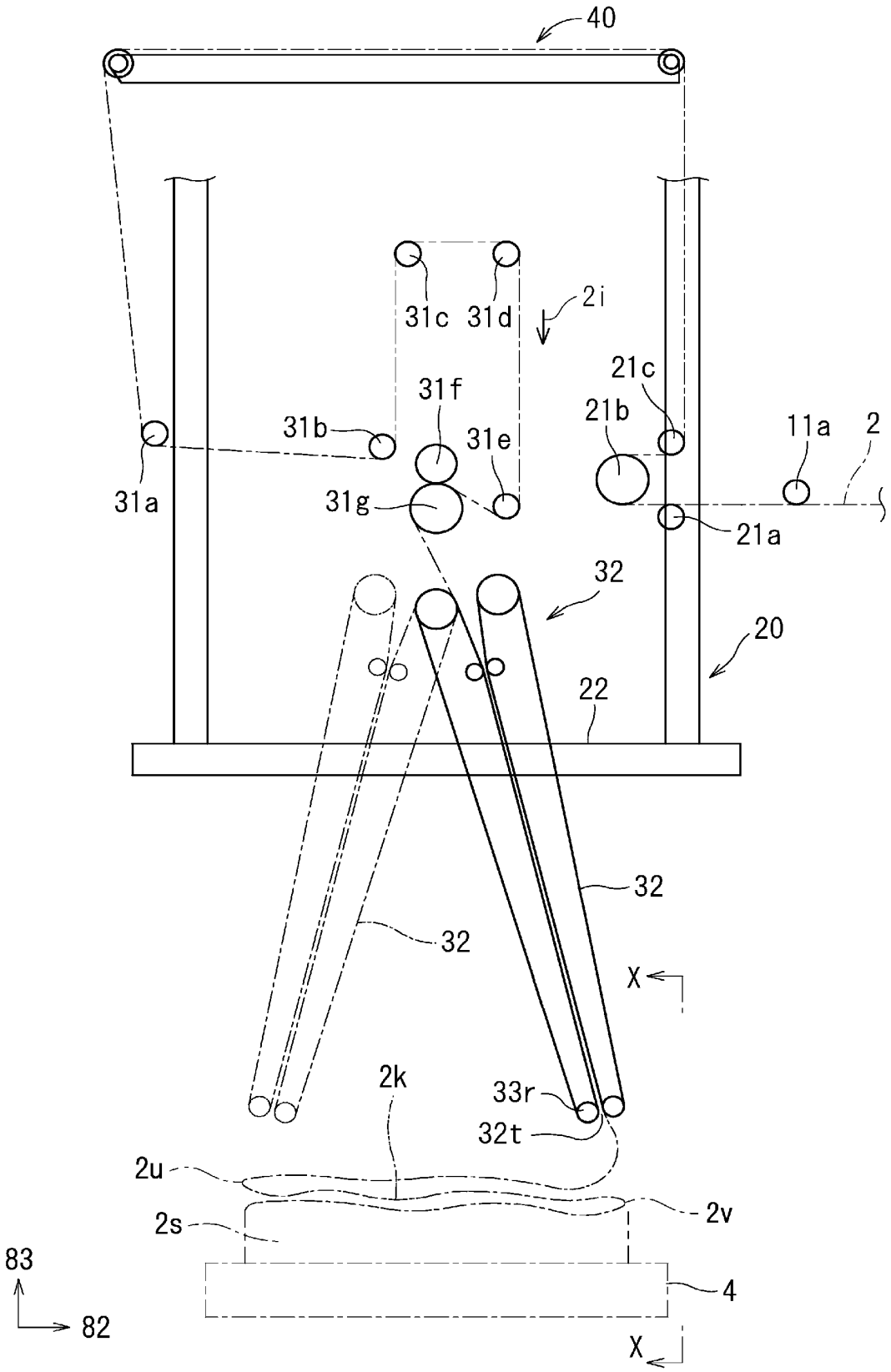
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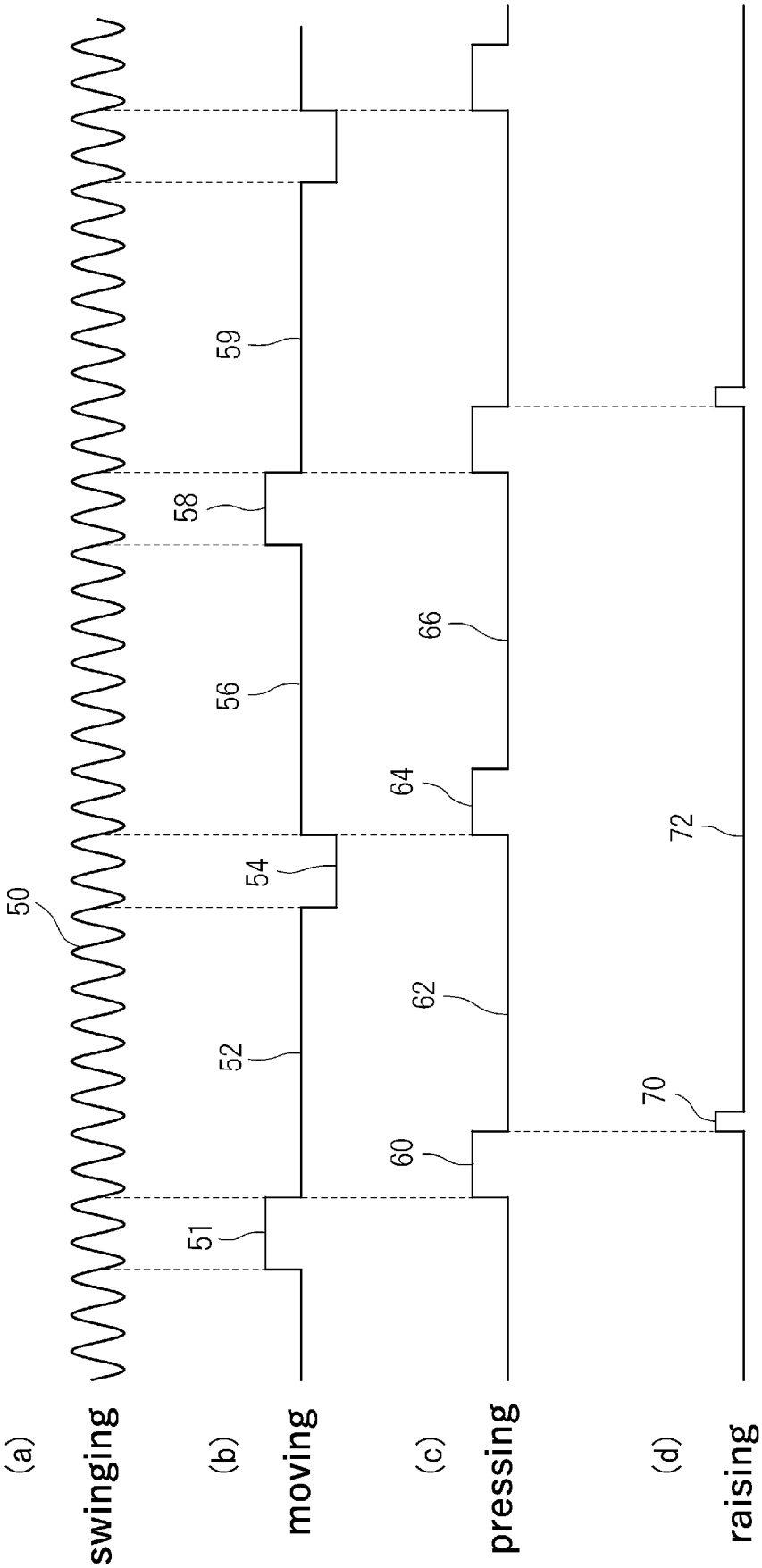
Fig. 8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(c)
pressing
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Fig. 9

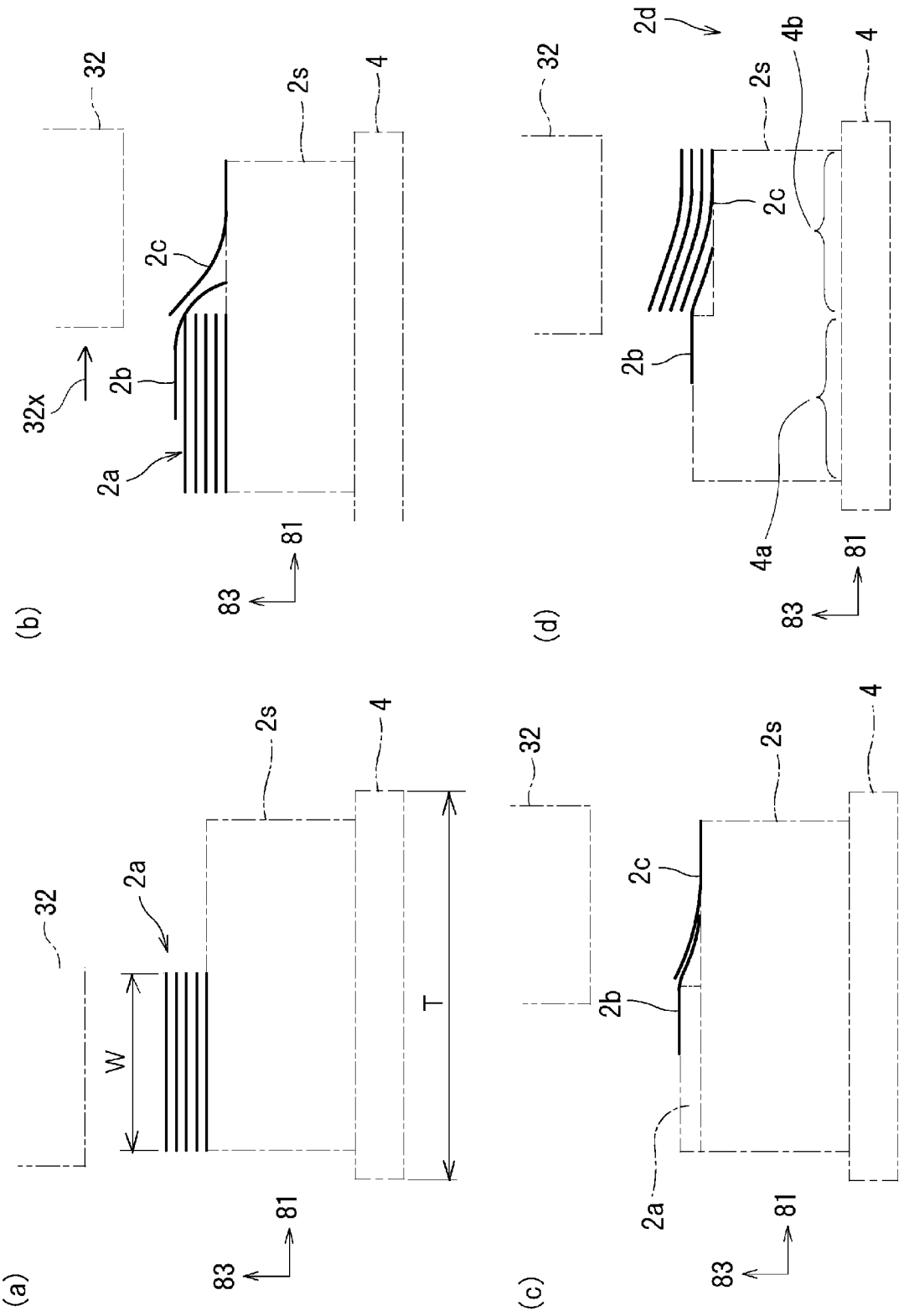
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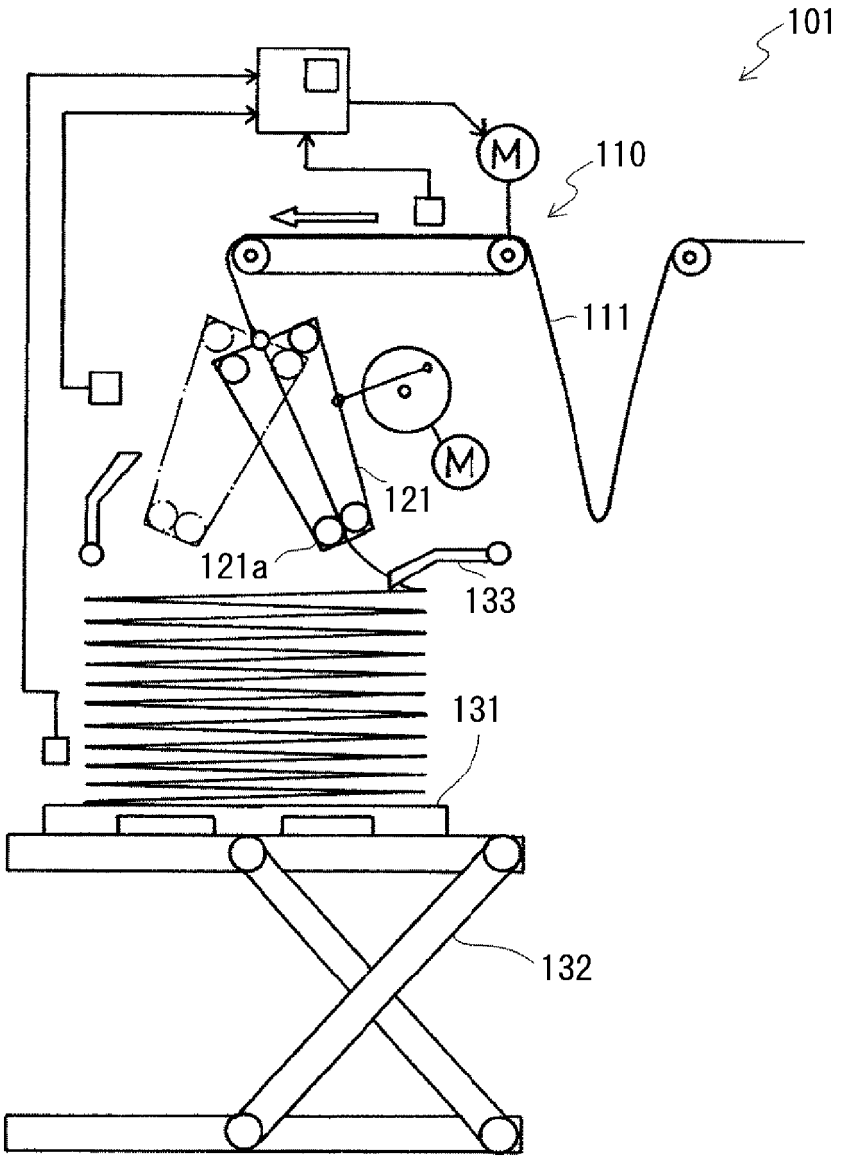
Fig. 10



# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/JP2022/036303**

## A. CLASSIFICATION OF SUBJECT MATTER

***B65H 45/107***(2006.01)i
FI: B65H45/107 A; B65H45/107 B

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)

B65H45/107

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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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| A | | 5 |
| Y | US 6209288 B1 (KORTEC GMBH) 03 April 2001 (2001-04-03)<br>column 9, line 13 to column 10, line 21, fig. 1-3 | 1-4 |
| A | | 5 |
| A | JP 48-99484 A (KAJI SEISAKUSHO CO., LTD.) 15 December 1973 (1973-12-15)<br>p. 1, lower right column, line 5 to p. 5, upper left column, line 5, fig. 1-12 | 1-5 |
| A | JP 49-69947 A (YOSHIDA INDUSTRY CO., LTD.) 06 July 1974 (1974-07-06)<br>p. 1, lower right column, line 5 to p. 2, lower right column, line 1, fig. 1-4 | 1-5 |
| A | JP 2007-533568 A (SAURER GMBH + CO. KG) 22 November 2007 (2007-11-22)<br>paragraphs [0022], [0023], fig. 1-7 | 1-5 |
| A | US 6155551 A (VMI AMERICAS, INC.) 05 December 2000 (2000-12-05)<br>column 4, line 33 to column 8, line 40, fig. 1-3 | 1-5 |

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| **18 November 2022** | **06 December 2022** |
| Name and mailing address of the ISA/JP<br>**Japan Patent Office (ISA/JP)**<br>**3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915**<br>**Japan** | Authorized officer<br><br>Telephone No. |

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/036303

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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| A | KR 10-1633597 B1 (HANDO MACHINERY CO., LTD.) 24 June 2016 (2016-06-24)<br>paragraphs [0016]-[0095], fig. 1-16 | 1-5 |
| A | CN 110950156 A (CHENGDU JINGWEI MACHINE MAKING CO., LTD.) 03 April 2020 (2020-04-03)<br>paragraphs [0016]-[0026], fig. 1-17 | 1-5 |
| P, X | KR 10-2321719 B1 (SEOUL FINE TECH CO., LTD.) 04 November 2021 (2021-11-04)<br>paragraphs [0041]-[0137], fig. 1-4 | 1–4 |

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**INTERNATIONAL SEARCH REPORT**
**Information on patent family members**

International application No.
**PCT/JP2022/036303**

| Patent document cited in search report | Publication date (day/month/year) | Patent family member(s) | Publication date (day/month/year) |
|---|---|---|---|
| JP 60-102367 A | 06 June 1985 | (Family: none) | |
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| JP 48-99484 A | 15 December 1973 | (Family: none) | |
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| KR 10-1633597 B1 | 24 June 2016 | (Family: none) | |
| CN 110950156 A | 03 April 2020 | (Family: none) | |
| KR 10-2321719 B1 | 04 November 2021 | (Family: none) | |

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## REFERENCES CITED IN THE DESCRIPTION

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