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(54) **Sheet reverse device**

(57) A sheet reverse controller is equipped with a reverse unit (29) to convey sheets conveyed from the first conveying means (31,33) in the second direction differing from the first direction; a second conveying means (31,33,49,51) to convey the sheets in the second

direction; a sensor (53) provided to the second conveying means to detect the sheets; and a controller (2,4,5) to decelerate or accelerate the sheet conveying velocity of the driving rollers based on the detected result of this sensor (53).

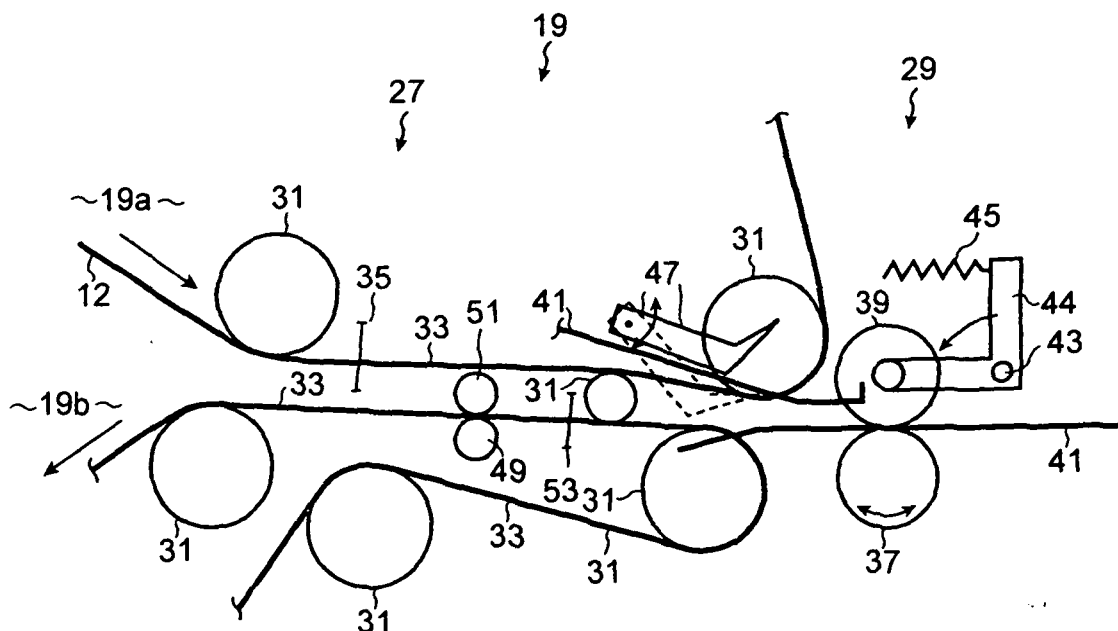


FIG. 6

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a sheet reverse device for reversing the conveying direction of sheets, for example, mails being conveyed.

2. Description of the Related Art

[0002] As a sheet processing apparatus, a mail processing apparatus to process mails such as, for example, sealed letters, post cards, etc. and a banknote processing apparatus to process banknotes are known. For example, a mail processing apparatus is composed of a sheet take-out unit to take out sheets such as sealed letters, post cards, etc. one by one that are set by operator, a sheet conveying unit to convey taken out sheets between various units on a conveying path, a discrimination unit to read image data from the front and back surfaces of sheets conveyed and discriminate a position where a stamp is pasted, a twist reverse unit to reverse the front and back surfaces of a sheet by turning it by 180° centering on the conveying direction with a twist reverse belt, a reverse controller to reverse the front and rear ends in the sheet conveying direction and the front and back of sheet at the same time, a stamping unit to stamp a postmark on a pasted stamp, a stacker to stack sheets in a stacking storage, and gates to sort sheets to respective units selectively.

[0003] In the mail processing unit, a twist reverse unit and a reverse controller are selectively used to move the position of a stamp pasted on a sheet to a position where a postmark can be stamped. A twist reverse unit turns (twist reversing) a sheet by 180° centering on the direction same as the sheet conveying direction. The reverse controller reverses the front and rear ends of a sheet in the conveying direction and the front and back of a sheet at the same time (the switchback reversing).

[0004] This will be explained taking an example of a sheet with a stamp on the upper side of the downstream side in the conveying direction on the right hand side surface toward the downstream side of the conveying direction when a sheet is conveyed in the erected state. When this sheet is twisted with a reverse controller, the stamped position comes to the left-hand surface toward the downstream in the conveying direction and at the downside of this surface. Further, when this sheet is switchback reversed with a reverse controller, the stamped position comes to the right hand side surface toward the downstream of the conveying direction and at the upstream side of the conveying direction and the downside on this surface.

[0005] As disclosed in Japanese Patent Application Publication No. 7-232847, an apparatus provided with a normal/reverse rotation roller, a hit blade, etc. to con-

vey a sheet that is conveyed directly in the straight direction or in the reverse direction is devised as a sheet reverse controller.

[0006] In a sheet processing apparatus including a mail processor, a conveying unit and other units are so controlled as to maintain a space (gap) between conveying sheets or a distance (pitch) between front edges of sheets being conveyed. However, in a reverse controller, when sheets are reversed, control to accelerate or decelerate a conveying speed of sheets is complicated. Therefore, before and after the reversing operation, a gap or pitch between sheets tend to change. In particular, when a gap or pitch after the reversing operation becomes short, sheets come too close each other in the conveying unit at the downstream side and sheets tends to jam easily.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a sheet reverse device capable of reducing generation of jamming by reducing change in gap or pitch of sheets before and after the reversing operation of sheets.

[0008] This object is achieved by a sheet reverse according to claim 1 or 5 or 8 or 9 or 10.

[0009] Further developments of the invention are given in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a block diagram showing a control system of a controller involved in the embodiment of the present invention;

FIG. 2 is a block diagram showing the construction of sheet processing device involved in the embodiment of the present invention;

FIG. 3 is a basic construction diagram of the sheet reverse device involved in respective embodiments;

FIG. 4 is a graph showing the operation of the normal/reverse rotation roller of the basic construction of the reverse controller shown involved in the first through third embodiments of the present invention and FIG. 3;

FIG. 5 is a schematic diagram showing the operation of the sheet reverse device in the reverse operation;

FIG. 6 is a schematic diagram showing the construction of the sheet reverse device involved in the first embodiment;

FIG. 7 is a sectional view of a driving roller, a pinch roller and a conveying belt involved in the first embodiment of the present invention;

FIG. 8 is a schematic diagram showing the construction of the sheet reverse device in-

- involved in the second embodiment of the present invention;
- FIG. 9 is a schematic diagram showing the construction of the sheet reverse device involved in the third embodiment of the present invention;
- FIG. 10 is a schematic diagram showing the construction of the sheet reverse device involved in the third embodiment of the present invention;
- FIG. 11 is a schematic diagram showing the construction of the sheet reverse device involved in the fourth embodiment of the present invention; and
- FIG. 12 is a graph showing the operation of the normal/reverse rotation roller involved in the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0011] In the description of the embodiments and the drawings, the sheet reverse device is also named reverse controller.

[0012] One embodiment of the present invention will be explained below referring to attached drawings.

[0013] FIG. 1 is a block diagram showing the control system of a sheet processing apparatus 1 of the present invention. A main controller 2 is composed of a CPU to process data sent from component units of sheet processing apparatus 1 and directs operations to the component units, a memory to store an application program required for the operation of this CPU, and controls the entire operation of the apparatus. Further, main controller 2 receives and processes data sent from a discrimination unit 15, a reject stacker 17, a seal unit 20, a stacker 21, etc. which will be described later and operates the component units.

[0014] A take-out controller 3 is connected to main controller 2 and receives/transmits various data, and is composed of memories storing drivers to operate a take-out portion 13 that will be described later.

[0015] A conveying controller 4 is connected to main controller 2, receives/transmits various data and is composed of a memory storing drivers to operate a twist reverse unit 18, a reverse controller (sheet reverse device) 19 and a conveying unit 14.

[0016] As shift sensor controller 5 is connected to main controller 2, receives/transmits various data, receives detected data of sheet 12 from shift sensors 35 and 53 installed in reverse controller 19 and conveying unit 14 that will be described later and transmits this detected data to main controller 1.

[0017] Gate controller 6 is connected to main controller 2, receives and transmits various data and controls the operations of gates 15a, 15b and 15c.

[0018] FIG. 2 is a block diagram showing the construction of sheet processing apparatus 1 involved in the embodiments of the present invention. Sheet process-

ing apparatus 1 shown in FIG. 2 discriminates stamps put on sheets 12 such as sealed letters, post cards, etc. and puts a postmark on the stamps. Such mails as sealed letters and postcards have sizes and stiffness largely differing from banknotes and valuable securities such as checks and are hard to treat. In the embodiments of the present invention, although the apparatus is explained as a mail processing apparatus, it can be sufficiently used as a valuable security processing apparatus to treat valuable securities.

[0019] Sheet processing apparatus 1 shown in FIG. 2 retains sealed letters, postcards and other mails (herein after called as sheet 12) together and is composed of take-out portion 13 to take out a sheet in the apparatus one by one, conveying unit 14 to convey a sheet to each unit along a conveying path such as a belt, rollers, etc., discrimination unit 15 to read image data on the front and back sides of conveyed sheet 12 and discriminate a stamp position put on a sheet 12, and a reject stacker 17 to stack sheets 12 with no stamp pasted and sheets that are pre-set to be rejected based on the result of discrimination of discrimination unit 15. Sheet processing apparatus 1 is further composed of twist reverse unit 18 to rotate (twist reverse) a sheet by 180° centering the same direction as the sheet conveying direction by the twist reverse belt, reverse controller (sheet reverse device) 19 to reverse (switchback reverse) the front and rear ends of sheet 12 in the conveying direction and the front and back sides of sheet 12 at the same time, seal unit 20 to put a postmark on a stamp pasted on sheet 12, stacker 21 to stack sheet 12 of which stamping process is completed in the stacking portion in order, and a gate 25a to sort sheets to the normal conveying path or reject stacker 17. Sheet processing apparatus 1 is further composed of a gate 25b to sort sheets to either the normal conveying path or twisted reverse unit 18 and a gate 25c to sort sheets to either the normal conveying path or reverse controller 19.

[0020] Plural sheets 12 are stacked in take-out portion 13 in the random direction by operator who operates sheet processing apparatus 1. Plural sheets 12 stacked in take-out portion are separated one by one and taken out on conveying unit 14 and conveyed to discrimination unit 15. Discrimination unit 15 reads image data on the front and back sides of sheet 12, discriminates the position of a stamp put on sheet 12 and sends the discrimination result to main controller 1. Main controller 2 judges whether sheet 12 is an object for rejection based on the result of discrimination from discrimination unit 15. When sheet 12 is an object for rejection, gate 25a operates to send it to reject stacker 17. Further, when sheet 12 is judged to be other than an object for rejection, main controller 2 judges the necessity for twist reverse or switchback reverse from the position of a stamp put on sheet 12 and selects gate 25b or gate 25c and actuates it.

[0021] Position of a stamp put on sheet 12 and the movement of stamp position pursuant to the twist re-

verse or the switchback reverse of sheet 12 will be explained. In a case where a stamp is on the upside of the right side in the downstream conveying direction of a sheet when it is conveyed in the erected state, the position of a stamp comes to the downside on the left side to the downstream in the conveying direction when sheet 12 is twist reverse with twist reverse unit 18. Further, when this sheet 12 is switchback reversed by reverse controller 19, the stamp position comes to the downside at the upstream side in the conveying direction on the right side surface to the downstream in the conveying direction. Further, when this sheet 12 is switchback reversed by reverse controller 19, the stamp position comes to the downside at the upstream side in the conveying direction on the right side surface to the downstream in the conveying direction.

[0022] When sheet 12 is twist reversed or switchback reversed selectively, a stamp pasted on sheet 12 being conveyed comes to a specified position, for example, the downstream side in the conveying direction and upside on the right side surface to the downstream in the conveying direction. This specified position is a place where a postmark can be stamped by seal unit 20 and is a position over which a stamp on sheet 12 passes.

[0023] Sheet 12 stamped in seal unit 20 is conveyed to stacker 21 and stacked in the stacking portion sequentially.

[0024] FIG. 3 shows a basic construction diagram of reverse controller 19 in the embodiments of the present invention. Reverse controller 19 is basically composed of a conveyor in a main body 27 and a reverse unit 29.

[0025] The conveyor in main body 27 is composed of conveying rollers 31 and conveying belts 33 likewise conveying unit 14 and conveys sheet 12 by holding it with conveying belts 33. The conveyor in main body 27 is provided with shift sensors 35 and detects sheet 12. The reverse operation of reverse unit 29 is triggered by this detection. Shift sensors 35 detect a length of sheet 12 by detecting its front and rear ends.

[0026] Reverse unit 29 is composed of a normal/reverse rotation roller 37 - equipped with a driving source independent from conveying rollers 31, etc., a pinch roller 39 that is driven following normal/reverse rotation roller 37, and guides 41 and 41 to lead sheet 12. Pinch roller 39 is attached rotatably to one end of an L-shaped lever 44. L-shaped lever 44 is supported in the oscillating state via a rotation fulcrum 43. The other end of L-shaped lever 44 is kept piled by the restoring force of a spring 45 and pinch roller 39 is pressed against normal/reverse roller 37 by the oscillation of L-shaped lever 44 in the counterclockwise direction.

[0027] At the transfer portion between conveyor in a main body 27 and reverse unit 29, there is provided a hit lever 47 which is driven by a solenoid and oscillates. When lever 47 is oscillated, the front end of reversed sheet 12 is led to an exit side 19b of reverse controller 19.

[0028] FIG. 4 is a graph showing the control of the

operation of normal/reverse rotation roller 37 in the basic construction of reverse controller 19 shown in the first through the third embodiments and FIG. 3 of the present invention. The axis of abscissa of the graph shown in FIG. 4 indicates a time T (s), the axis of ordinate indicates a peripheral velocity (conveying velocity) V (m/s) of normal/reverse rotation roller 37. The peripheral velocity of normal/reverse rotation roller is $V_0 = 3$ m/s and $V_1 = 5$ m/s/. Peripheral velocity V_0 of normal/reverse rotation roller 37 is almost the same velocity of the conveying velocity of conveying unit 14. However, the peripheral velocities V_0 , V_1 are changes as appropriate according to characteristic amounts such as size, stiffness, weight of sheets 12 that are conveyed and not specifically restricted.

[0029] Next, the operation of reverse controller 19 will be explained referring to FIG. 3 and FIG. 4. Sheet 12 is conveyed from an entrance side 19a of reverse controller 19, its front and rear ends are detected by shift sensors 35 of conveyor in main body 27 and these detected signals trigger the reverse operation of reverse unit 29.

[0030] Sheet 12 is conveyed to reverse unit 29 while being led by guides 41 and 41 and held by normal/reverse rotation roller 37 and pinch roller 39 ($T = t_1$). At this time, pinch roller 39 rotates centering around pinch roller rotation fulcrum 43 according to a thickness of sheet 12 and escapes by the thickness of sheet 12. Further, normal/reverse rotation roller 37 is normally rotating clockwise at a peripheral velocity $V = V_0$ in FIG. 3.

[0031] Normal/reverse rotation roller 37 starts to accelerate ($T = t_1$) in a moment to hold sheet 12 based on the detection of the front end of sheet 12 by shift sensors 35 and accelerate to peripheral velocity $V = V_1$. Then normal/reverse rotation roller 37 rotates at the constant velocity $V = V_1$ while $T = t_2$. At a time $T = t_2$, normal/reverse rotation roller 37 starts to decelerate from peripheral velocity V_1 and stop the rear end of sheet 12 at the reference position ($T = t_3$).

[0032] While sheet 12 is kept stopped or while from the rear end of sheet 12 is released from pinching by belt 33 to stopped, hit lever 47 is actuated and the rear end of sheet 12 (the end in the conveying direction of sheet 12 after reversed) is directed toward exit side 19b.

[0033] At a time $T = t_4$, normal/reverse rotation roller 37 starts to rotate in the reverse direction (the counterclockwise direction in FIG. 3) and the peripheral velocity reaches $-V_0$. When the rear end of sheet 12 is released from the holding by normal/reverse rotation roller 37 and pinch roller 39, normal/reverse rotation roller 37 starts to decelerate and stops ($T = t_5$).

[0034] At $T = t_6$, normal/reverse rotation roller 37 starts the rotation in the normal direction again and the peripheral velocity V reaches V_0 ($V = V_0$) at $T = t_7$.

[0035] In reverse controller 19, normal/reverse rotation roller 37 performs a series of operations; that is, normal rotation at a constant velocity, acceleration, normal rotation at a constant velocity, deceleration, stop, acceleration in reverse rotation and reverse rotation at a con-

stant velocity. Thus, a space; that is, a gap (or pitch) between sheets 12 is maintained and therefore, it is possible to make a gap (or pitch) and improve the processing capacity of sheet processing apparatus 1. Here, a gap is a distance to the front end of another sheet 12 being conveyed at the upstream side in the conveying direction rather than this sheet 12. Further, a pitch is a distance from the front end of sheet 12 being conveyed to the front end of another sheet 12 being conveyed at the upstream side in the conveying direction rather than this sheet 12.

[0036] Further, the accelerating operation of normal/reverse rotation roller 37 is made at a different acceleration curve (accelerating inclination) based on the detection result of length of sheets 12 by shift sensors 35. The longer the conveying direction of sheet 12 is, the larger acceleration curve (accelerating inclination) is demanded. When sheets 12 that are conveyed are in the same size such as tickets or checks or when a difference in length is small as in banknotes, it is not required to change an acceleration curve.

[0037] Next, causes for changing a gap (or a pitch) of sheet 12 before and after the reverse in the reverse operation in reverse controller 19 will be explained. FIG. 5 shows the construction of reverse controller 19 in the reverse operation. The component elements of reverse controller 19 shown in FIG. 5 are the same as those of an apparatus shown in FIG. 3 and the explanations of common elements will be omitted.

[0038] FIG. 5 shows the state that the front end 12a of sheet 12 is held between normal/reverse rotation roller 37 and pinch roller 39 and normal/reverse rotation roller 37 starts the accelerating operation. At this time, a portion of sheet 12 from the rear end 12b to 12c in the vicinity of the exit of conveyor in a main body 27 is held by conveyor belt 33. Therefore, even when normal/reverse rotation roller 37 holding the front end 12a starts to accelerate, the portion of sheet 12 from the rear end 12b to 12c in the vicinity of the exit of conveyor in a main body 27 is held by conveyor belt 33 and becomes a resistance and the stop position of sheet 12 shifts to the upstream side in the conveying direction (the left side in FIG. 5).

[0039] When the stop position of sheet 12 is shifted to the upstream side in the conveying direction and stops there, a gap (or a pitch) with sheet 12 conveyed at the downstream side in the conveying direction rather than this sheet 12 becomes shorter than that before the reverse operation. When a gap (or a pitch) between sheets 12 becomes short, the jamming tends to generate. To reverse sheet 12 by considering the change of this gap (or pitch), it is necessary to set a gap (or a pitch) rather long. If a gap (or a pitch) between sheets is long, conveying density becomes low and the processing throughout of sheet processing apparatus 1 drops.

[0040] FIG. 6 is a diagram showing the entire structure of reverse controller 19 in the first embodiment of the present invention. In the first embodiment, a driving

roller 49 having a driving source independent from conveying unit 14 is provided to the conveying path for conveying sheets 12 after reverse and a pinch roller 51 is provided at a position opposite to this driving roller 49 when compared with the basic structure shown in FIG. 3. Further, a shift sensor 53 that acts as a trigger to operate driving roller 49 is provided at the upstream side in the conveying direction upper than driving roller 49. The shift sensor 53 detects the front and rear ends of sheet 12 and monitors a gap between sheets 12. Further, shift sensor 53 detects the front end of sheet 12 and monitors a pitch between sheets.

[0041] FIG. 7 is a sectional view of driving roller 49, pinch roller 51 and conveying belt 33 shown in FIG. 6 viewed from the conveying direction. As shown in FIG. 7, a pair of driving rollers 49 and pinch rollers 51 is provided both sides of conveying belt 33. Driving roller 49 rotates normally at the same peripheral velocity as the conveying velocity of conveying belt 33 and does not change the conveying velocity of conveyed sheets 12.

[0042] Shift sensor 53 detects a gap (or a pitch) between a sheet 12 reversed by reverse controller 19 and another sheet conveyed at the downstream side in the conveying direction of this sheet 12. Based on the result of this detection, when a gap (or a pitch) becomes short, driving roller 49 and pinch roller 51 decelerate at a moment when they hold a sheet 12 and decelerate a sheet 12 and a gap (or a pitch) with another sheet 12 being conveyed at the downstream side in the conveying direction is corrected to a proper length.

[0043] On the contrary, when the conveying position of sheet 12 is shifted and a gap (or a pitch) between sheets 12 becomes long at the upper stream side in the conveying direction than reverse controller 19, this change in gap (or pitch) is detected by shift sensor 53. Based on this detected result, driving roller 49 and pinch roller 51 are accelerated at a moment when they hold sheet 12 and correct a gap (or pitch) to shift sheet 12 to the downstream side in the conveying direction to a position originally sheet 12 should have been conveyed.

[0044] In FIG. 6, reversed sheet 12 is held on conveying belt 33. However, the conveying path is straight through and its holding force is small and when a pinching pressure of pinch roller 51 is made moderately larger than the holding force of conveying belt 33, it becomes possible to correct a gap properly.

[0045] According to the first embodiment, change in gap (or pitch) of sheets 12 after reversed by reverse controller 19 can be resolved by correcting a gap (or pitch) not only when a gap (or pitch) becomes short but also when it becomes long.

[0046] Next, a second embodiment will be explained referring to FIG. 8. FIG. 8 is a diagram showing the construction of reverse controller 19 in the second embodiment. Explanations of component elements common to those of reverse controller 19 shown in FIG. 3 will be omitted. In reverse controller 19 shown in FIG. 8, driving roller 57 to convey sheet 12, pinch roller 59 arranged at

a position opposite to this driving roller 57 to give a pinch pressure to sheet 12 and guides 41, 41, 41, and 41 to lead sheet 12 to reverse unit 29 are provided at an exit 55 in main body conveyor immediately before reverse unit 29.

[0047] Driving roller 57 receives a driving force from conveying unit 14 of sheet processing apparatus 1 and rotates at the same peripheral velocity as the conveying velocity of conveying unit 14. Further, driving roller 57 is equipped with a one-way clutch that freely rotates only in the direction to which sheet 12 is pulled out. Therefore, when a sheet 12 is pulled out in a moment when normal/reverse rotation roller 37 and pinch roller 39 hold sheet 12, the rear end of sheet 12 does not resist even when it remains in the vicinity of exit in main body conveyor.

[0048] A series of operations in the second embodiment will be explained. First, sheet 12 conveyed through entrance side 19a is held by normal/reverse rotation roller 37 and pinch roller 39 at its front end and pulled out to reverse unit 29 side as accelerated. At this time, the rear end of sheet 12 is held between driving roller 57 and pinch roller 59. However, it escapes in the pulled-out direction by one-way clutch of driving roller 57 and therefore, it is free from resistance by being held by driving roller 57 and pinch roller 59.

[0049] Therefore, by preventing the shift of the stop position sheet 12, it becomes possible to reduce change in gap (or pitch) after reversed and generation of jamming. Driving roller 57 and pinch roller 59 are one set but it is not necessary to restrict especially and plural sets may be installed according to the shape of conveying unit 14 or other conditions.

[0050] FIG. 9 and FIG. 10 show the structure of reverse controller 19 in a third embodiment of the present invention. Explanation of component elements common to those of reverse controller 19 shown in FIG. 3 will be omitted. As shown in FIG. 9 and FIG. 10, a swingable tension roller 61 equipped with an independent motor driving source is provided in conveying unit 14 at the upstream side from reverse unit 29 of reverse controller 19. Swingable tension roller 61 is normally pressed by conveying belt 33 at the upper stream side in the conveying direction of exit in main body conveyor 55 as shown in FIG. 9 and a holding force to sheet 12 is generated in conveying belt 33. When sheet 12 is reversed, swingable tension roller 61 is separated from conveying belt 33 as shown in FIG. 10. Therefore, exit in main body conveyor 55 is released from the thrust pressure of swingable tension roller 61 and the holding force of belt 33 decreases.

[0051] A series of reverse operations of reverse controller 19 equipped with swingable tension roller 61 will be explained. When front end of sheet 12 conveyed through entrance side 19a passes shift sensors 35, its front and rear ends are detected. With this detection as a trigger, swingable tension roller 61 is separated from conveying belt 33 in a moment when sheet 12 is held

by normal/reverse rotation roller 37 and pinch roller 39, conveying belt 33 of exit in main body conveyor 55 is freed. At this time, as conveyor belt 33 is freed, the rear end of sheet 12 does not give a resistance to the acceleration operation of normal/reverse rotation roller 37. By preventing the shift of the stop position of sheet 12, it is possible to reduce change in a gap (or a pitch) of sheet 12 before and after the reverse operation of reverse controller 19.

[0052] FIG. 11 shows the construction of sheet processing apparatus 1 involved in a fourth embodiment of the present invention. The explanations of component elements common to those of reverse controller 19 shown in FIG. 3 will be omitted. Conveying unit 14 from entrance side 19a of reverse controller 19 to exit in main body conveyor 55 is composed of shift sensors 35 and plural rollers described later, etc.

[0053] These plural rollers are composed of driving rollers 63 and 63 which rotate at the same conveying velocity as conveying unit 14 of sheet processing apparatus 1, an acceleration drive roller 65 which rotates at a conveying velocity faster than driving rollers 63, and pinch rollers 67, 67 and 67 which are arranged opposing to drive rollers 63 and 63 and acceleration drive roller 65 and give pinch pressure. Further, guides 41, 41, 41 and 41 are provided to lead sheet 12 to reverse unit 29.

[0054] Sheet 12 is accelerated every time when passes drive rollers 63 and 63 and acceleration drive roller 65. Drive rollers 63 and 63 are provided with a one-way clutch and accelerate the conveying velocity of sheet 12 without receiving a resistance.

[0055] FIG. 12 is a graph showing the control of the peripheral velocity V (conveying velocity) of normal/reverse rotation roller 37 of reverse controller 19 in a fourth embodiment of the present invention.

[0056] The axis of abscissas of the graph shows a time T (s), and the axis of ordinate shows a peripheral velocity (a conveying velocity) V (m/s) of normal/reverse rotation roller 37. Peripheral velocities of normal/reverse rotation roller 37 are $V_0 = 3\text{m/s}$ and $V_1 = 5\text{m/s}$. Here, the peripheral velocity V_0 of normal/reverse rotation roller is almost the same velocity as the conveying velocity of conveying unit 14. However, the peripheral velocity is changed properly according to various characteristic amounts such as size, stiffness, weight, etc. of sheet 12 that is conveyed and not particularly restricted.

[0057] Conveying velocity of drive rollers 63 and 63 shown in FIG. 11 is $V = V_0$ and conveying velocity of acceleration drive roller 65 is $V = V_1$. Therefore, sheet 12 already reached the conveying velocity of normal/reverse rotation roller 37 before it is conveyed to reverse unit 29. Further, the conveying velocity of normal/reverse rotation roller 37 is in a series of operations such as normal rotation at a constant velocity (V_1), deceleration, stop, acceleration to reverse rotation at a constant velocity ($-V_0$) as shown in FIG. 12. Therefore, normal/reverse rotation roller 37 and pinch roller 39 are not required to make the accelerating operation when hold

sheet 12 and the control of normal/reverse rotation roller 37 is simplified and stabilized.

[0058] Further, when shift sensors 35 detect the rear end of sheet 12, normal/reverse rotation roller 37 starts to decelerate after a specified time from the detected time (t11) and stops to rotate (t12). At this time, it becomes possible to make the rear end positions of sheets 12 (or the front end after reversed) uniform at the same deceleration curve irrespective of the length of sheet 12 in the conveying direction.

[0059] Further, it becomes possible to reduce change in pitch (or gap) between sheets 12 and reduce generation of jamming before and after the reverse operation of reverse controller 19. Here, acceleration drive roller 65 and pinch roller 67 are not restricted to be one set but plural sets of acceleration drive rollers 65 equipped with a one-way clutch may be provided so as to accelerate in stages.

[0060] Further, as a modification of the fourth embodiment, acceleration drive rollers 65 may be constructed with drive rollers equipped with a one-way clutch so as to accelerate normal/reverse rotation roller 37 in a moment when it holds sheet 12. At this time, the conveying velocity of normal/reverse rotation roller 37 is so controlled as shown in FIG. 4. According to the modification of the fourth embodiment, when normal/reverse rotation roller 37 pulls out sheet 12, acceleration drive roller 65 and pinch roller 67 do not resist and therefore, it becomes possible to reduce change in gear or pitch of sheet 12 and generation of jamming before and after the reverse operation.

[0061] From the explanations of the first through the fourth embodiments described above, it is possible to provide a reverse controller 19 for sheets 12 capable of reducing generation of jamming by reducing change in gap or pitch between sheets 12 before and after the reverse operation of sheet 12.

[0062] As described above, the sheet reverse device (reverse controller) of the present invention has the structure and actions as described above and is capable of reducing generation of jamming by reducing change in gap or pitch between sheets before and after the sheet reversing operation.

[0063] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A sheet reverse device comprising:

first conveying means (31, 33) for conveying a sheet in a first direction;
a reverse unit (29) to reverse the sheet conveyed from the first conveying means in a second direction differing from the first direction;
second conveying means (31, 33, 49, 51) for conveying the sheet reversed in the reverse unit in the second direction;
a sensor (53) provided on the second conveying means to detect the sheet;
calculation means (2, 4, 5) for calculating a space between the sheets based on the detected result of the sensor; and
a controller (2, 4, 5) adapted to control the conveying velocity of the second conveying unit so as to decelerate the conveying velocity of the sheet when the space between the sheets is shorter than a specified value and accelerate the conveying velocity of the sheets when a space between the sheets is longer than a specified value.

2. The device as set forth in claim 1, wherein the sensor (53) detects a front end of the sheet and a rear end of the sheet conveyed preceding to the next sheet,

the calculating means calculates a gap and/or a pitch between the sheets based on the result of detection by the sensor.

3. The device as set forth in claim 1 or 2, wherein the reverse unit includes a normal/reverse rotation roller (37) capable of rotating in a normal/reverse direction and a pinch roller (39) arranged opposing to the normal/reverse rotation roller, the normal/reverse rotation roller rotating in the normal direction and taking the sheet conveyed from the first conveying means and then, the normal/reverse rotation roller rotating in the reverse direction and conveying the taken sheet in the second direction differing from the first direction.

4. The device as set forth in one of claims 1 to 3, wherein the second conveying unit includes a driving roller (49) and a pinch roller (51) arranged opposing to the driving roller so as to hold the sheet, the controller controlling the rotating velocity of the driving roller based on the result of calculation by the calculating means.

5. A sheet reverse device comprising:

first conveying means (31, 33) for holding and conveying a sheet in a first direction;

a reverse unit (29) to reverse the sheet conveyed from the first conveying means in a second direction differing from the first direction; second conveying means (31, 33) for conveying the sheet reversed in the reverse unit in the second direction; and
 resistance reducing means (57, 59; 61; 63, 65, 67) provided on the first conveying means for reducing a conveying resistance resulting from the holding of the sheet by the first conveying means when the sheet is conveyed to the reverse unit from the first conveying means.

6. The sheet reverse device as set forth in claim 5, wherein the reverse unit includes a normal/reverse rotation roller (37) capable of rotating in a normal/reverse direction and a pinch roller (39) arranged opposing to the normal/reverse rotation roller, the normal/reverse rotation roller rotating in the normal direction and taking the sheet by accelerating the conveying velocity of the sheet conveyed from the first conveying means and then, rotating in the reverse direction and conveying the taken sheet in the second direction differing from the first direction.

7. The sheet reverse device as set forth in claim 5 or 6, wherein the resistance reducing means includes a one-way clutch that is rotated and driven only in the first direction.

8. A sheet reverse device comprising:

a conveying roller (57; 63, 65) equipped with a one-way clutch that is rotated and driven only in a first direction to convey a sheet in a first conveying direction;
 a reverse unit (29) to take the sheet from the conveying rollers with a normal/reverse rotation roller (37) capable of rotating in a normal/reverse direction and a pinch roller (39) provided opposing to the normal/reverse rotation roller while accelerating the conveying velocity of the sheet and convey in a second direction differing from the first direction; and
 conveying means (31, 33) for conveying the sheet conveyed from the reverse unit in the second direction.

9. A sheet reverse device comprising:

a conveying belt (33) to hold and convey a sheet in a first direction;
 holding force adjusting means (61) provided to the conveying belt detachably for increasing a holding force of the conveying belt to hold the sheet by contacting the conveying belt and decreasing the holding force of the conveying belt to hold the sheet by getting away from the con-

veying belt;
 a reverse unit (29) to take in the sheet conveyed from the conveying belt while accelerating the conveying velocity of the sheet by a normal/reverse rotation roller (37) capable of rotating in the normal/reverse direction and convey the sheet in a second direction differing from the first direction;
 conveying means (31, 33) for conveying the sheet conveyed from the reverse unit in the second direction; and
 a controller (2, 4, 5) to control the holding force adjusting means so as to reduce the holding force of the conveying belt by operating the holding force adjusting means.

10. A sheet reverse device comprising:

a conveying roller (63) equipped with a one-way clutch that is rotated and driven in a first direction only to convey a sheet in a first direction at a first conveying velocity;
 an acceleration drive roller (65) to convey the sheet conveyed from the conveying roller in the first direction at a second conveying velocity faster than the first conveying velocity;
 a reverse unit (29) to take the sheet conveyed from the acceleration drive roller at the second conveying velocity by a normal/reverse rotation roller capable of rotating in a normal/reverse direction and a pinch roller provided opposing to the normal/reverse rotation roller and convey in a second direction differing from the first direction; and
 conveying means for conveying the sheet conveyed from the reverse unit in the second direction.

11. The sheet reverse device as set forth in Claim 10 further comprising:

a sensor (35) provided at the upper stream side in the conveying direction from the reverse unit to detect a rear end of the sheet,
 wherein the reverse unit decelerates the conveying velocity of the sheet and stops the sheet based on the detection result of the sensor.

12. The sheet reverse device as set forth in Claim 10 or 11, wherein the acceleration drive roller (65) is equipped with a one-way clutch that is rotated and driven in a first direction only, and

the reverse unit (29) accelerates the sheet that is conveyed by the acceleration drive roller to a third conveying velocity faster than the second conveying velocity.

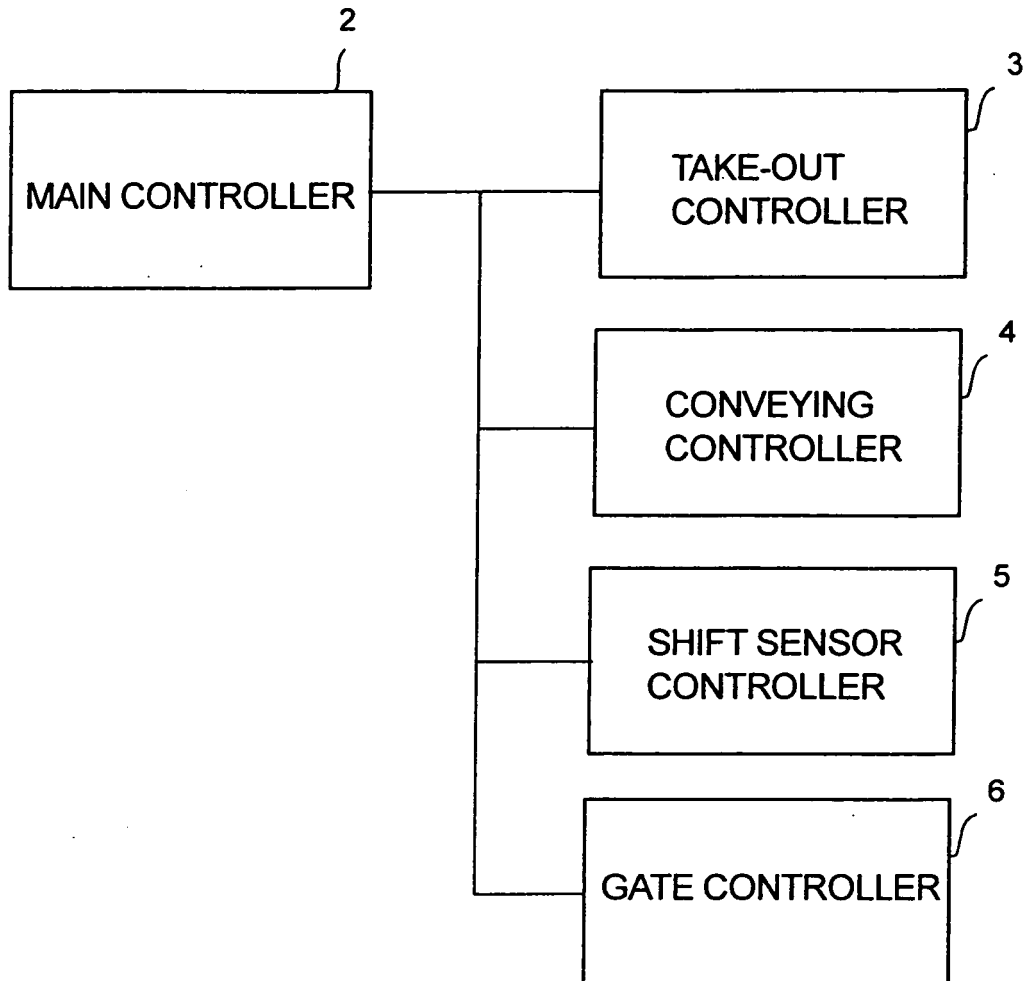


FIG. 1

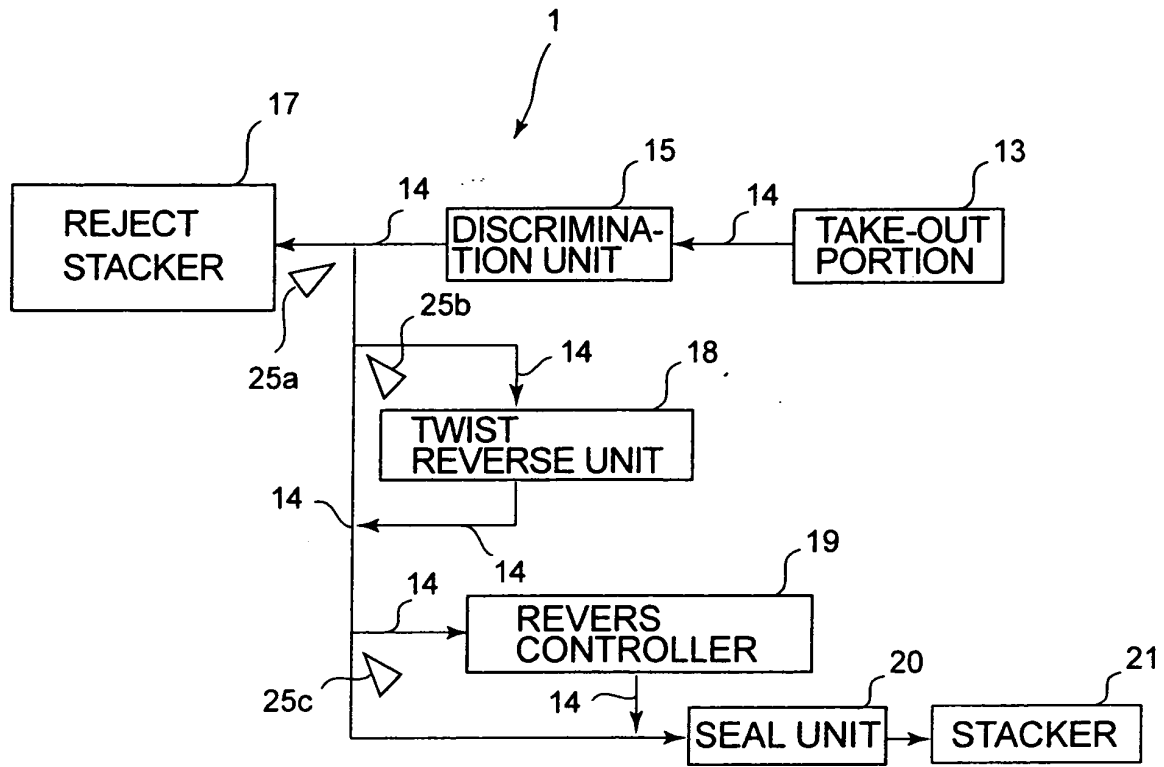


FIG. 2

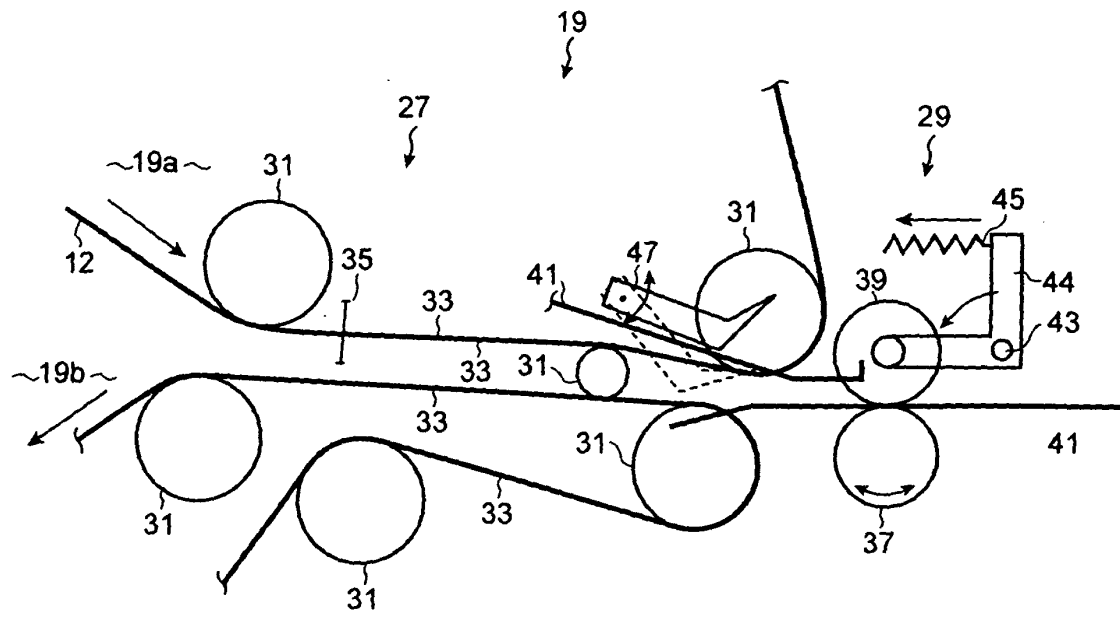


FIG. 3

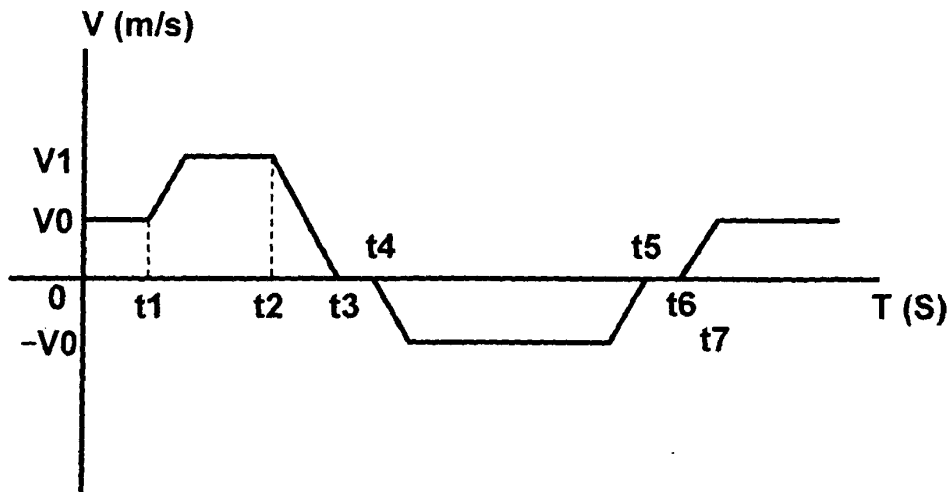


FIG. 4

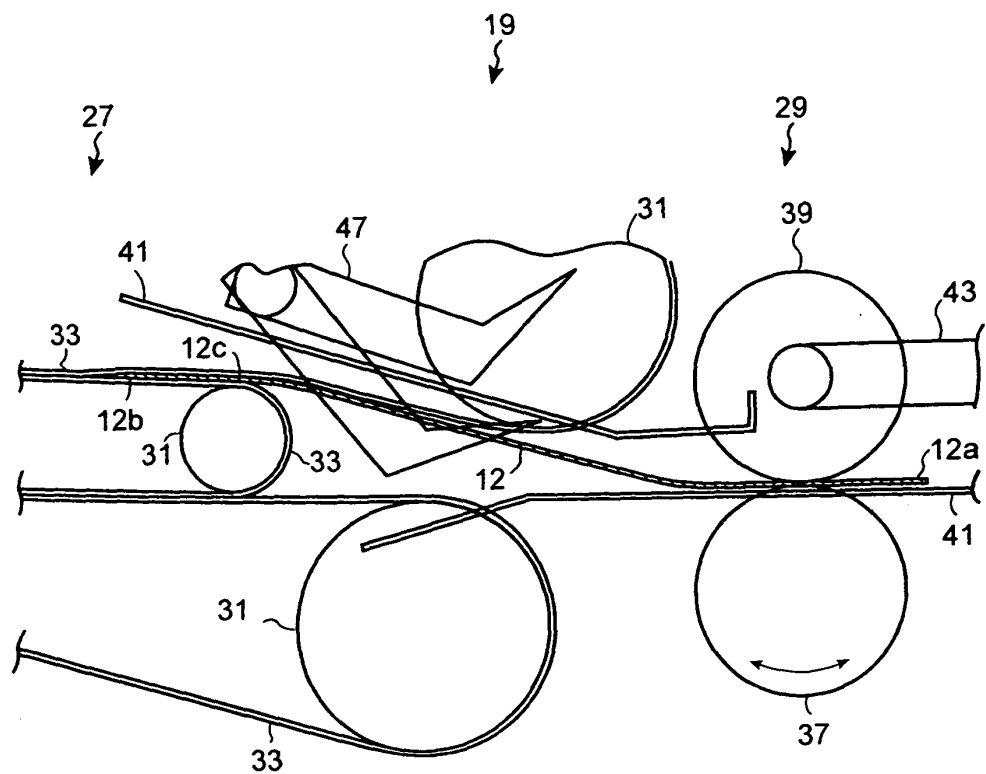


FIG. 5

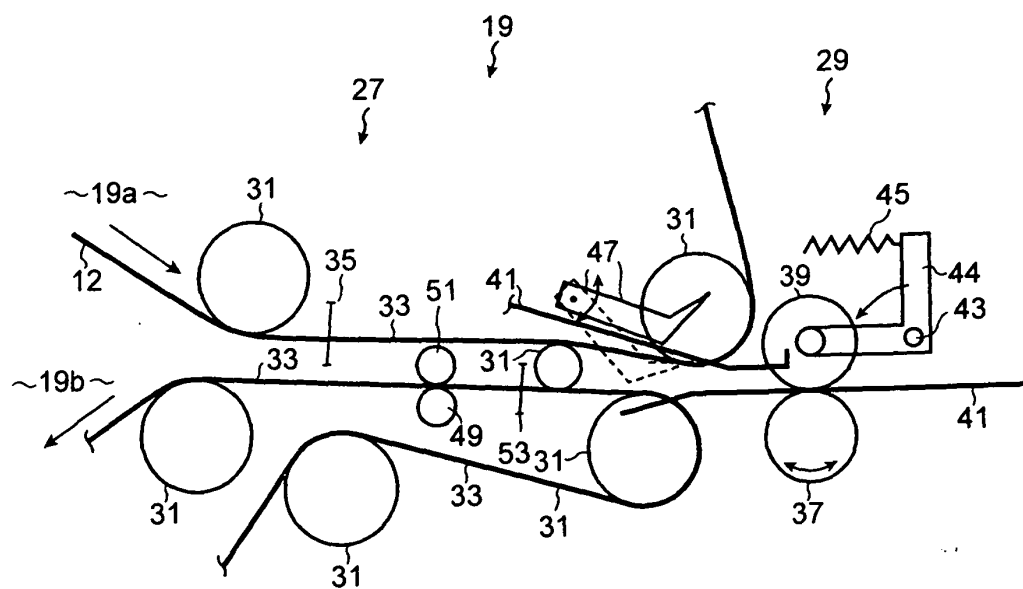


FIG. 6

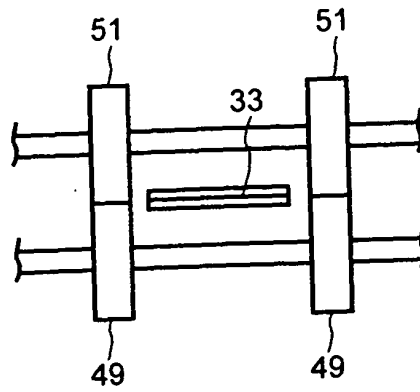


FIG. 7

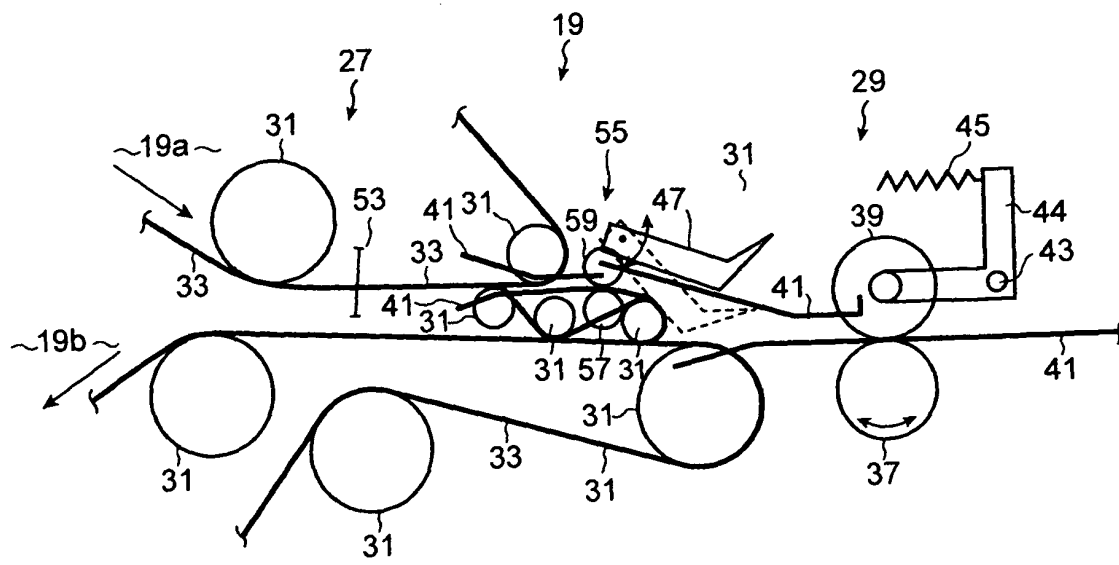


FIG. 8

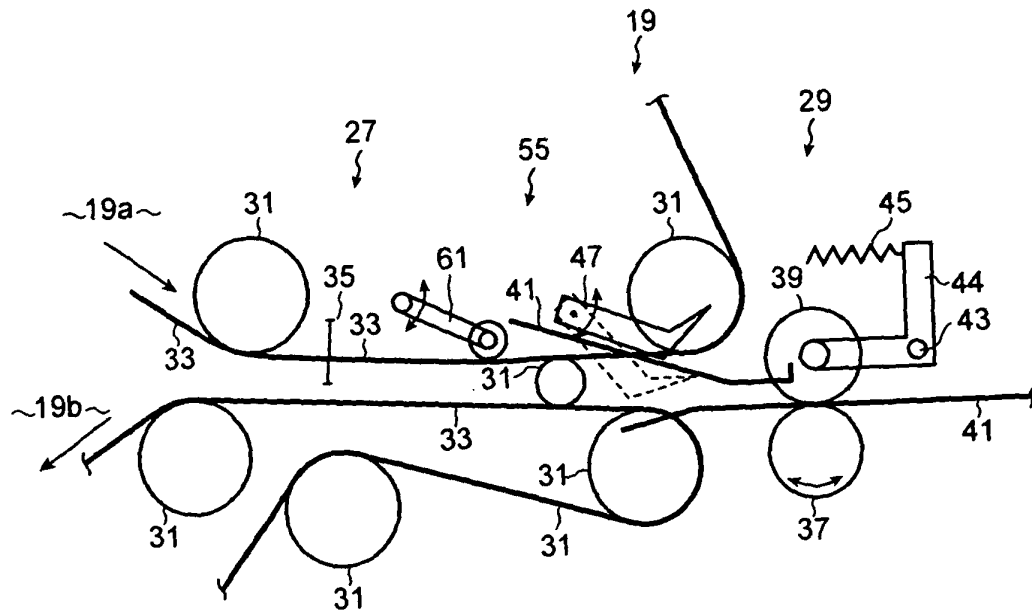


FIG. 9

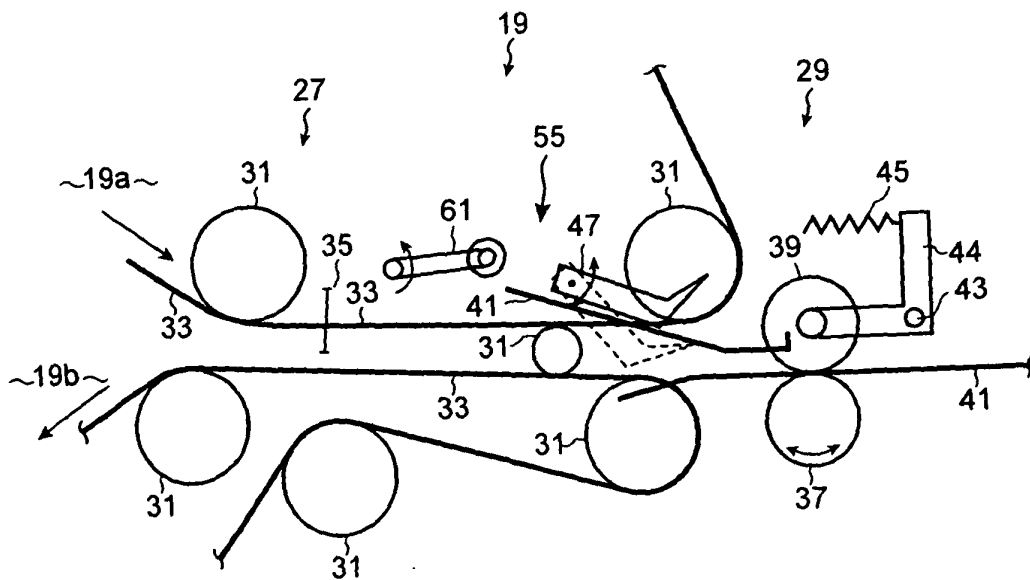


FIG. 10

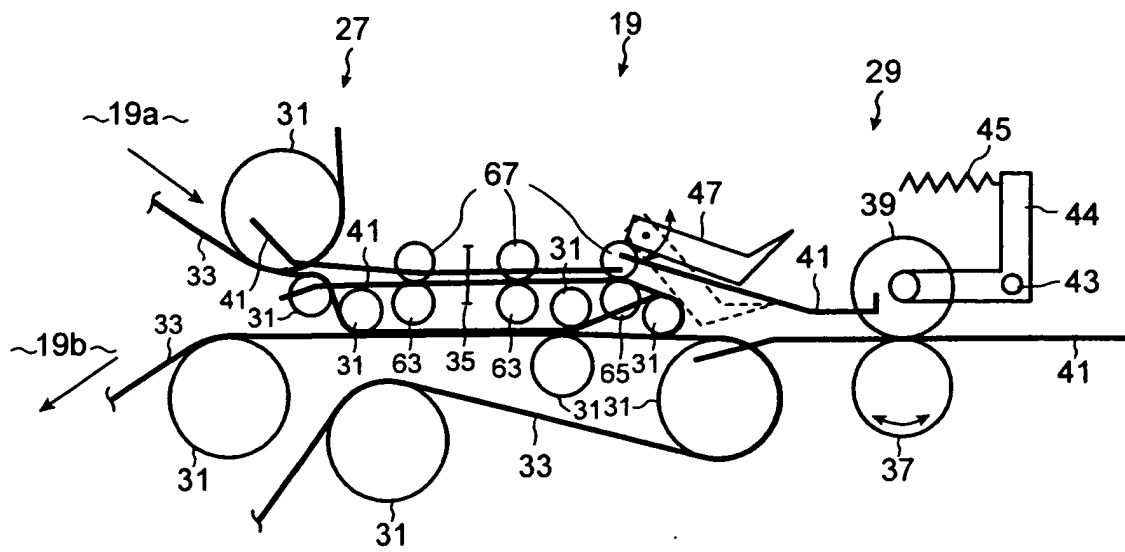


FIG. 11

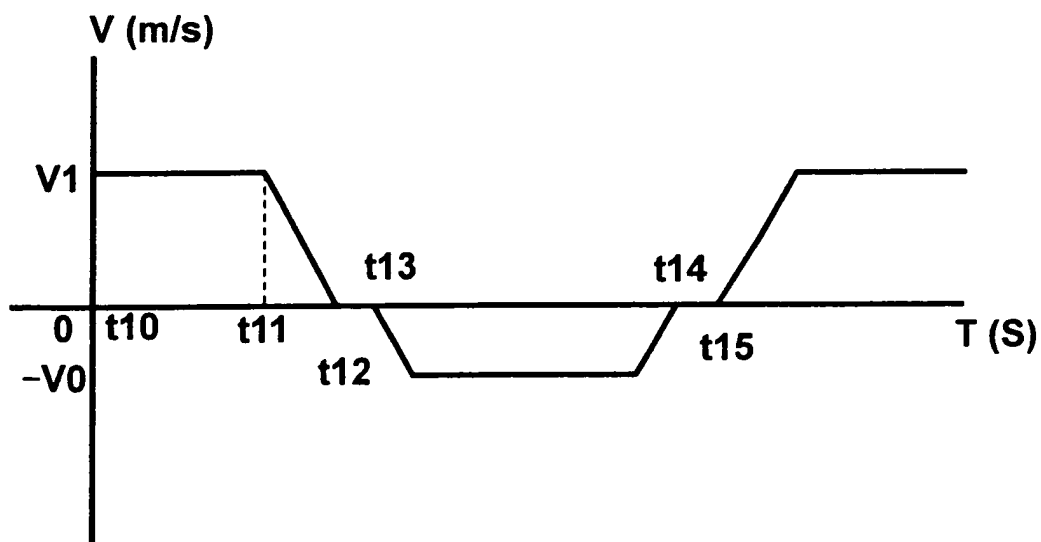


FIG. 12