(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 211 207 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.06.2002 Bulletin 2002/23

(51) Int Cl.[7]: **B65H 29/60**, B65H 33/06

(21) Application number: **01308951.1**

(22) Date of filing: **22.10.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **30.11.2000 JP 2000364510**

(71) Applicant: **Kabushiki Kaisha Toshiba**
Tokyo (JP)

(72) Inventor: **Otsuka, Toru,**
c/o Intellectual Property Division
Minato-ku, Tokyo (JP)

(74) Representative: **Brookes Batchellor**
102-108 Clerkenwell Road
London EC1M 5SA (GB)

(54) Paper-like material processing apparatus and paper-like material processing method

(57) A paper-like material processing method includes the steps of conveying paper-like materials, discriminating in discriminator (9) the direction of the front/back and top/bottom of paper-like materials being conveyed, a step of changing the directions of paper-like materials to prescribed directions by switching conveying paths of paper-like materials with gate (13) according to the result of discrimination, a step of stacking paper-like materials of which directions are changed, and changing the directions of succeeding paper-like materials to be stacked to the reverse direction of paper-like materials already stacked by changing the conveying path whenever paper-like materials in the prescribed number of sheets are stacked.

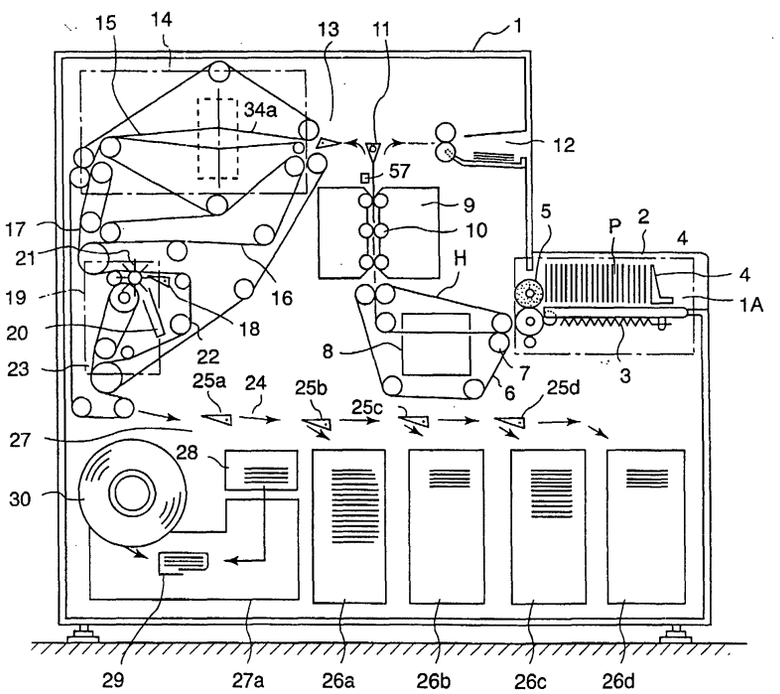


FIG.1

EP 1 211 207 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a paper-like materials processing apparatus that is applied as, for example, a paper-like material sorting/arranging apparatus and a paper-like materials processing method.

2. Description of the Related Art

[0002] Paper-like materials including banknotes, bank checks, merchandise coupons, etc. function as key media of social and economical activities. These paper-like materials are concentrated in large quantities in specific points in the process of circulation and an activity to arrange these paper-like materials separately according to face value or kind has become necessary.

[0003] For automatic processing and labor saving of this kind of activity, an apparatus called a paper-like material sorting/arranging apparatus has been so far developed and put in practical use. In this paper-like sorting/ arranging apparatus, paper-like materials are inserted therein in the unsorted state, kinds of them are discriminated, sorted, stacked for each discriminated kind or sorted, and stacked paper-like materials are bundled in a bundle of 100 sheets.

[0004] By the way, when sorting and stacking paper-like materials for each kind, it is desirable that all of paper-like materials are in the same direction as could as possible. So, apparatuses that are capable of arranging paper-like materials in the uniform direction by discriminating a direction of individual paper-like materials when they are inserted in the state in uneven top/bottom and front/back directions and reversing them to a prescribed direction has been developed in recent years.

[0005] However, in the above-mentioned paper-like materials processing apparatus capable of correcting postures of paper-like materials in the front/back and top/bottom directions, there arises a new problem that did not become a problem in conventional apparatuses that are not capable of uniformly arranging the directions of paper-like materials.

[0006] That is, the problem is uneven heights of paper-like materials accompanied with stacking of them, crumbling of stacked paper-like materials resulting therefrom, and impediment of the stacking operation.

[0007] The uneven heights accompanied with stacking of paper-like materials are due to uneven thickness of paper-like materials. For example, in the case of banknotes, the relief printing is used for printing patterns. In the relief printing, ink rises from the surface of a banknote. When a banknote paper is, for example, 100 μm thick, the height of protrude ink will be 10 ~ 40μm.

[0008] Therefore, in the case of watermarked banknotes without printing at one side and printed at the other side, if, for example, 1,000 sheets of the banknotes are stacked, the height of stacked banknotes becomes 100 mm at one side and 140 mm at the other side. As a result, there was a problem that the stacked banknotes will crumble.

[0009] On the other hand, the stacked banknotes may be bundled in a specified number of sheets, for example, 500 sheets by operator.

[0010] However, for example, 1,000 sheets of banknotes were simply stacked only and 500 sheets of banknotes were counted and bundled by operator and a much time was needed for this work.

SUMMARY OF THE INVENTION

[0011] An object of the present invention is to provide a paper-like materials processing apparatus and a paper-like materials processing method capable of preventing generation of uneven height accompanied with stacking of paper-like materials and preventing crumbling of stacked paper-like materials.

[0012] According to the present invention, there is provided a paper-like material processing apparatus comprising: conveying means for conveying paper-like materials; discriminating means for discriminating the front/back and top/bottom directions of paper-like materials being conveyed by the conveying means; switching means for changing the direction of paper-like materials to a prescribed direction by switching the paper-like materials conveying paths according to the result of discrimination of the discriminating means; stackers for stacking paper-like materials of which directions are changed by the switching means; and control means for reversing the direction of succeeding paper-like materials to be stacked in the stackers against the direction of already stacked paper-like materials.

[0013] Further, according to the present invention, there is provided a paper-like material processing apparatus comprising: conveying means for conveying paper-like materials; posture correction means for correcting the postures of the paper-like materials being conveyed by the conveying means; discriminating means for discriminating the directions of the front/back and the top/bottom of the paper-like materials of which postures are corrected by the posture correction means; switching means for changing the direction of paper-like materials to a prescribed direction by switching the

paper-like material conveying path according to the result of discrimination by the discriminating means; stackers for stacking paper-like materials of which directions are changed by the switching means; first control means for changing the direction of succeeding paper-like materials to be stacked in the stacker to the direction reverse to that of the already stacked paper-like materials; and second control means for displacing paper-like materials to be stacked in the stacker or already stacked paper-like materials in a prescribed amount to the face direction by changing the conveying position of the paper-like materials by operating the posture correction means whenever the paper-like materials is stacked in the stacker in prescribed number of sheets.

[0014] Further, according to the present invention, there is provided A paper-like materials processing method comprising the steps of: conveying paper-like materials; discriminating the directions of front/back and top/bottom of the paper-like materials being conveyed; changing the direction of the paper-like materials to a prescribed direction by switching the conveying path of the paper-like materials according to the result of the discrimination; stacking the paper-like materials of which directions were changed; and changing the direction of succeeding paper-like materials to be stacked to the direction reverse to the direction of the already stacked paper-like materials by changing the conveying path whenever the paper-like materials is stacked in the prescribed number of sheets.

Further, according to the present invention, there is a paper-like material processing method comprising the steps of: conveying paper-like materials; correcting the posture of the paper-like materials being conveyed to the prescribed posture; discriminating the front/back and top/bottom of the posture corrected paper-like materials; changing the direction of paper-like materials to the prescribed direction by switching the paper-like material conveying paths according to the result of the discrimination; stacking the paper-like materials of which directions were changed; controlling the direction of succeeding paper-like materials to be stacked to the direction reverse to that of already stacked paper-like materials by changing the conveying path whenever a prescribed number of sheets are stacked; and controlling paper-like materials to be stacked or succeeding paper-like materials in the prescribed number of sheets so as to displace them by a prescribed amount in the face direction against the already stacked paper-like materials whenever the paper-like materials are stacked in the prescribed number of sheets.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is an internal structural diagram showing a banknote classifying & arranging apparatus of one embodiment of the present invention;
FIG. 2 is a perspective view showing a posture correction device for correcting banknote postures;
FIG. 3 is a plan view showing the posture correction device;
FIG. 4 is a perspective view showing the banknote conveying state;
FIG. 5 is a block diagram showing a posture correction device driving control system;
FIG. 6 is a plan view showing the posture correcting operation;
FIG. 7 is a diagram showing a first conveying path;
FIG. 8 is a diagram showing a second conveying path;
FIG. 9 is a diagram showing a third conveying path;
FIG. 10 is a diagram showing a fourth conveying path;
FIG. 11 is a block diagram showing a conveying path setting control system;
FIG. 12 is a flowchart showing the sorting and stacking operation of paper-like materials;
FIG. 13 is a perspective view showing the directions of paper-like materials conveyed and stacked in first and second models;
FIG. 14 is a front view showing the stacking state of paper-like materials conveyed and stacked in the first and second modes;
FIG. 15 is a front view showing the state of paper-like materials displaced in the face direction and stacked whenever stacked in prescribed number of sheets;
FIG. 16 is a front view showing the state of paper-like materials displaced and stacked in the face direction whenever stacked in the prescribed number of sheets;
FIG. 17 is a diagram showing the state of the left and right sides of paper-like materials having the thickness distributions at the left and right in a second embodiment of the invention;
FIG. 18 is a diagram showing the switching state of the left/right and the front/back of paper-like materials having the thickness distributions at the left and right;
FIG. 19 is a diagram showing the top/bottom switching state of paper-like materials having the thickness distributions at the top and bottom;
FIG. 20 is a diagram showing the top/bottom and the front/back switching state of paper-like materials having the thickness distributions at the top and bottom and;

FIG. 21 is a flowchart showing the switching operation of bank device stacking directions.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Preferred embodiments of the present invention will be described below in detail with reference to the attached drawings.

[0017] FIG. 1 is an internal structural diagram showing a banknote classifying and arranging apparatus which is a paper-like materials processing apparatus of an embodiment of the present invention.

[0018] A table portion 1A is provided at the central portion of a housing 1. This table portion 1A is provided with a banknote supply portion 2. Plural sheets of banknotes which are paper-like materials P are retained in the banknote supply portion 2 in the erected state. Banknotes are pressed against a take-out roller 5 by a backup plate 4 that is pushed by a spring 3.

[0019] Banknotes P are separated and taken out one by one by the rotation of the take-out roller 5 and conveyed by a clamp type conveying unit H comprising a belt 6 and a roller 7. There is provided a posture correction device 8 on the conveying unit H for correcting shift and skew of taken out banknotes P.

[0020] The belt 6 comprises 3 conveying belt pairs 49 as described later and banknotes P passing through the posture correction device 8 are clamped and conveyed by 3 conveying belt pairs. The clamping force of the conveyor belt pair 49 is designed weak so that it does not become load to the posture correction device 8 when changing the postures of banknotes P.

[0021] At the downstream side in the banknote conveying direction of the conveying unit H, a discriminator 9 is provided as a discriminating unit. The discriminator 9 reads various information from the surfaces of banknotes P conveyed by a roller pair 10, and logically calculating the read information and comparing with reference information, discriminates presence of stain and break, face value, and four directions of the top/bottom and front/back of banknotes.

[0022] At the downstream side in the banknote conveying direction of the discriminator 9, a counter 57 is provided for counting the number of sheets of banknotes passing the discriminator and a first gate 11 is provided as a switching means. The first gate 11 is for leading banknotes judged by the discriminator 9 as being broken, considerably stained, taken in two sheets at a time or extremely skewed and banknotes that are not judged to be proper notes to a reject box 12 or leading banknotes judged to be proper notes to a second gate 13 that is a switching means.

[0023] The second gate 13 divides the conveying direction of banknotes P into first and second directions. A reversing path 14 is provided in the first direction. This reversing path 14 has a twist belt 15 that reverses banknotes P by 180°, In the second direction, a simple belt conveyor 16 is provided for conveying paper-like materials P in the as-is condition. The banknotes divided and conveyed in the first and second directions are joined in a joining portion 17. The lengths of paths to the joining portion 17 are made equal so that spaces between them after joined do not become divergent.

[0024] At the downstream side of the banknote conveying direction of the joining portion 17, a third gate 18 is provided as a switching means and the conveying direction of banknotes P is divided into third and fourth directions by the third gate 18. A switchback path 19 is provided in the third direction.

[0025] The switchback path 19 is provided with a reversing box 20 for introducing banknotes P and a tapping wheel 21 for pressing the rear ends of banknotes led to the reversing box 20 against a reversing roller 21a. When banknotes P are sent out from the reversing box 20, the top/bottom of them are reversed and conveyed. In the fourth direction, a simple belt conveyor 22 is provided and banknotes P are conveyed in the as-is posture. Banknotes P divided in the third and fourth directions and conveyed are joined in a joining portion 23. The divided path lengths are equal to each other so that spaces between them after joined do not become divergent.

[0026] At the downstream side in the banknote conveying direction of the joining portion 23, a lateral conveyor 24 is provided. On the lateral conveyor, gates 25a ~ 25d are arranged. These gates are less than the number of portions to be divided by one. Under the gates 25a ~ 25d, first ~ fourth stackers 26a ~ 26d are arranged. Banknotes P are stacked in these stackers 26a ~ 26d in the lateral state.

[0027] Under the first gate 25a, a packaging device 27 is provided. The packaging device 27 has a stacking portion 28 to sort and stack every 100 sheets of banknote P, a conveying portion 27a to convey banknotes P from the stacking portion 28 and a winding portion 29 to wind every 100 sheets of banknote P conveyed on the conveying portion 27a with a paper strip 30.

[0028] FIG. 2 is a perspective view of the posture correction device 8 and FIG. 3 is a plan view of the posture correction device 8. The posture correction device 8 is provided with first and second correction portions 32 bad 33 on a base 31. Since the first and second correction portions 32 and 33 are in the same structure, the first correction portion 32 only will be described.

[0029] The first correction portion 32 has a U-shape frame 34. This frame 34 has side plates 34a and 34a at the positions wider than the banknote conveying width. Between the left and right side plates 34a and 34a of the frame 34, a shaft 35a of driving rollers 35 is put over. One end of the shaft 35a is held by a bearing 36 and a driving motor 38 is connected to the other end. The surfaces of the driving rollers 35 are formed with rubber. Rubber rollers 39 are

kept in contact with the upper sides of the driving rollers 35. The rubber rollers 39 are held rotatably by a shaft 40 via bearings 38. The shaft 40 is fit into slits 41 of the left and right side plates 34a and 34a of the frame 34 and pressed downward by a spring 42. The driving rollers 35 and the rubber rollers 39 are rotated by the rotation of the driving motor 38 and banknotes P are firmly clamped and conveyed.

[0030] The U-shape frame 34 is supported by the upper end of a shaft 44 so that it can rotate centering around an intersecting point C of the central line of the conveyor and the roller shaft line when viewed from the above. The shaft 44 is held rotatably by a housing 43. A servo motor 48 is connected to the lower end of the shaft 44 via pulley 45, a belt 46 and a pulley 47.

[0031] Further, 3 conveying belt pairs 49 for clamping and conveying banknotes P are provided to the posture correction device 8 by penetrating it. The roller pairs 35 and 39 are so set that their clamping forces become stronger than the banknote clamping forces of 3 conveying belt pairs.

[0032] At the inlet side of the posture correction device 8, there is provided a sensor array 53 optically detecting banknotes P and a sensor 54 is provided at the central portion of the conveying path near the second correction portion 33 for optically detecting banknotes.

[0033] FIG. 4 shows the posture of banknotes P taken out from the banknote supply portion 2.

[0034] In other words, banknotes P, notes used as money, etc. are in different sizes depending on nominal values and therefore, when they are set in the banknote supply portion 2 in a lump, even if they are uniformly arranged manually, small notes may be buried in maximum size notes and it is highly possible that they can be shifted to both sides or skewed.

[0035] A medium size note with the front side turned downward and the tom/bottom reversed (hereinafter, called as FR note) has less positional shift but skewed to the right side. A note succeeding to this FR note with the back side turned upward and the proper top/bottom (hereinafter, called as BF note) is shifted to the left side and skewed to the left. A note taken out following to the BF note with the back side turned downward and the top/bottom reversed (hereinafter, called as BR note) is not skewed nor shifted. Further, a note taken out next is a proper note with the front side turned upward and the top/back properly set called as FF note.

[0036] FIG. 5 is a block diagram showing a driving control system of the posture correction device 8.

[0037] The sensor array 53, the sensor 54 and further, a counter 57 are connected to a controller 55 via a signal transmission line. The first and second correction portions 32 and 33 are connected to the controller 55 via a control line. The operations of the first and second correction portions 32 and 33 are controlled by the controller 55 corresponding to banknote detection signals from the sensor array 53 and the sensor 54 and the postures of banknotes are corrected.

[0038] When the counter 57 counts a prescribed number of banknotes passed, for example, 500 sheets, the counter operates the first correction portion 32 and displaces the position shift Δs mm from the conveying center line of banknotes by ± 5 mm.

[0039] FIG. 6 is a plan view showing the banknote posture correction operation.

[0040] The posture of a banknote P sent to the posture correction device 8 is detected by the sensor array 53 and from the result of this detection, the position shift Δs mm and a skew angle $\theta 1$ are calculated. Then, assuming the width of banknotes P at L, $\theta 2$ at tan 2 = $\Delta S/L$ is calculated. The servo motor 48 is driven to rotate so as to turn the first correction roller 32 in the arrow direction by the angle of this $\theta 2$. As a result, the bank paper P is moved in the direction shifted by an angle $\theta 2$ against the conveying direction and the position shift is corrected by the rotation of the first correction roller 32 while maintaining the skew angle.

[0041] Then, when the leading edge of a banknote P passes the sensor 54, the second correction portion 33 is rotated in the arrow direction by an angle $\theta 1$. As a result, the banknote P is clamped and conveyed by the rotation of the rollers 35 and 39 and its skew is corrected.

[0042] Further, in the case of a banknote P having no skew and position shift, it is conveyed to the next discriminator 9 while keeping the correct posture without rotating the first and second correction portions 32 and 33.

[0043] A banknote P is conveyed to the discriminator 9 in the state without skew and shift as a result of the posture correction and therefore, information that is obtained from its surface is stable and discrimination of its kind, judgment, and logical calculation of the front/back and top/bottom become easy.

[0044] FIG. 7 through FIG. 10 show the conveying paths a-d of banknotes P. FIG. 11 is a block diagram showing a control system for selectively setting the conveying paths a $\sim$ d.

[0045] As shown in FIG. 11, the discriminator 9 and the counter 57 are connected to a controller 51 via the information transmission circuit and the gates 11, 13 and 18 are connected to the controller 51 via the control circuit. These gates 11, 13 and 18 are operated by the controller 51 according to discrimination information from the discriminator 9 and the conveying paths a - d are selectively set.

[0046] That is, when a banknote P is discriminated to be an FF note by the discriminator 9, the first conveying path a shown in FIG. 7 is set. When a banknote P is discriminated to be a FR note, the second conveying path b shown in FIG. 8 is set. When a banknote P is discriminated to be a BF note, a third conveying path c shown in FIG. 9 is set and

when a banknote P is discriminated to be a BR note, a fourth conveying path d shown in FIG. 10 is set.

[0047] In the first conveying path a shown in FIG. 7, a banknote P passes a switchback path 19, in the second conveying path b shown in FIG. 8, a banknote P passes the reversing path 14, in the third conveying path c shown in FIG. 9, a banknote P passes the reversing path 14 and the switchback path 19, and in the fourth conveying path d shown in FIG. 10, a banknote P does not pass both the reversing path 14 and the switchback path 19.

[0048] Banknotes P pass one of the above-mentioned first through fourth conveying paths a ~ d and therefore, all of them are in such the state that the front/back and the top/bottom are uniformly arranged when entering into the lateral conveyor 24. Accordingly, all banknotes are stacked in the first - fourth stackers in the lateral state with the front/back and the top/bottom uniformly arranged, and all banknotes can be wound with the paper strip 30 in the packaging device 27 in the state of the front/back and the top/bottom uniformly arranged.

[0049] As described above, this invention has first and second modes A and B for arranging the front/back and the top/bottom shown in Table 1 for the basic control system for the arrangement of the front/back and the top/bottom as shown below. These first and second modes A and B are switched by the controller 51 whenever the counter 57 counts up a prescribed number of banknotes, for example, 500 sheets.

[Table 1]

Mode A		Mode B	
FF Note	Route (a)	FF Note	Route (b)
FR Note	Route (b)	FR Note	Route (a)
BF Note	Route (c)	BF Note	Route (d)
BR Note	Route (d)	BR Note	Route (c)

[0050] When the first mode A is set, FF notes, FR notes, BF notes and BR notes are conveyed along the first conveying path a, the second conveying path b, the third conveying path c and the fourth conveying path d, respectively.

[0051] When the second mode B is set, FF notes, FR notes, BF notes and BR notes are conveyed along the second conveying path b, the first conveying path a, the forth conveying path d and the third conveying path c, respectively.

[0052] Banknotes P are conveyed and stacked in the first and the second modes A and B, the front sides of the banknotes P are turn upward but the left and right directions of the banknotes are reversed in the first mode and the second mode as shown in FIG. 13.

[0053] FIG. 12 is a flowchart showing the banknote sorting and stacking operation.

[0054] When plural banknotes P are set in the banknote supply portion 2 and a start switch (not illustrated) is depressed, the first mode A is set and the counter 57 is set at n = 0 (Step S1). Then, the take-out roller 5 is rotated and banknotes P are taken out from the banknote supply portion 2 one by one. The banknotes P taken out are clamped and conveyed by the conveying belt pair 49 and the skew or shift is corrected by the first and the second correction portions 32 and 33 while they are being conveyed. After the correction, a kind of banknote P, its front/back, top/bottom, etc. are discriminated by the discriminator 9 (Step S2).

[0055] When a kind of banknote is discriminated to be, for example, K1, whether the mode is the first mode A is discriminated (Step S3). When the mode is discriminated to be the first mode A, the number of sheets of K1 banknote is counted by the counter 57 (Step S4). Then, whether the counted number of sheets is larger than 500 sheets is discriminated (Step S5). When the counted number of banknotes is discriminated to be more than 500 sheets, the second mode B is set (Step S6) and the counter 57 is set at n=0 (Step S7). Then, the number of passed banknotes is again counted by the counter 57 (Step S8) and whether the counted number of sheets is larger than 500 sheets is discriminated (Step S9). When the number of passed banknotes is discriminated to be more than 500 sheets, the first mode A is set (Step 10) and then, the counter 57 is set at n=0 (Step S11). Thereafter, the same operations are repeated and banknotes are sorted and stacked in the first stacker 26a.

[0056] Further, in the case when the kind of banknote is K2 or K3, the banknotes are also stacked in the stackers 26b and 26c by the same operations.

[0057] The left and right sides of stacked banknotes P are reversed for every 500 sheets when the above control operation is repeated as shown in FIG. 14. Thus, a difference in thickness of the left and right sides of banknotes P is absorbed and the left and right side heights are made uniform. Therefore, the uneven heights resulting from the stacking of banknotes P are eliminated, generation of crumbling of stacked banknotes can be prevented, and the banknote arranging wok efficiency can be promoted.

[0058] Further, in the above embodiment, the case to stack banknotes in different left and right heights is explained. In the case of banknotes having a difference in the top and bottom thickness, it is only necessary to change the upward and downward directions alternately. For this purpose, what is only needed is to change the above-mentioned first

mode A and the second mode B table.

[0059] Further, in the above embodiment, the mode is changed for every 500 sheets. This number of sheets for changing the mode is not restricted to 500 sheets but can be changed according to the entire banknote stacking capacity.

[0060] Further, as a method to make it easy to see the portion switched for the first and second modes A and B, a control amount of the banknote shift ΔS mm from the conveying center line can be switched to Δ+5 mm and ΔS-5 mm by the posture control device.

[0061] As a result of this control, banknotes P will shift to the left and right for every 500 sheets as shown in FIG. 15 and therefore, it is easy to discriminate the switching point when taking out banknotes P. Accordingly, for example, when binding every 500 sheets of stacked banknotes manually, worker is not needed to count the number of banknotes and work efficiency can be improved.

[0062] Further, when only one sheet of a bank note is shifted in the left/right direction for every 500 sheets, the same effect as described above is obtained.

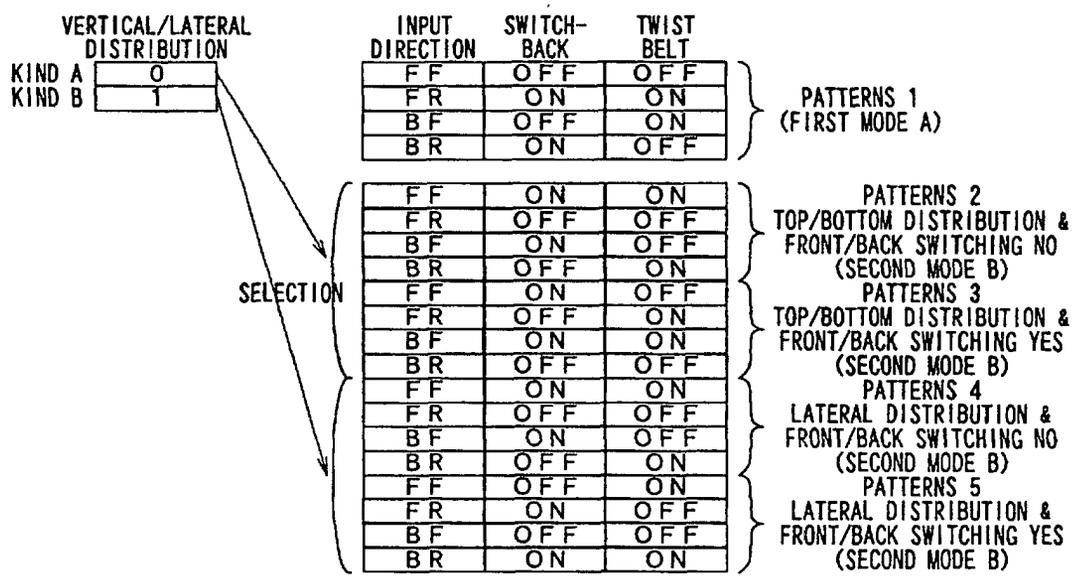
[0063] Next, the second embodiment of the present invention will be described referring to FIG. 17 - FIG. 21.

[0064] The distribution of thickness (the printed portion a) of banknotes as banknotes P exists not only in the lateral direction shown in FIG. 17 but also in the vertical direction as shown in FIG. 19. Thai is, there is a difference in the thickness of banknotes P between the right half and the left half as well as between the upper half and the lower half. When the thickness differs between the left and right portions of banknotes, the thickness of stacked banknotes can be made uniform by exchanging the left and right portions of banknotes whenever banknotes P are stacked in the prescribed number of sheets. Further, when the thickness differs between the upper and lower portions of banknotes, the thickness of the upper and lower portions can be made uniform by turning over the upper and lower portions each other.

[0065] By the way, the thickness distribution of banknotes P depends upon kind of banknote P (face value). Accordingly, it is possible to determine a proper stack switching method according to a face value of banknote P discriminated by the discriminator 9. Further, depending upon the post processing method of stacked banknotes P, they can be stacked without turning over the front/back sides as shown in FIG. 18 and FIG. 20.

[0066] In order to achieve the switching of banknote stacking according to kind of face value, the reversing mechanism is controlled according to a flowchart shown in FIG. 21.

[Table 2]



SWITCHING PATTERN TABLE

[0067] In Table 2, the vertical and lateral distribution patterns (A), (B) of banknote thickness according to face values are pre-set. Further, the operation patterns 1 of the gates 11, 13 and 18 at the first mode A are set and further, the operation patterns 2, 3, 4 and 5 of the gates 11, 13 and 18 corresponding to the vertical and lateral distribution patterns at the second mode B are set in Table 2.

[0068] Next, the switching operation of banknote stacking directions in the second mode B will be described referring to the flowchart in FIG. 21.

[0069] When a banknote P is sent to the discriminator 9, its kind and direction are discriminated and the result is obtained (Step S21). Thereafter, the vertical distribution/lateral distribution table for the kind of the banknote is referred to (Step S22). Then, whether a table value is 0 is discriminated (Step S23). When the table value is discriminated to be 0, the vertical operation pattern 2 (or 3) of the switching pattern table is selected (Step S24) and the contents of operation for the banknote direction is acquired from the switching pattern table (Step S25). Then, whether the banknote P should be passed through the switchback path 19 (Step S26) is discriminated. When the banknote P is discriminated that it should be passed through the switchback path 19, the reversing operation of the banknote P is carried out by the switchback path 19 (Step S27). Then, whether the banknotes should be passed through the twist belt 15 is discriminated (Step S28). When it is discriminated that the banknotes should be passed through the twist belt 15, the banknote is reversed by the twist belt 15 (Step S29). Further, when it is discriminated that a table value is not 0 in Step 23, the lateral distribution operation pattern 4 (or 5) of the switching pattern table is selected and the operations subsequent to Step 25 are carried out.

[0070] According to this second embodiment, the vertical and lateral thickness distribution patterns corresponding to kinds of banknotes are pre-set and the operating patterns of the gates 11, 13 and 18 corresponding to the discriminated thickness distribution patterns are selected, and therefore, there are such merits that the operating patterns are selectable without especially reading and discriminating a banknote thickness distribution pattern and process efficiency is promoted.

[0071] As described above, in this embodiment, the conveying path is changed by operating the gate whenever the prescribed number of banknotes are stacked in a stacker and the direction of succeeding banknotes that are stacked in the stacker are reversed against the banknotes already stacked. Therefore, the uneven height of stacked banknotes is eliminated and accordingly, generation of crumbling of stacked banknotes can be prevented and paper-like material arranging work efficiency can be improved.

[0072] Further, the stacking position of succeeding banknote stacked in the stacker is displaced against the already stacked banknotes whenever the banknotes are stacked to a prescribed number of sheets, stacked banknotes can be sorted in a prescribed number of sheets without counting stacked banknotes as before. Accordingly, when binding banknotes in a prescribed number of sheets, work efficiency can be promoted.

[0073] Further, because a thickness distribution pattern of paper-like material according to its kind is pre-set, the thickness distribution patter is discriminated according to its kind, and an operating pattern of a gate corresponding to this discriminated distribution pattern is selected. Therefore, an operating pattern can be selected without especially reading and discriminating a banknote thickness distribution pattern and process efficiency can be improved.

Claims

1. A paper-like material processing apparatus comprising:

conveying means for conveying paper-like materials;
discriminating means for discriminating the front/back and top/bottom directions of paper-like materials being conveyed by the conveying means;
switching means for changing the direction of paper-like materials to a prescribed direction by switching the paper-like materials conveying paths according to the result of discrimination of the discriminating means;
stackers for stacking paper-like materials of which directions are changed by the switching means; and
control means for reversing the direction of succeeding paper-like materials to be stacked in the stackers against the direction of already stacked paper-like materials.

2. A paper-like material processing apparatus according to Claim 1, further comprising:

a reversing path provided on the conveying path for changing the lateral direction of paper-like materials; and
a switchback path portion for changing the vertical direction of paper-like materials.

3. A paper-like material processing apparatus according to Claim 2, wherein the conveying path comprises a first conveying path where the paper-like materials pass the switchback path; a second conveying path where the paper-like materials pass the reversing path; a third conveying path where the paper-like materials pass the reversing path and the switchback path; and a fourth conveying path where the paper-like materials do not pass the reversing path and the switchback path.

4. A paper-like material processing apparatus according to Claim 3, wherein the conveying means conveys paper-like materials along the first conveying path when the front surface of a banknote is upward and the top/bottom is in the proper direction and after paper-like materials are stacked in the stacker in a prescribed number of sheets, paper-like materials are conveyed by switching the gate to the second conveying path.

5. A paper-like material processing apparatus according to Claim 3, wherein the conveying means conveys the paper-like materials along the second conveying path when the front surface of a banknote is upward and the top/bottom direction is in the reverse direction and after stacking a prescribed number of sheets in the stacker, conveys succeeding paper-like materials by switching the conveying path to the first conveying path.

6. A paper-like material processing apparatus according to Claim 3, wherein the conveying unit conveys the paper-like materials along the third conveying path when its back side is turned upward and the direction of the top/bottom is normal, and after prescribed number of sheets are stacked in the stacker, conveys paper-like materials by switching the conveying path to the fourth conveying path.

7. A paper-like material processing apparatus according to Claim 3, wherein the conveying unit conveys the paper-like materials along the fourth conveying path when its back side is turned upward and the direction of the top/bottom is in the reverse direction, and after prescribed number of sheets are stacked in the stacker, conveys paper-like materials by switching the conveying path to the third conveying path.

8. A paper-like material processing apparatus comprising:

conveying means for conveying paper-like materials;
posture correction means for correcting the postures of the paper-like materials being conveyed by the conveying means;
discriminating means for discriminating the directions of the front/back and the top/bottom of the paper-like materials of which postures are corrected by the posture correction means;
switching means for changing the direction of paper-like materials to a prescribed direction by switching the paper-like material conveying path according to the result of discrimination by the discriminating means;
stackers for stacking paper-like materials of which directions are changed by the switching means;
first control means for changing the direction of succeeding paper-like materials to be stacked in the stacker to the direction reverse to that of the already stacked paper-like materials; and
second control means for displacing paper-like materials to be stacked in the stacker or already stacked paper-like materials in a prescribed amount to the face direction by changing the conveying position of the paper-like materials by operating the posture correction means whenever the paper-like materials is stacked in the stacker in prescribed number of sheets.

9. A paper-like material processing apparatus comprising:

conveying means for conveying paper-like materials;
discriminating means for discriminating kinds of paper-like materials being conveyed by the conveying means and also directions of paper-like materials;
gate means for changing the direction of paper-like materials in a prescribed direction by switching the conveying path of the paper-like materials according to the direction of paper-like materials discriminated by the discriminating means;
stackers for stacking paper-like materials of which directions are changed by the gate means;
thickness distribution patterns that are pre-set according to kinds of paper-like materials;
operation patterns of the gate means that are set according to the thickness distribution patterns; and
control means for changing the direction of succeeding paper-like materials to be stacked in the stackers to a direction reverse to the direction of already stacked paper-like materials by discriminating a thickness distribution pattern according to a kind of the paper-like materials whenever the paper-like materials is stacked in a prescribed number of sheets in the stacker, selecting the operation pattern according to the thickness distribution pattern and changing a conveying path by operating the gate means based on the operation pattern.

10. A paper-like materials processing method comprising the steps of:

conveying paper-like materials;

discriminating the directions of front/back and top/bottom of the paper-like materials being conveyed;
changing the direction of the paper-like materials to a prescribed direction by switching the conveying path of the paper-like materials according to the result of the discrimination;
stacking the paper-like materials of which directions were changed; and
changing the direction of succeeding paper-like materials to be stacked to the direction reverse to the direction of the already stacked paper-like materials by changing the conveying path whenever the paper-like materials is stacked in the prescribed number of sheets.

11. A paper-like material processing method according to Claim 10, further comprising the steps of:

changing the lateral direction of the paper-like materials; and
changing the vertical direction of the paper-like materials.

12. A paper-like material processing method according to Claim 11, wherein the conveying paths comprise: a first conveying path for changing the vertical direction of the paper-like materials, a second conveying path for changing the lateral direction of the paper-like materials, a third conveying path for changing the lateral direction and the vertical direction of the paper-like materials, and a fourth conveying path for not changing the lateral direction nor the vertical direction of the paper-like materials.

13. A paper-like material processing method according to Claim 12, wherein a paper-like material is conveyed along the first conveying path when its front side is upward and the vertical direction is normal and after a prescribed number of sheets are stacked, the conveying path is switched to the second conveying path for conveying paper-like materials.

14. A paper-like material processing method according to Claim 12, wherein a paper-like material is conveyed along the second conveying path when its front side is upward and the vertical direction is the reverse direction, and after the prescribed number of sheets are stacked, the conveying path is switched to the first conveying path for conveying paper-like materials.

15. A paper-like material processing method according to Claim 12, wherein a paper-like material is conveyed along the third conveying path when its back side is upward and its vertical direction is normal, and after the prescribed number of sheets are stacked, the conveying path is switched to the fourth conveying path for conveying paper-like materials.

16. A paper-like material processing method according to Claim 12, wherein a paper-like material is conveyed along the fourth conveying path when its back side is upward and the vertical direction is in the reverse direction, and after a number of sheets are stacked, the conveying path is switched to the third conveying path for conveying paper-like materials.

17. A paper-like material processing method comprising the steps of:

conveying paper-like materials;
correcting the posture of the paper-like materials being conveyed to the prescribed posture;
discriminating the front/back and top/bottom of the posture corrected paper-like materials;
changing the direction of paper-like materials to the prescribed direction by switching the paper-like material conveying paths according to the result of the discrimination;
stacking the paper-like materials of which directions were changed;
controlling the direction of succeeding paper-like materials to be stacked to the direction reverse to that of already stacked paper-like materials by changing the conveying path whenever a prescribed number of sheets are stacked; and
controlling paper-like materials to be stacked or succeeding paper-like materials in the prescribed number of sheets so as to displace them by a prescribed amount in the face direction against the already stacked paper-like materials whenever the paper-like materials are stacked in the prescribed number of sheets.

18. A paper-like material processing method comprising the steps of:

conveying paper-like materials;
discriminating a kind of the paper-like materials being conveyed and also, the direction of the paper-like ma-

terials;
changing the direction of the paper-like materials to the prescribed direction by switching the paper-like materials conveying path according to the paper-like material direction discriminated;
stacking the paper-like materials of which direction was changed;
acquiring a thickness distribution pattern of the paper-like materials pre-set according to a kind of the paper-like materials;
acquiring an operation pattern for changing the direction of the paper-like materials that was set according to the thickness distribution pattern to the prescribed direction; and
controlling to change the direction of succeeding paper-like materials to be stacked to the direction reverse to the direction of already stacked paper-like materials by discriminating the thickness distribution pattern of the paper-like materials according to the discriminated result of its kind whenever the paper-like materials are stacked in the prescribed number of sheets, selecting the operation pattern according to the thickness distribution pattern and changing the conveying path based on the selected operation pattern.

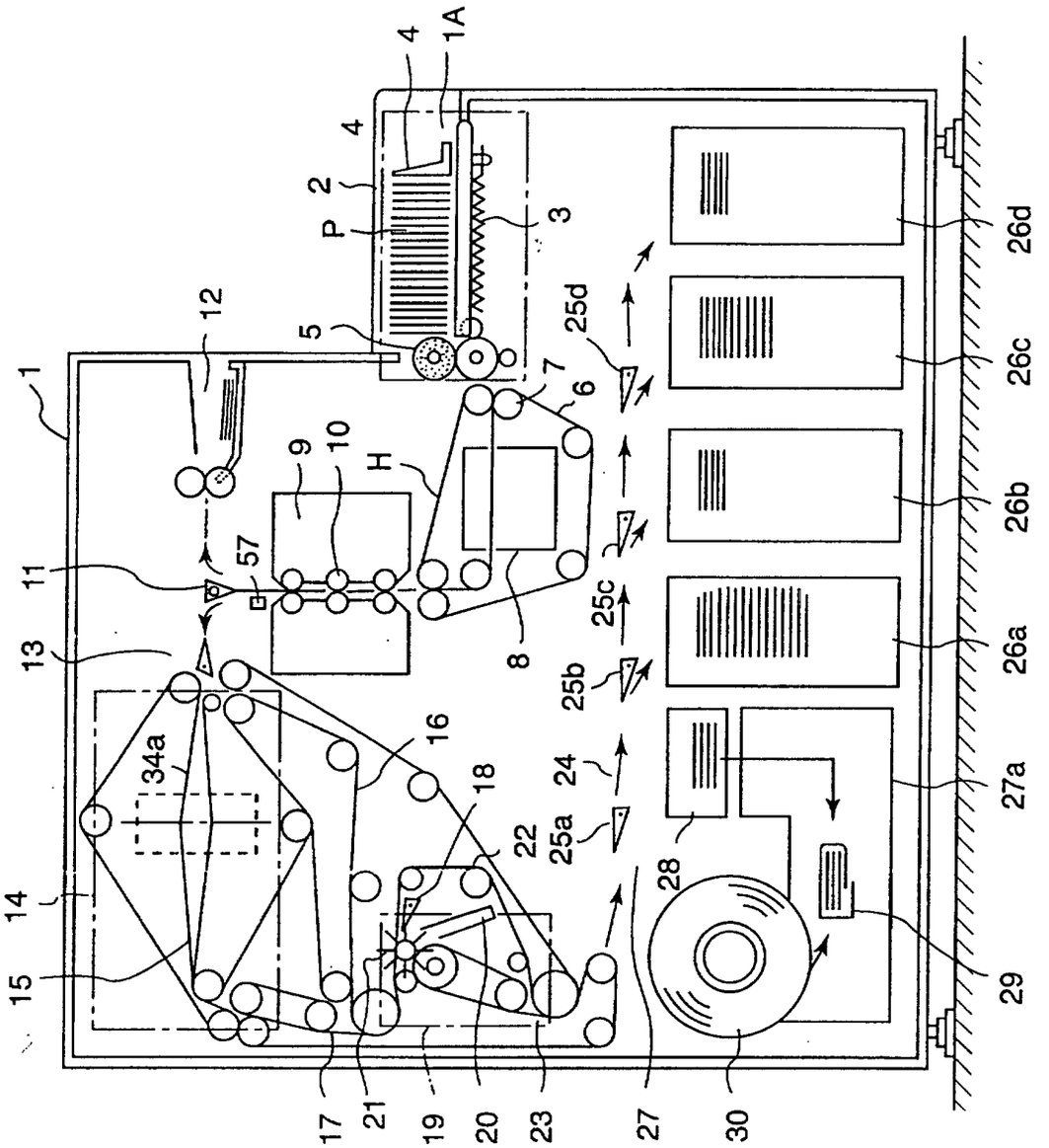

1
1A
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25a
25b
25c
25d
26a
26b
26c
26d
27
27a
28
29
30
34a
57
H
P

FIG.1

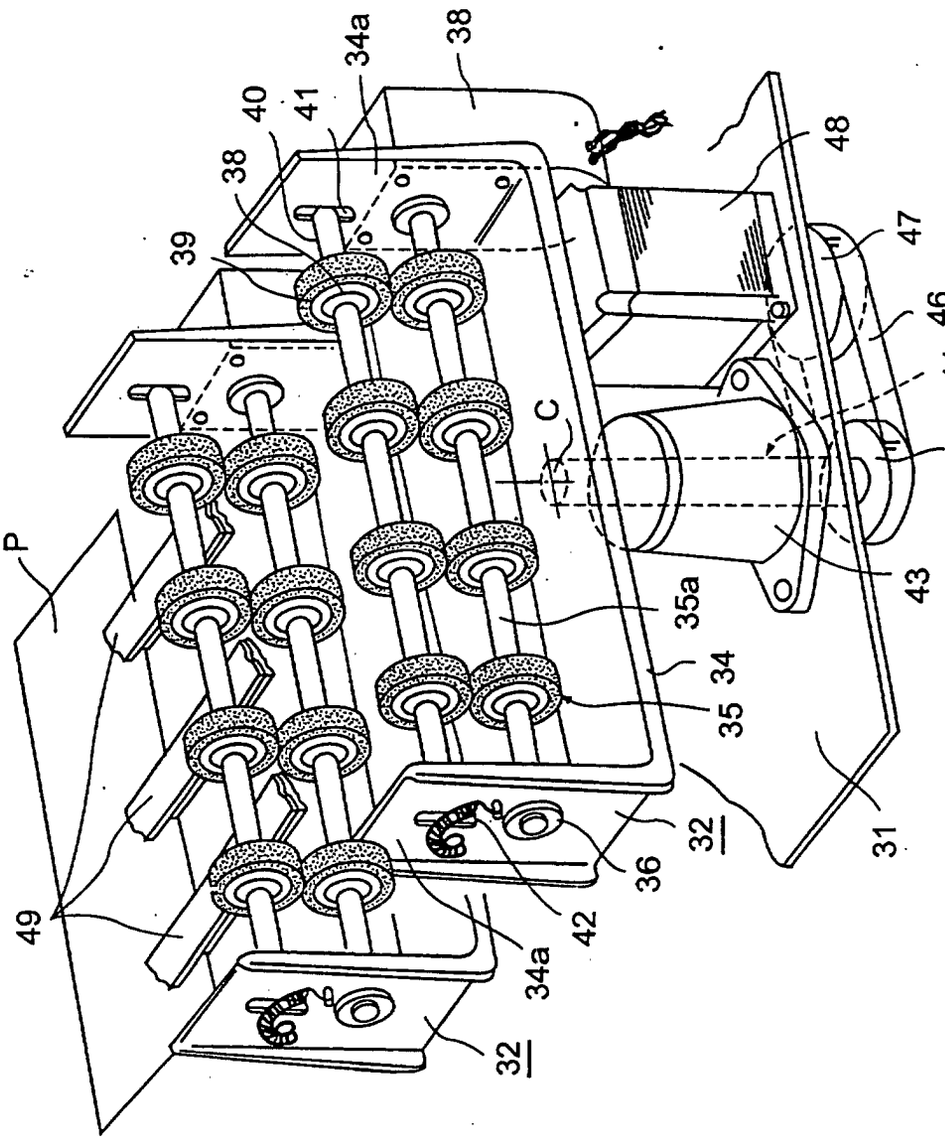


FIG.2

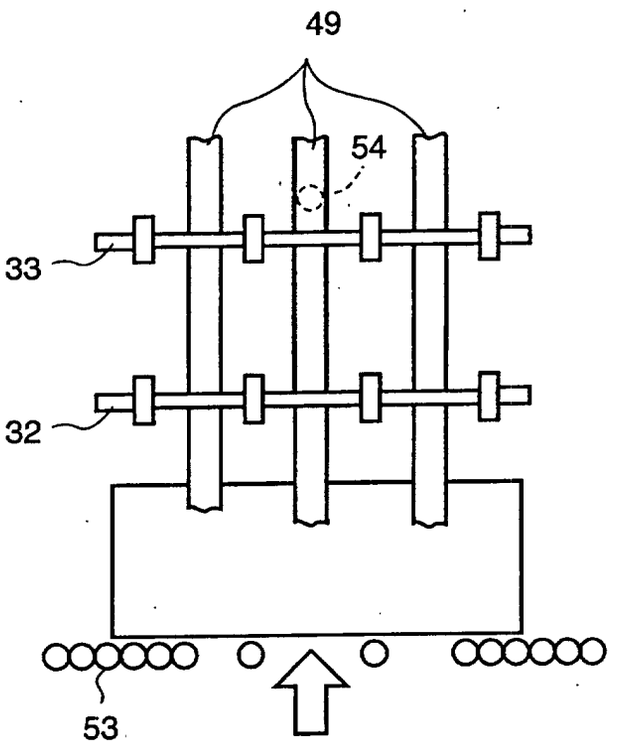


FIG.3

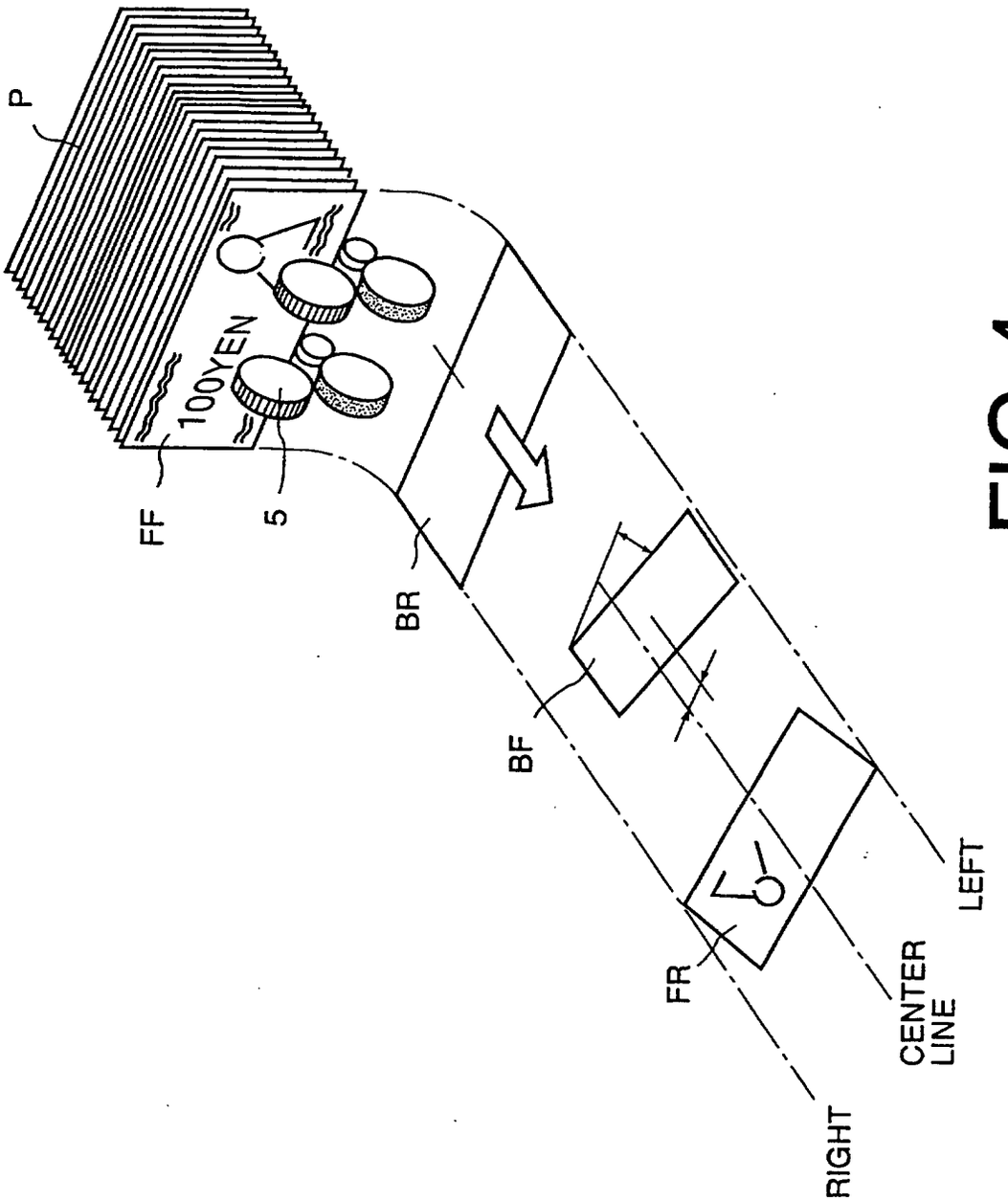


FIG.4

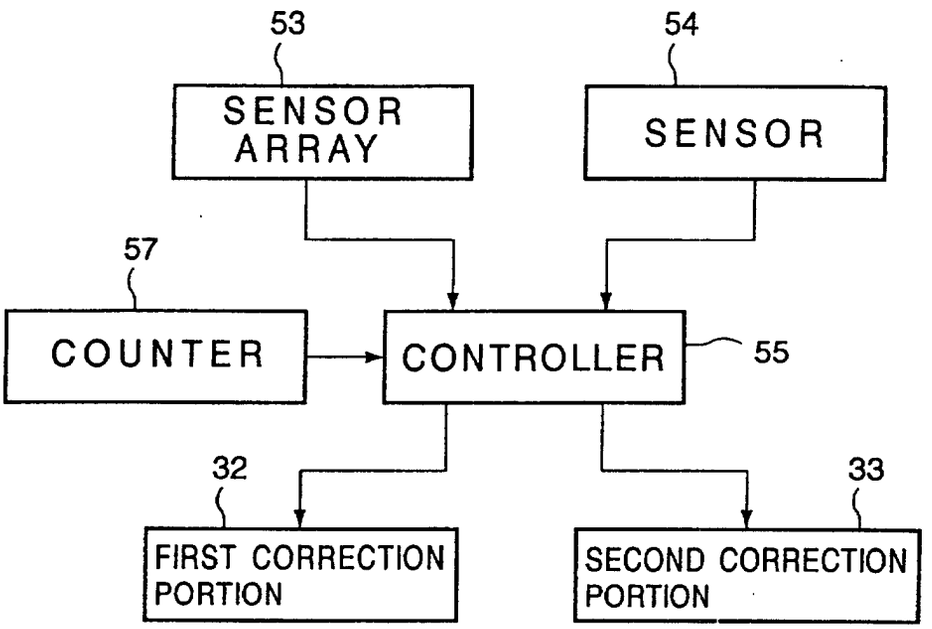

53
SENSOR ARRAY
54
SENSOR
57
COUNTER
CONTROLLER
55
32
FIRST CORRECTION PORTION
33
SECOND CORRECTION PORTION

FIG.5

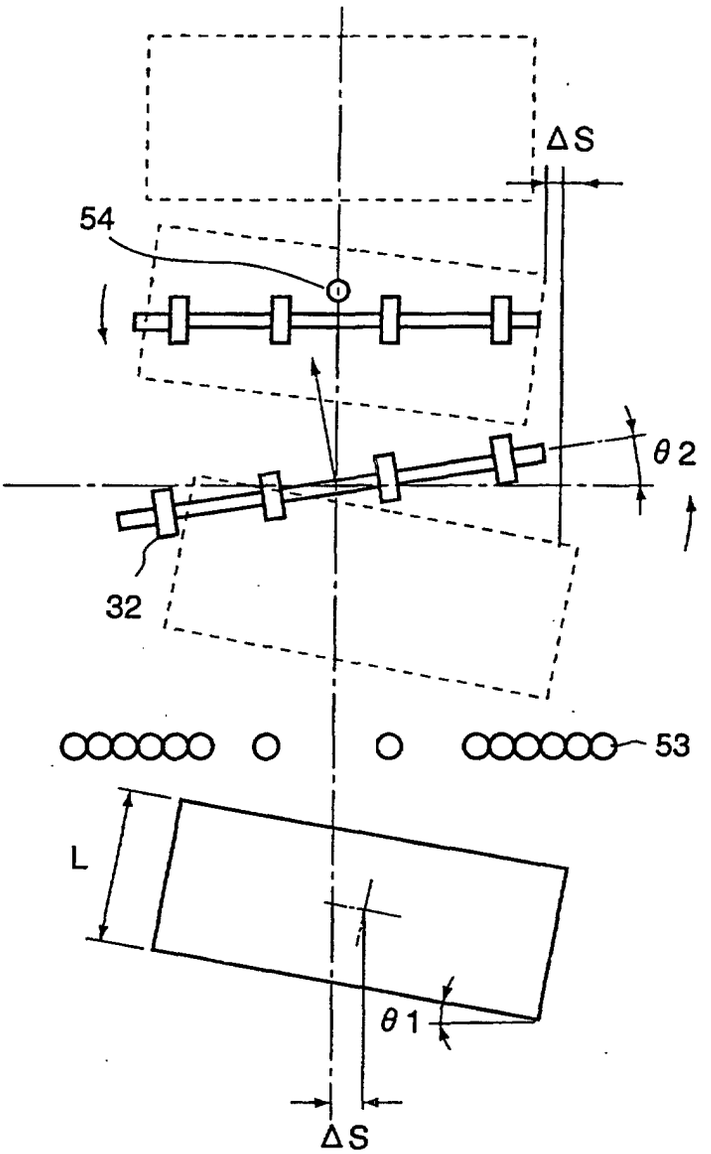


FIG.6

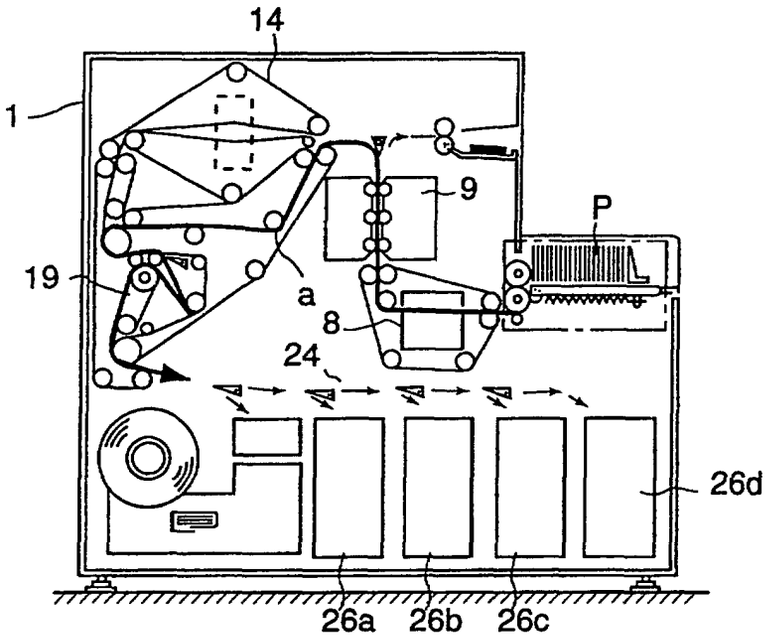


FIG.7

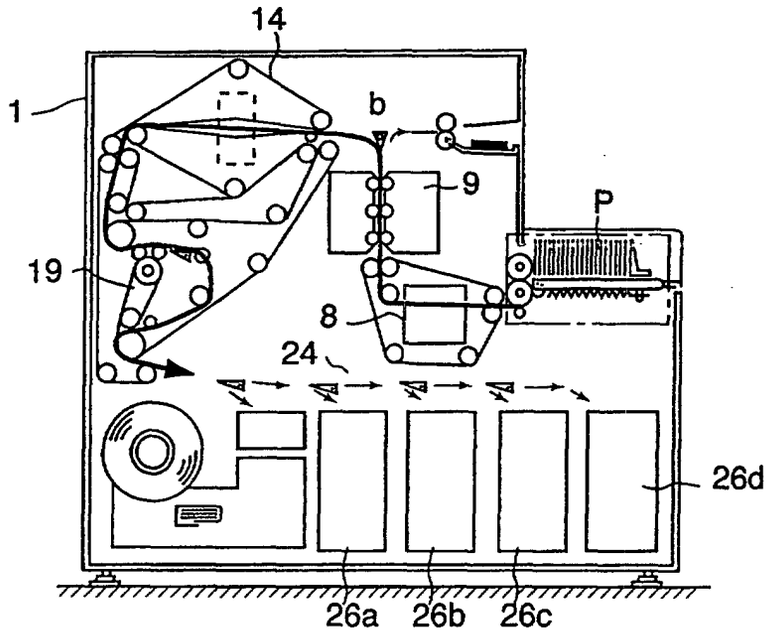


FIG.8

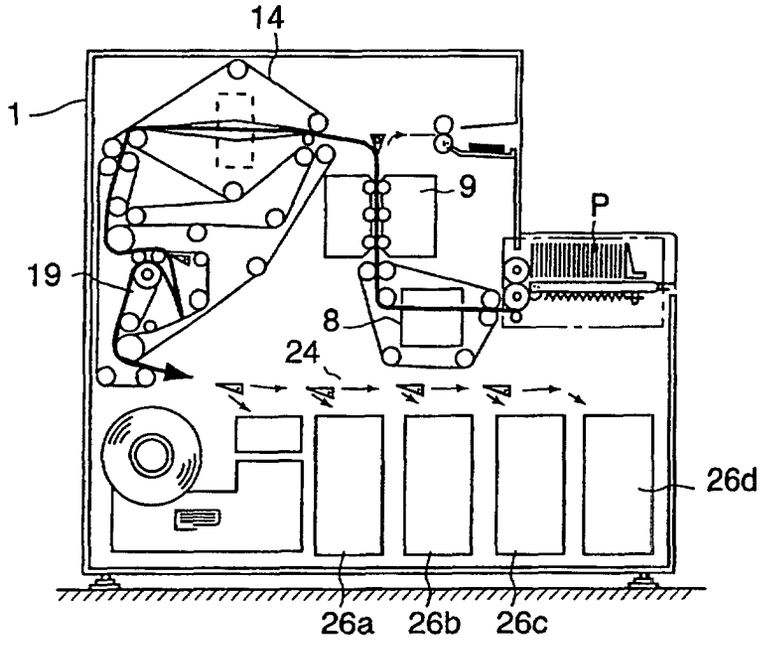


FIG.9

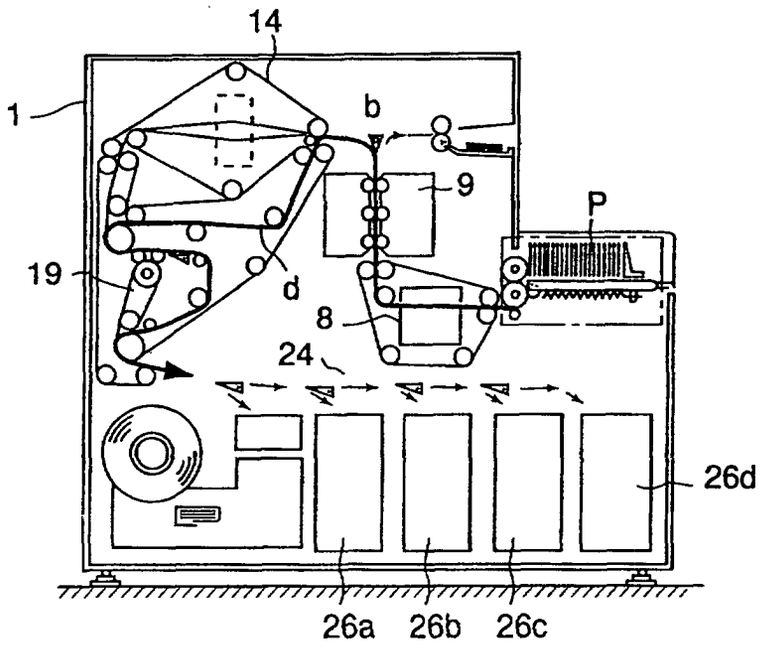


FIG.10

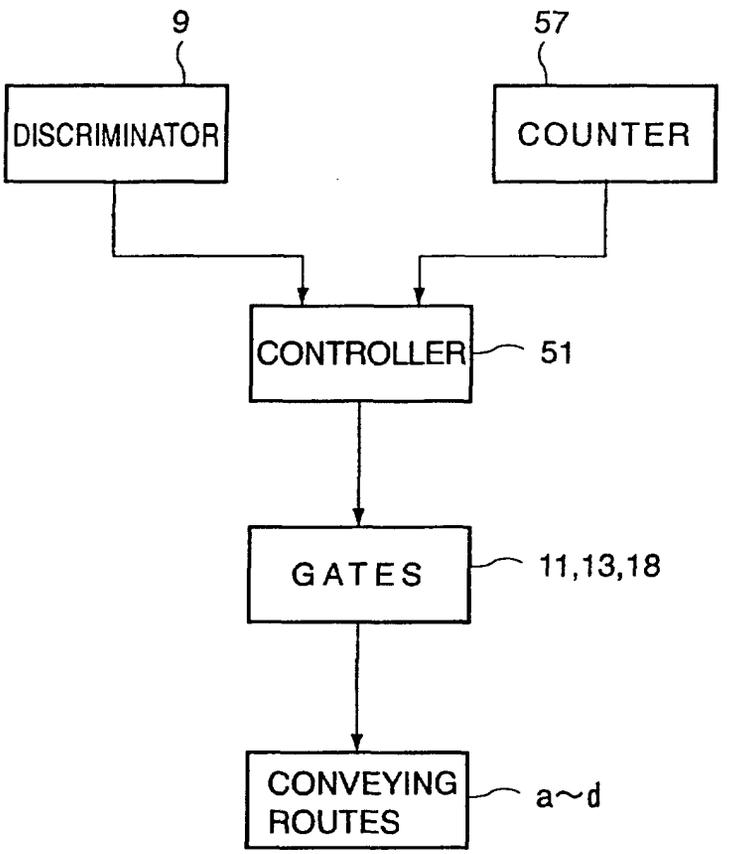

9
57
DISCRIMINATOR
COUNTER
CONTROLLER
51
GATES
11,13,18
CONVEYING ROUTES
a~d

FIG.11

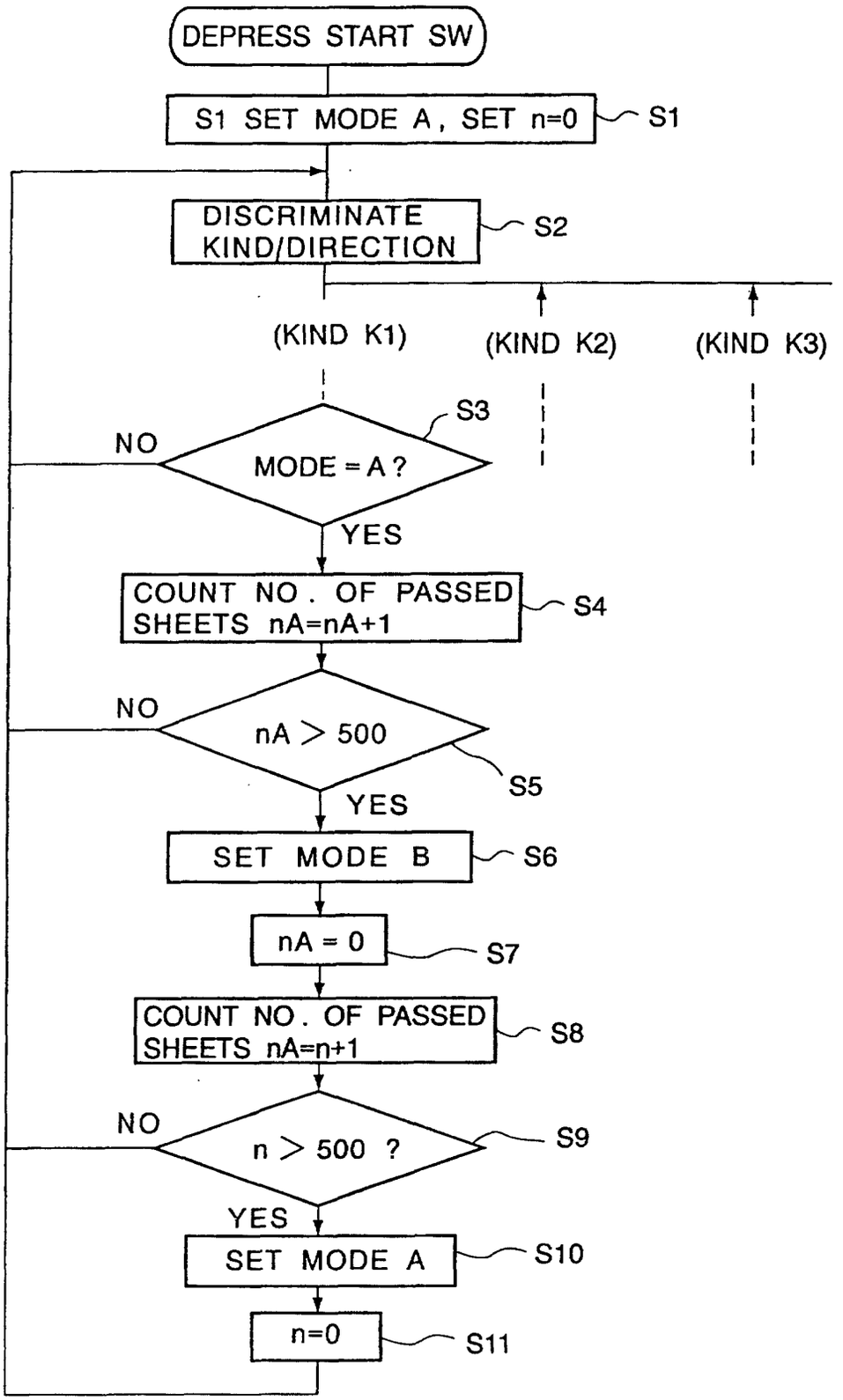

DEPRESS START SW
S1 SET MODE A, SET n=0
S1
DISCRIMINATE KIND/DIRECTION
S2
(KIND K1)
(KIND K2)
(KIND K3)
S3
NO
MODE = A ?
YES
COUNT NO. OF PASSED SHEETS nA=nA+1
S4
NO
nA > 500
S5
YES
SET MODE B
S6
nA = 0
S7
COUNT NO. OF PASSED SHEETS nA=n+1
S8
NO
n > 500 ?
S9
YES
SET MODE A
S10
n=0
S11

FIG.12

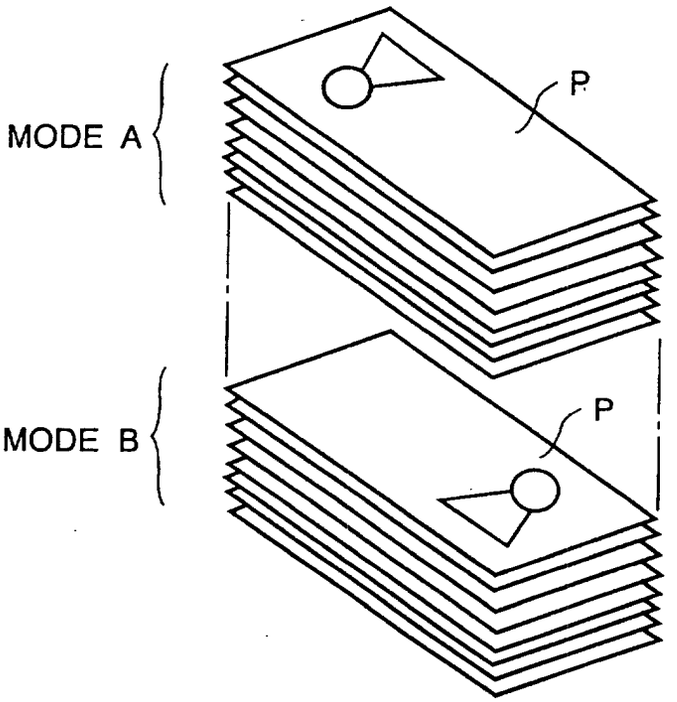


FIG.13

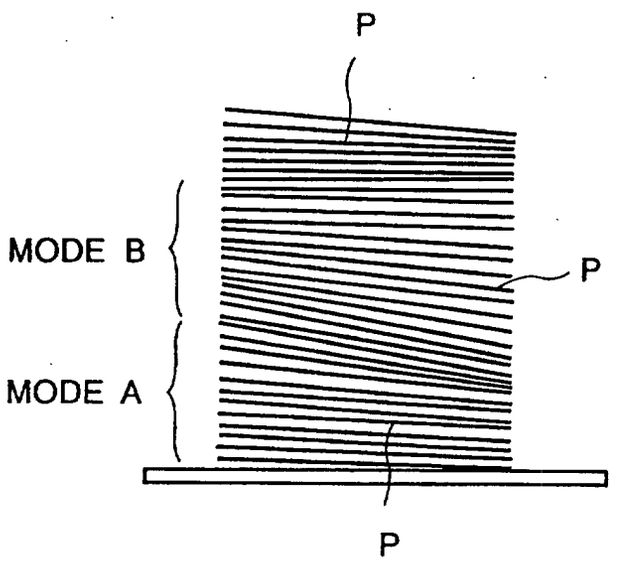


FIG.14

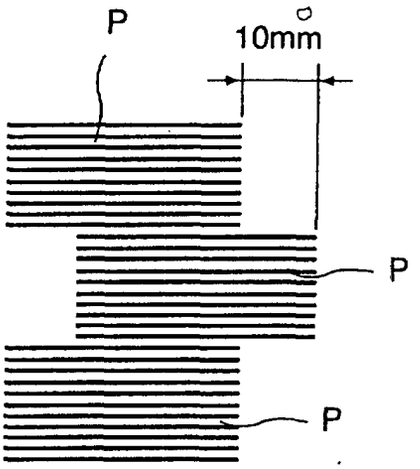


FIG.15

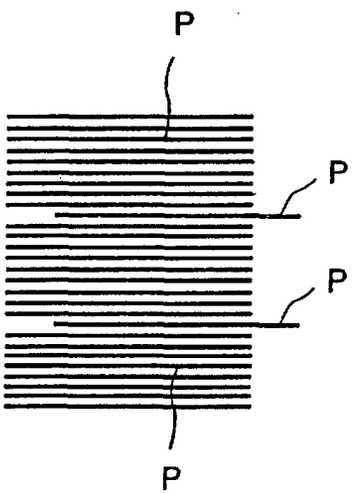


FIG.16

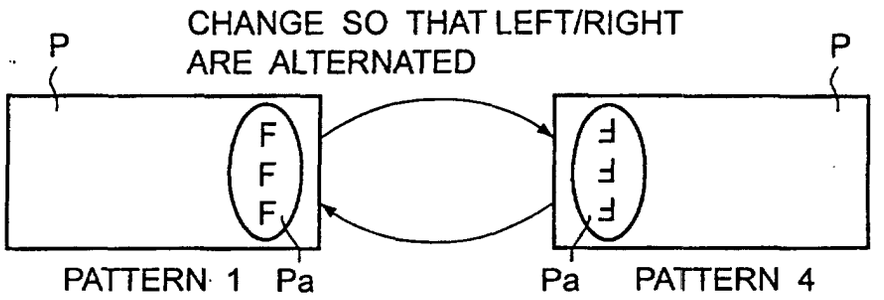

CHANGE SO THAT LEFT/RIGHT
ARE ALTERNATED
P
P
F
F
F
PATTERN 1
Pa
Pa
PATTERN 4

FIG.17

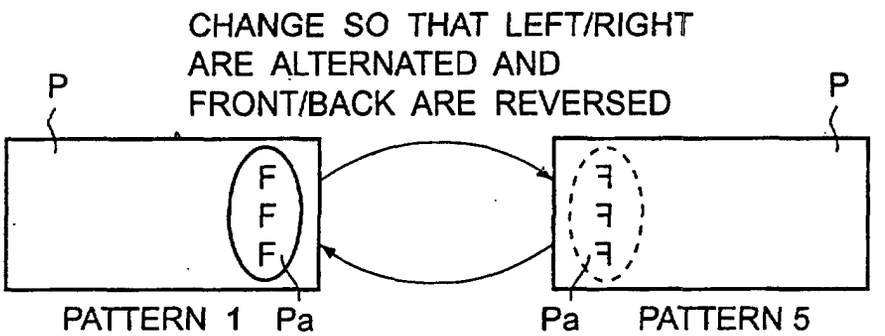

CHANGE SO THAT LEFT/RIGHT
ARE ALTERNATED AND
FRONT/BACK ARE REVERSED
P
P
F
F
F
PATTERN 1
Pa
Pa
PATTERN 5

FIG.18

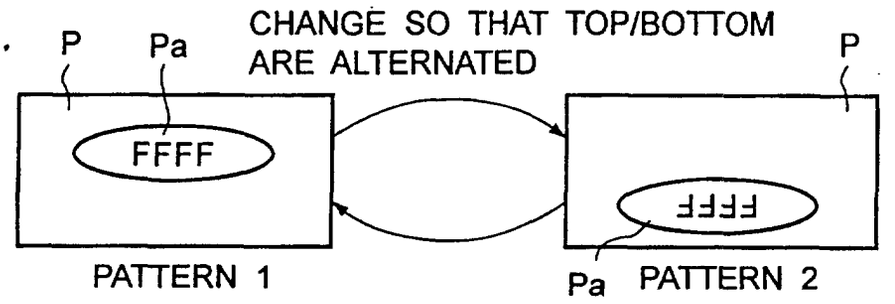

CHANGE SO THAT TOP/BOTTOM
ARE ALTERNATED
P
Pa
P
FFFF
PATTERN 1
Pa
PATTERN 2

FIG.19

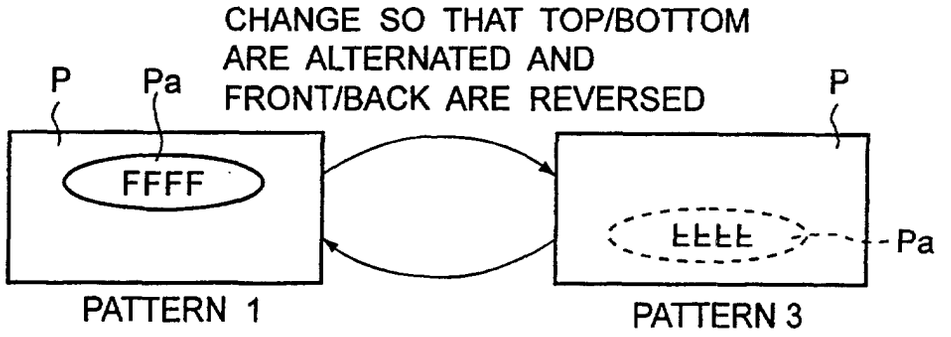
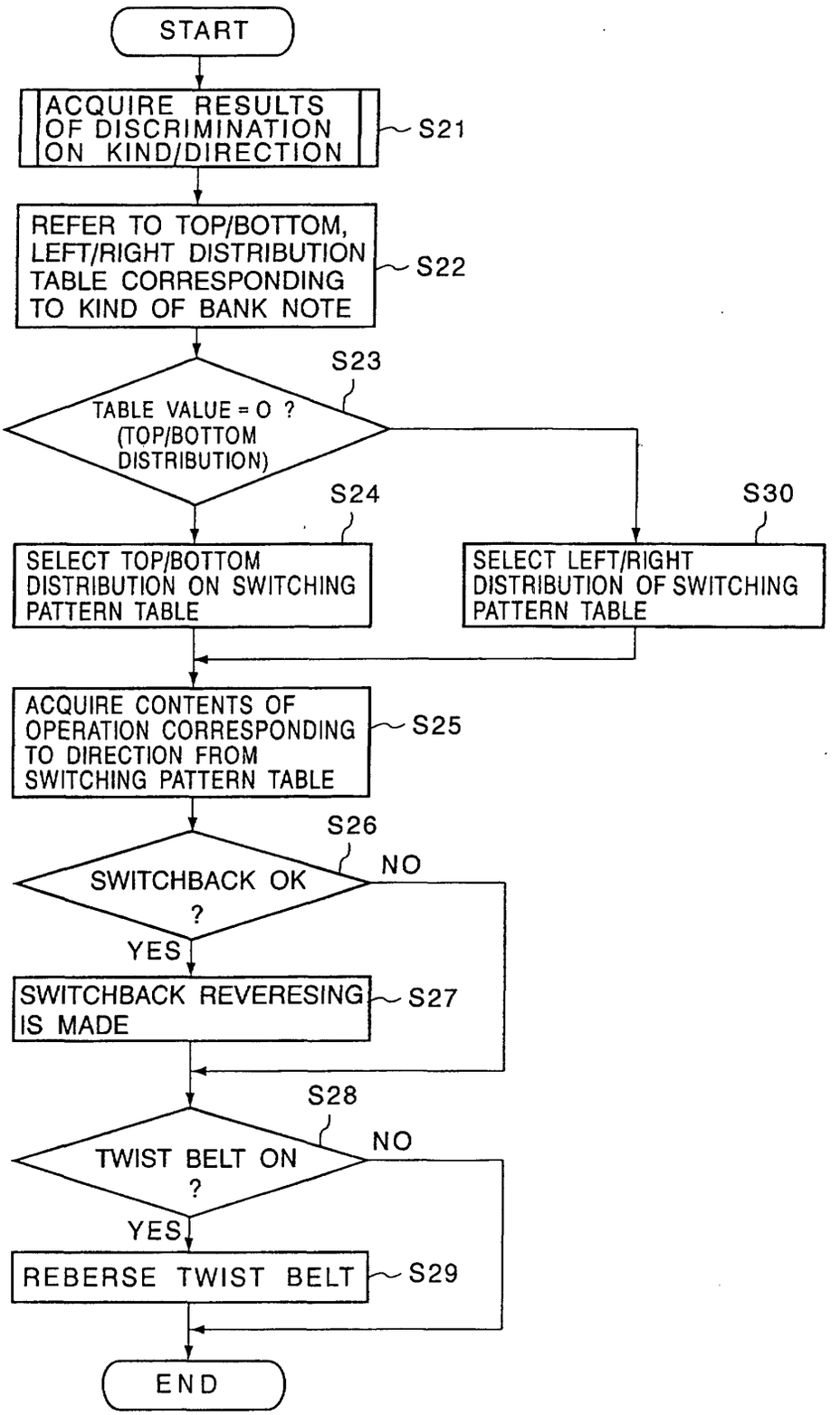

CHANGE SO THAT TOP/BOTTOM
ARE ALTERNATED AND
FRONT/BACK ARE REVERSED
P
Pa
P
FFFF
Pa
PATTERN 1
PATTERN 3

FIG.20



DIRECTION SWITCHING PROCESS FLOW

FIG.21