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(54) Apparatus and method for processing a sheet material

(57) A sheet material processing apparatus comprises a second sorting section (12, 13) configured to allow the sheet which is processed by a processing section (10) to be sorted in a third or a fourth direction based on processing information of the processing section (10), a stacking section (15, 16) configured to allow the sheet which is sorted by the second sorting section (12, 13) in the third direction to be stacked thereon, a second conveying path (18) configured to allow the sheet which is sorted by the second sorting section (12, 13) in the fourth direction to be conveyed, a meeting site (19) where the first and second conveying paths (8, 18) meet, and a discharge stacking section (20) configured to allow the sheet which is conveyed along the first or the second conveying paths (8, 18) and passed through the meeting site (19) to be stacked thereon.

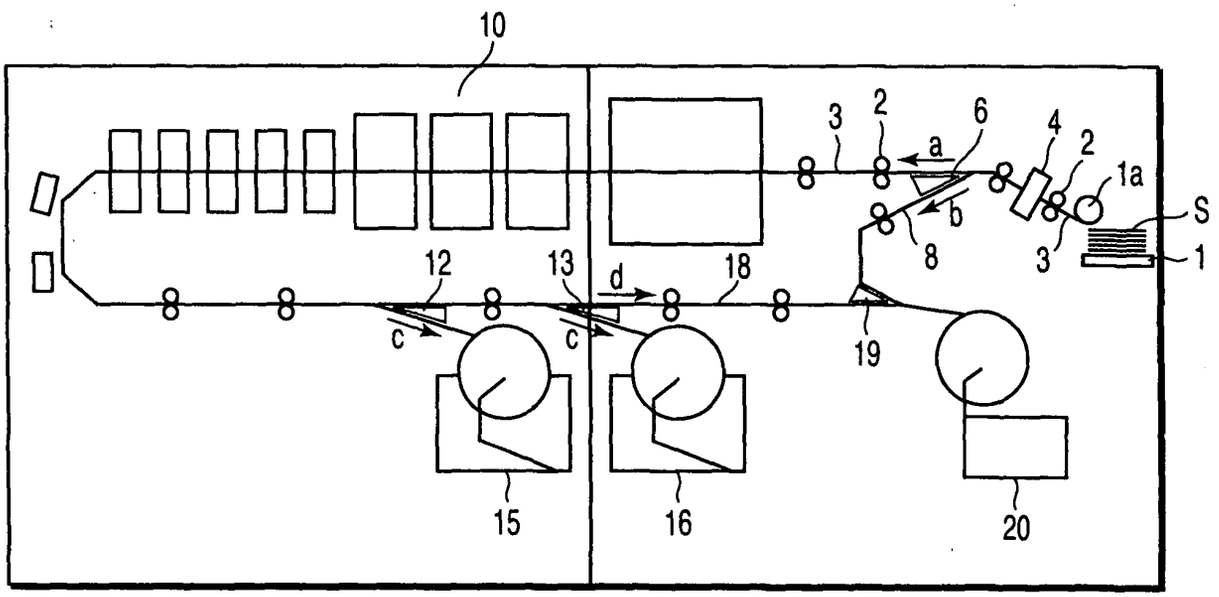

FIG. 1

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Description

[0001] The present invention relates to an apparatus and method for processing a sheet material which allow a sheet which is discharged based on, for example, a result of checking to be stacked on a discharge stacking section.

[0002] This kind of sheet material processing apparatus is known, for example, in JPN PAT APPLN KOKAI PUBLICATION No. 2003-216999. In this sheet material processing apparatus, a sheet is picked up from a pick-up section and, for example, conveyed to a checking section where checking is made to see whether or not it is rejected. The sheet, if being found "not fit", is rejected and rejected sheet is discharged on a first discharge stacking section.

[0003] If, on the other hand, the sheet is found to be normal, it is sorted by kind and stacked onto a "normal processing" stacking section. Where a predetermined number of normal sheets are stacked on the normal processing stacking section, a subsequent sheet and sheets are stacked onto a second discharge stacking section.

[0004] In the prior art disclosed, it is necessary to provide first and second discharge stacking sections and it is also necessary to manually collect those stacked sheets on these discharge stacking sections. Therefore, such manual collection operations are cumbersome and time-consuming.

[0005] Further, even if an automatic discharge sheet collection operation is adopted, it takes a longer operation time and requires more complex mechanism because a plurality of (two) discharge collection sections are involved.

[0006] One aspect of the present invention has been achieved with the above situations in view and the object of the present invention is to provide a sheet material processing apparatus and method which can stack those sheets which are discharged in a plurality of directions onto a single discharge stacking section.

[0007] In one aspect of the present invention, there is provided an apparatus for processing a sheet material which comprises a pick-up device configured to pick up a sheet; a conveying device configured to allow the sheet which is picked up by the pick-up device to be conveyed along a conveying path; a first processing device configured to process the sheet which is conveyed by the conveying device; a first sorting device configured to allow the sheet which is processed by the first processing device to be sorted in first and second directions based on processing information of the first processing device; a second processing device configured to process the sheet which is sorted by the first sorting device in the first direction;

a first conveying path configured to allow the sheet which is sorted by the first sorting device in the second direction to be conveyed; a second sorting device configured to allow the sheet which is processed by the second processing device to be sorted in a third or a fourth direction based on the processing information of the second processing device; a stacking section configured to allow the sheet which is sorted by the second sorting device in the third direction to be stacked thereon; a second conveying path configured to allow the sheet which is sorted by the second sorting device in the fourth direction to be conveyed; a meeting site where the first and second conveying paths meet; and a discharge stacking section configured to allow the sheet which is conveyed along the first or the second conveying path and passed through the meeting site to be stacked thereon.

[0008] In another aspect of the present invention, there is provided an apparatus for processing a sheet material which comprises a pick-up device configured to pick up a sheet; a conveying device configured to allow the sheet which is picked up by the pick-up device to be conveyed along a conveying path, a first processing device configured to process the sheet which is conveyed by the conveying device; a first sorting device configured to allow the sheet which is processed by the first processing device to be sorted in first and second directions based on processing information of the first processing device; a second processing device configured to process the sheet which is sorted by the first sorting device in the first direction; a first conveying path configured to allow the sheet which is sorted by the first sorting device in the second direction to be conveyed; a second sorting device configured to allow the sheet which is processed by the second processing device to be sorted in a third or a fourth direction based on processing information of the second processing device; a stacking section configured to allow the sheet which is sorted by the second sorting device in the third direction to be stacked thereon; a second conveying path configured to allow the sheet which is sorted by the second sorting device in the fourth direction to be conveyed;

a meeting site where the first and second conveying paths meet; and a discharge stacking section configured to allow the sheet which is conveyed along the first or the second conveying path and passed through the meeting site to be stacked thereon, wherein, with L1 indicating a path length extending from the first sorting device through the first sorting device and further through the second sorting device to the meeting site and L2 indicating a path length of the first conveying path, a relation of $L1 = m \times P + \alpha$ and $L2 = n \times P \times \alpha$ is established, provided that P:

a conveying distance; α: a constant distance, and m, n: integers.

[0009] In another aspect of the present invention, there is provided a method for processing a sheet material comprising a step of picking up a sheet; a step of conveying the picked-up sheet along a conveying path; a step of processing the conveyed sheet by a first processing device; a step of sorting the sheet which is

processed by the first processing device by the first sorting device in first and second directions based on the processing information of the first processing device; a step of processing the sheet which is sorted by the first sorting device in the first direction by a second processing device; a step of conveying the sheet which is sorted by the first sorting device in the second direction by the first conveying path;
a step of sorting the sheet which is processed by the second processing device by a second sorting device in a third or a fourth direction based on the processing information of the second processing device; a step of stacking the sheet which is sorted by the second sorting device in the third direction onto a stacking section; a step of conveying the sheet which is sorted by the second sorting device in the fourth direction by a second conveying path; a step of meeting the first and second conveying paths at a meeting site; and a step of stacking the sheet which is conveyed along the first or the second conveying path and passed through the meeting site onto a discharge stacking section.

[0010] This summary of the invention does not necessarily describe all necessary features so that the invention may also be a sub-combination of these described features.

[0011] The invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a diagrammatic view showing a sheet material processing device according to one embodiment of the present invention;
FIG. 2 is a front view showing a sheet meeting site in the sheet material processing device;
FIG. 3 is a plan view showing the sheet meeting site;
FIG. 4 is a side view showing the sheet meeting site; and
FIG. 5 is a front view showing a sheet meeting site according to another embodiment of the present invention.

[0012] The embodiments of the present invention will be explained below with reference to the drawing.

[0013] FIG. 1 is a diagrammatic view showing a sheet material processing apparatus according to a first embodiment of the present invention.

[0014] In FIG. 1, reference numeral 1 shows a loading section for receiving sheets S in a stacked state and, at the loading section 1, a pick-up roller 1a is provided, as a pick-up device, to sequentially separate and pick up the sheet from a top surface side on a one-by-one basis.

[0015] A conveying roller pair 2 is provided as
a conveying device to allow the sheet which is picked up by the pick-up roller 1a to be conveyed along a conveying path 3. At the conveying path 3,
a checking section 4 is provided as a first processing device to check whether or not the sheets S are conveyed, for example, in a partially/wholly overlapped state.

[0016] At the sheet conveying side of the checking section 4, a first sorting device 6 is provided as a first sorting device to allow any overlapped sheets to be separated in a first direction and in a second direction. The sheet separated in the first direction (an arrow a direction) is conveyed along a conveying path 3 while, on the other hand, the sheet separated in a second direction (an arrow b direction) is conveyed along a first "discharge" conveying path 8 as a first conveying path.

[0017] In the conveying path 3, a processing section 10 is provided as a second processing device to check whether the sheet is fit or unfit. On the sheet conveying side of the processing section 10, a second sorting device comprising second sorting sections 12 and 13 is provided for allowing the sheet to be sorted in a third direction and in a fourth direction. In the third direction (an arrow C direction) sorted by the second sorting sections 12 and 13, stacking sections 15, 16 are arranged to allow the fit sheet to be stacked thereon.

[0018] In the fourth direction (an arrow d direction) sorted by the second sorting section 13, a second "discharge" conveying path 18 is provided as a second conveying path. The second "discharge" conveying path 18 and first "discharge" conveying path 8 meet at a meeting site 19. On the sheet conveying side of the meeting site 19, a stacking unit 20 is provided as a single "discharge" stacking unit 20.

[0019] If the conveying path length extending from the first sorting section 6 through the processing section 10 and then through the second sorting sections 12, 13 to the meeting site 19 is given by L1 and the conveying path length of the first "discharge" conveying path 8 extending from the first sorting section 6 to the meeting site 19 is given by L2, the sheet conveying path is so designed as to satisfy a relation

$$L1 = m \times P + \alpha$$

$$L2 = n \times P + \alpha$$

(P: sheet pick-up distance; α: a given distance, m, n: integers)

[0020] By doing so, the sheet conveyed by the first "discharge" conveying path 8 and sheet conveyed by the second "discharge" conveying path 18 can have their leading edges substantially coincide with each other if these sheets meet at the meeting site 19.

[0021] FIG. 2 shows a structure of the meeting site 19.

[0022] As shown in FIGS. 3 and 4, a guide 22 is provided at the meeting site 19 to allow the sheet which is conveyed on the first and second "discharge" conveying paths 8, 18 to be guided therealong. The sheet passed through the meeting site 19 is conveyed past a conveying path 23 onto the stacking section 20 for discharge.

[0023] The first "discharge" conveying path 8 is so

configured as to have a roller 8a, a conveying belt 8b running on the roller 8a, and a conveying belt 8c overlappingly running on the upper surface of the conveying belt 8b. The second "discharge" conveying path 18 is so configured as to have a roller 18a, a conveying belt 18b running on the roller 18a, and a conveying belt 18c overlappingly running on the lower surface of the conveying belt 18b. The conveying path 23 comprises the conveying belt 8c and conveying belt 18c. The conveying belts 8c, 18c are wrapped around a fixed idle roller 24 such that these belts are downwardly bent with the fixed idle roller 24 as a fulcrum to impart a sandwiching force thereto.

[0024] The guide 22 is so formed as to bend a rectangular plate partway at an acute angle. One side section 22a of the guide 22 is provided opposite to the lower surface side of the conveying belt 8c in a manner to be spaced a predetermined distance, while, on the other hand, the other side section 22b of the guide 22 is provided opposite to the upper surface side of the conveying belt 18c in a manner to be spaced a predetermined distance.

[0025] An explanation will be made below about the processing operation of the sheet material processing apparatus.

[0026] When the pick-up roller 1a is rotated, the sheets S on the sheet loading section 1 are sequentially picked up, one by one, from their top side and sent out onto the conveying path 3. The sheets S thus sent out, while being sandwiched between the paired rollers 2, are conveyed at a constant speed to a checking section 4 where they are subjected to various processing, for example, they are checked whether or not they are conveyed in an overlapped state.

[0027] If, as a result of checking, the sheets are found as not being in the overlapped state, the respective sheet is sorted in the first direction as indicated by an arrow a in FIG. 1. If, on the other hand, the sheets are found as being in the overlapped state, the overlapped sheet is separated in the second direction as indicated by an arrow b in FIG. 1.

[0028] The sheet S sorted in the first direction as indicated by an arrow a is conveyed along the conveying path 3 to the processing section 10 where the content of the sheet is decided as being normal or not. The sheet S separated in the second direction as indicated by an arrow b is conveyed along the first "discharge" conveying path 8 to a meeting site 19. At the meeting site 19, the sheet is guided by the one side section 22a of the guide 22 as indicated by a solid arrow onto the conveying path 23 and further conveyed past the conveying path onto a "discharge" stacking section 20 where it is stacked.

[0029] The sheet S processed by the processing section 10 is conveyed therefrom and, based on the processing information of the processing section 10, the sheet S thus conveyed is sorted by the operations of the second sorting sections 12 and 13 and conveyed in the third or fourth direction. That is, the normal sheet which is sorted by the second sorting sections 12, 13 in the third direction (arrow c direction) is stacked, as in a bundle unit, onto the normal sheet stacking sections 15, 16. The sheet which is sorted in a fourth direction (arrow d direction) as being not normal is conveyed through the second "discharge" conveying path 18 to the meeting site 19. At the meeting site 19, the sheet is guided, by the other side section 22b of the guide 22, as indicated by a broken arrow line onto the conveying path 23 and, along the conveying path 23, onto the "discharge" stacking unit 20 where the sheet is stacked.

[0030] According to the present embodiment, as set out above, the first and second "discharge" conveying paths 8, 18 meet at the meeting site 19 and, therefore, the sheets discharged from the first and second "discharge" conveying paths 8 and 18 can be stacked onto a single "discharge" stacking unit (20). It is not necessary to provide individual corresponding stacking units and it is easier to collect the discharged sheets and to obtain a simple automatic unit.

[0031] With L1 indicating the conveying path length extending from the first sorting section 6 through the processing section 10 and then through the second sorting sections 12 and 13 to the meeting site 19 and L2 indicating the conveying path length of the first "discharge" conveying path 8 extending from the first sorting section 6 to the meeting site 19, the relation is set to be $L1 = m \times P + \alpha$ and $L2 = n \times P + \alpha$. As a result, when the sheet conveyed from the first "discharge" conveying path 8 and sheet conveyed from the second "discharge" conveying path 18 meet at the meeting site 19, the leading edges of these sheets are made to substantially coincide with each other, so that it is possible to improve the stacking performance at the "discharge" stacking unit 20.

[0032] Further, by freely varying the conveying path lengths L1 and L2, it is possible to intentionally change an overlapped state at a sheet meeting time.

[0033] Further, at the sheet meeting time, the conveying belt 8c can be freely set on the fixed idle roller 24 in accordance with the thickness of the sheet and it is possible to prevent jamming of sheets and their lodging.

[0034] FIG. 5 shows another embodiment of a meeting site 19.

[0035] In this embodiment, a conveying belt 8c and conveying belt 18c are sandwiched between a fixed idle roller 24 and a pinch roller 25. By doing so, a proper sandwiching can be provided without forcing the conveying belts 8c and 18c to be bent with the fixed idle roller 24 as a fulcrum. It is, therefore, possible to freely set the direction of a conveying path provided by the conveying belts 8c and 18c.

[0036] Even in this embodiment, when a plurality of sheets meet at a meeting site 19, the pinch roller 25 is retracted in accordance with the thickness of the sheet and it is of course possible to prevent jamming or lodging of sheets.

[0037] 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. An apparatus for processing a sheet material comprising

a pick-up device (1a) configured to pick up a sheet;

a conveying device (2) configured to allow the sheet which is picked up by the pick-up device (1a) to be conveyed along a conveying path (3);

a first processing device (4) configured to process the sheet which is conveyed by the conveying device (2);

a first sorting device (6) configured to allow the sheet which is processed by the first processing device (4) to be sorted in first and second directions based on processing information of the first processing device (4);

a second processing device (10) configured to process the sheet which is sorted by the first sorting device (6) in the first direction;

a first conveying path (8) configured to allow the sheet which is sorted by the first sorting device (6) in the second direction to be conveyed;

a second sorting device (12, 13) configured to allow the sheet which is processed by the second processing device (10) to be sorted in a third or a fourth direction based on the processing information of the second processing device;

a stacking section (15, 16) configured to allow the sheet which is sorted by the second sorting device (12, 13) in the third direction to be stacked thereon; and

a second conveying path (18) configured to allow the sheet which is sorted by the second sorting device in the fourth direction to be conveyed,

characterizing by further comprising

a meeting site (19) where the first and second conveying paths (8, 18) meet and

a discharge stacking section (20) configured to allow the sheet which is conveyed along the first or second conveying paths (8, 18) to be stacked thereon.

2. An apparatus according to claim 1, **characterized in that** the meeting site has a guide (22) configured to allow the sheets which are conveyed by the first and second conveying paths (8, 18) to be guided and met thereat.

3. An apparatus according to claim 2, **characterized in that** the meeting site has a conveying belt pair (8c, 18c) configured to allow the sheet which is guided by the guide (22) to be sandwiched and conveyed.

4. An apparatus according to claim 3, **characterized in that** the conveying belt pair (8c, 18c) is configured to run on a fixed idle roller (24) and obtain a sandwiching force by being downwardly bent with the fixed idle roller as a fulcrum.

5. An apparatus according to claim 3, **characterized in that** the conveying belt pair obtains a sandwiching force by being sandwiched between a fixed idle roller (24) and a pinch idle roller.

6. An apparatus for processing a sheet material, comprising:

a pick-up device (1a) configured to pick up a sheet;

a conveying device (2) configured to allow the sheet which is picked up by the pick-up device (1a) to be conveyed along a conveying path (3);

a first processing device (4) configured to process the sheet which is conveyed by the conveying device (2);

a first sorting device (6) configured to allow the sheet which is processed by the first processing device (4) to be sorted in first and second directions based on processing information of the first processing device (4);

a second processing device (10) configured to process the sheet which is sorted by the first sorting device (6) in the first direction;

a first conveying path (8) configured to allow the sheet which is sorted by the first sorting device (6) in the second direction to be conveyed;

a second sorting device (12, 13) configured to allow the sheet which is processed by the second processing device (10) to be sorted in a third or a fourth direction based on the processing information of the second processing device (10);

a stacking section (15, 16) configured to allow the sheet which is sorted by the second sorting device (12, 13) in the third direction to be stacked thereon; and

a second conveying path (18) configured to allow the sheet which is sorted by the second sorting device (12, 13) in the fourth direction to be conveyed, **characterized by** further com-

prising

a meeting site (19) where the first and second conveying paths (8, 18) meet, and

a discharge stacking section (20) configured to allow the sheet which is conveyed along the first or second conveying path (8, 18) and passed through the meeting site (19) to be stacked thereon, wherein, with L1 indicating a path length extending from the first sorting device (6) through the second processing device (10) and further through the second conveying path (18) to the meeting site (19) and L2 indicating a path length of the first conveying path, a relation

$$L1 = m \times P + \alpha \text{ and } L2 = n \times P + \alpha$$

is established, provided that P: a conveying distance of the sheet; d: a constant distant; and m, n: integers.

7. An apparatus according to claim 6, **characterized in that** the difference between the path lengths L1 and L2 is an integral multiple of the conveying distance of the sheet.

8. An apparatus according to claim 6, **characterized in that** the meeting site (19) has a guide (22) configured to allow the sheets which are conveyed by the first and second conveying paths (8, 18) to be guided and met thereat.

9. An apparatus according to claim 8, **characterized in that** the meeting site (19) has a conveyer belt pair (8c, 18c) configured to allow the sheet which is guided by the guide (22) to be sandwiched therebetween and conveyed.

10. An apparatus according to claim 9, **characterized in that** the conveying belt pair (8c, 18c) is configured to be run on a fixed idle roller (24) and to obtain a sandwiching force by being downwardly bent with the fixed idle roller (24) as a fulcrum.

11. An apparatus according to claim 9, **characterized in that** the conveying belt pair (8c, 18c) is configured to obtain a sandwiching force by being sandwiched between a fixed idle roller (24) and a pinch roller (25).

12. A method for processing a sheet materials, comprising

a step of picking up a sheet;

a step of conveying the pick-up sheet along a conveying path;

a step of processing the conveyed sheet by a first processing device (64);

a step of sorting the sheet which is processed by the first processing device by a first sorting device (6) in first and second directions based on processing information of the first processing device (4);

a step of processing the sheet which is sorted by the first sorting device (6) in the first direction by a second processing device (10);

a step of conveying the sheet which is sorted by the first sorting device (6) in the second direction by a first conveying path (8);

a step of sorting the sheet which is processed by the second processing device (10) by a second sorting device (12, 13) in a third or a fourth direction based on the processing information of the second processing device (10);

a step of stacking the sheet which is sorted by the second sorting device (12, 13) in the third direction on a stacking section (15, 16); and

a step of conveying the sheet which is sorted by the second sorting device (12, 13) in the fourth direction by a second conveying path (18), **characterized by** further comprising

a step of meeting the first and second conveying paths at a meeting site and

a step of stacking the'sheet which is conveyed along the first or second conveying path (8, 18) and passed through the meeting site (19) onto a discharge stacking section (20).

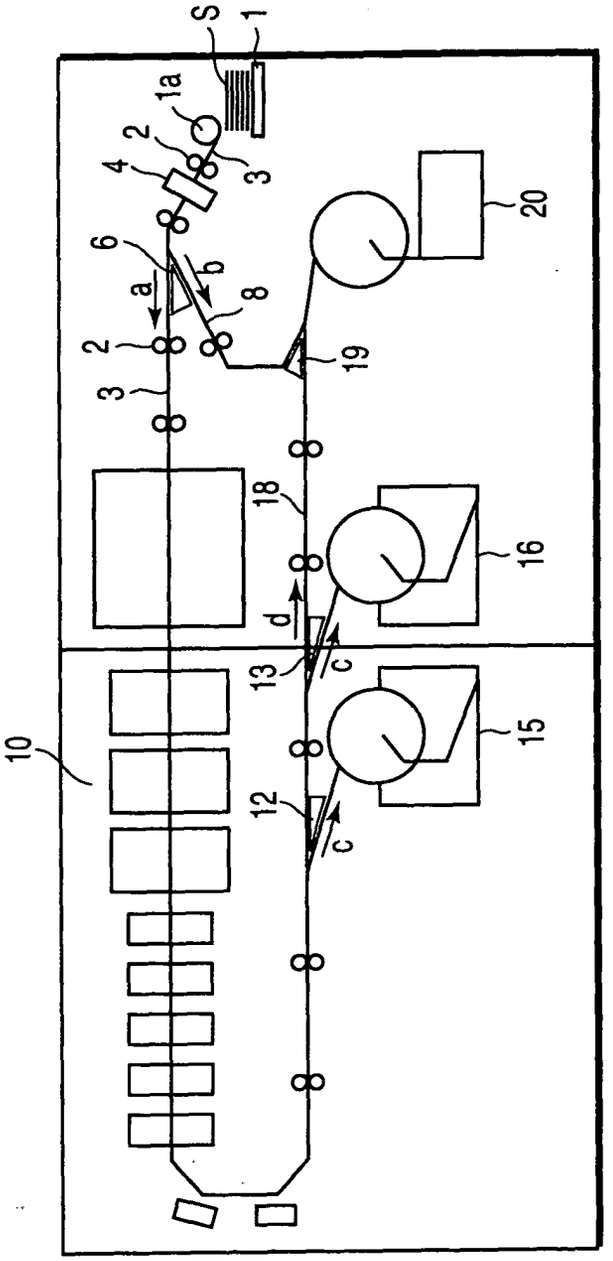


FIG. 1

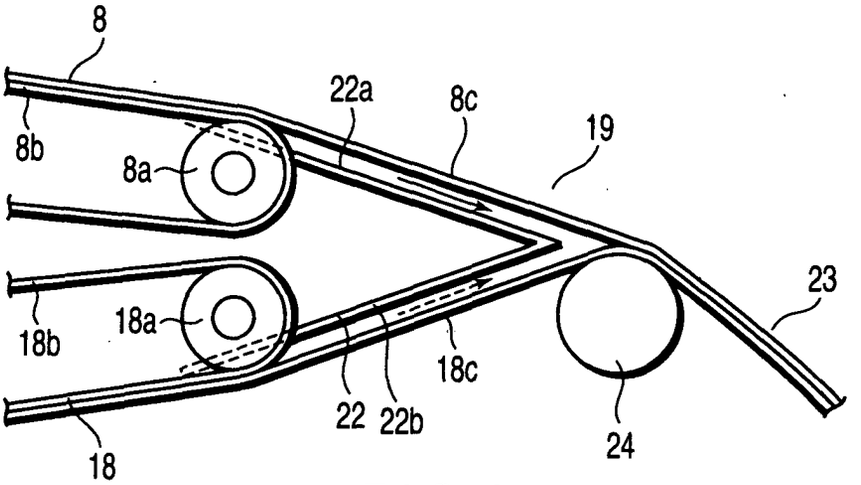


FIG. 2

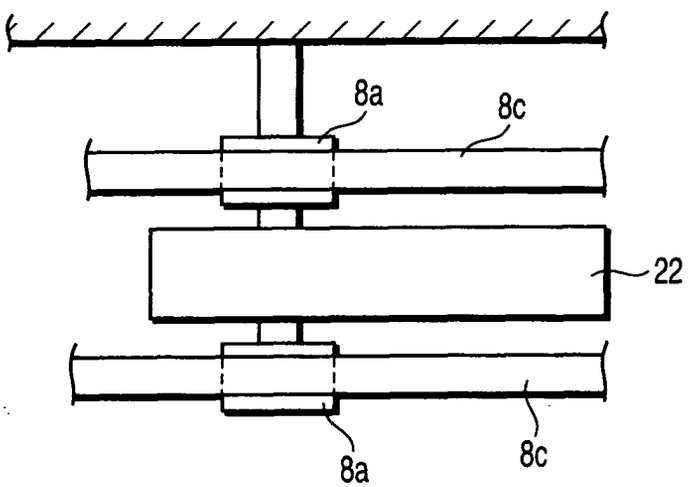
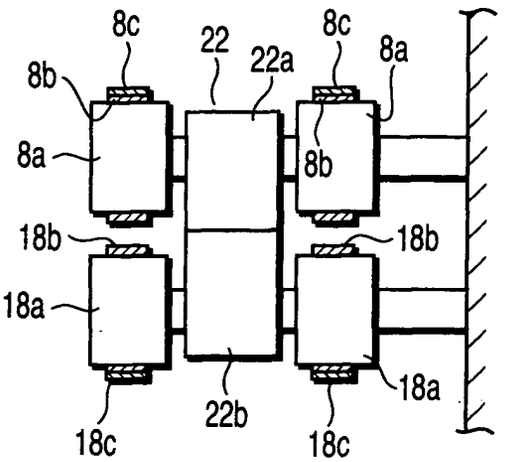


FIG. 3


8c
22
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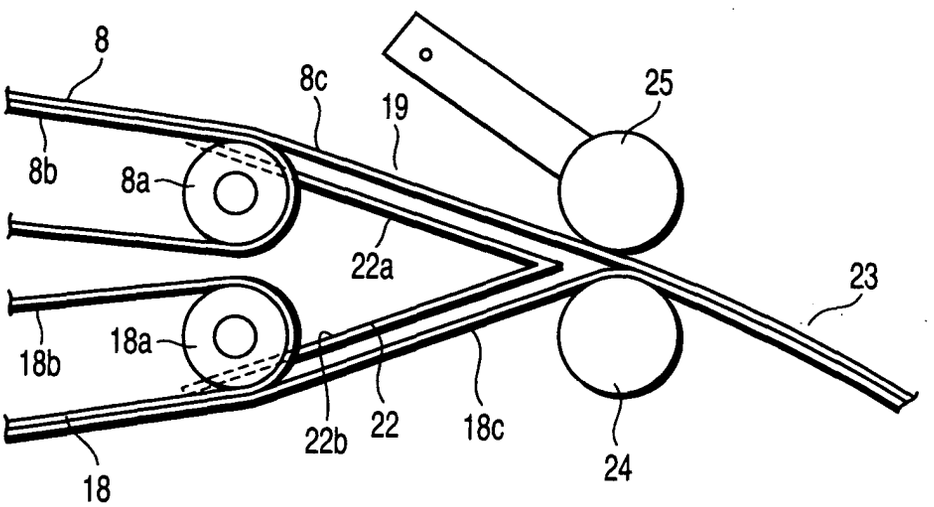
8a
8b
8a
8b
18b
18b
18a
18a
22b
18c
18c

FIG. 4


8
8c
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25
8b
8a
22a
23
18b
18a
22b
22
18c
24
18

FIG. 5