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(54) **Sheet convey apparatus**

(57) A sheet convey apparatus includes a pile board (111), sheet air blowers (116) and a leveling foot (117), and first, second, and third suction ports (112,113,121). A plurality of sheets are to be stacked on the pile board. The sheet air blowers (116) and the leveling foot (117) supply air between first and second sheets which are the first and second when counted from an uppermost one of the sheets stacked on the pile board, to separate the first sheet from the second sheet. The first suction ports (112) are supported to be movable in a direction of sheet thickness, and chuck and hold a trailing edge of the sep-

arated first sheet to lift upward the separated first sheet. The second suction ports (113) are supported to be movable in a sheet back-and-forth direction, and chuck and hold a more sheet leading edge side than a portion chucked by the first suction ports of the first sheet transferred from the first suction ports, and convey the first sheet forward. The third suction ports (121) are supported to be movable in the sheet back-and-forth direction, and chuck and hold the trailing edge of the first sheet transferred from the first suction ports, and convey the first sheet forward.

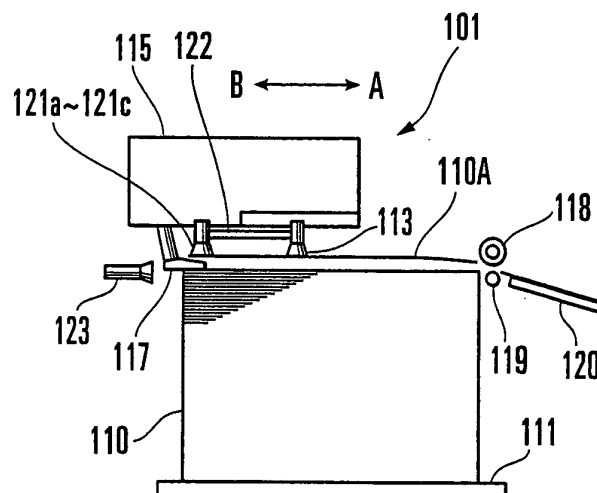


FIG. 1A

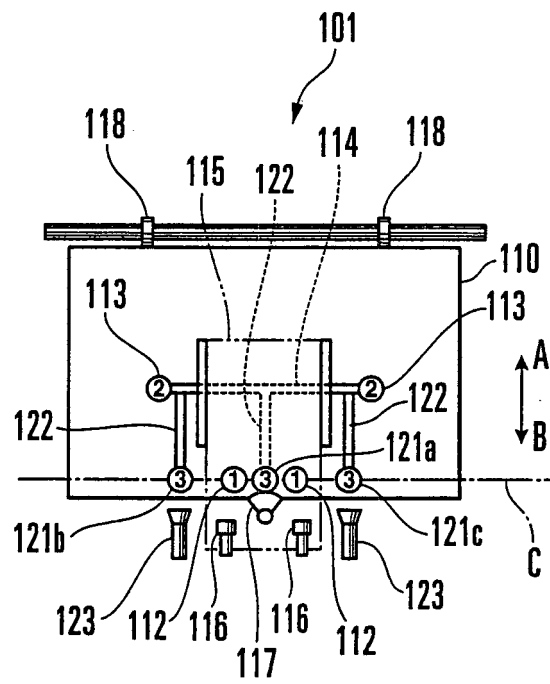


FIG. 1B

Description

Background of the Invention

[0001] The present invention relates to a sheet convey apparatus which is used in a sheet feeder or the like for a sheet-fed offset rotary printing press and serves to chuck stacked sheets one by one from the uppermost one and feed it forward.

[0002] Conventionally, a sheet convey apparatus has been proposed as shown in Japanese Utility Model Laid-Open No. 5-51835, which comprises a suction port holder which chucks the trailing edge of the uppermost one of stacked sheets and upper and lower cams and front and rear cams which are fixed parallel to each other to cam shafts rotatably driven by motors. In the conventional convey apparatus, the suction port holder is moved downward by the cam action of the upper and lower cams to chuck the trailing edge of a sheet, and moved upward. The sheet is then conveyed to a feed roller by the cam action of the front and rear cams.

[0003] Figs. 6A and 6B show another conventional sheet convey apparatus described in Japanese Utility Model Publication No. 3-24511. Referring to Fig. 6A, a sheet convey apparatus 101 comprises a pile board 11 on which a plurality of sheets 10 are to be stacked, a pair of first suction ports 12 which are supported to be movable in the widthwise direction of the sheets 10 stacked on the pile board 11, and a pair of second suction ports 13 which are supported to be movable in the back-and-forth direction (a direction of arrows A - B) of the sheets 10 staked on the pile board 11. As shown in Fig. 6B, the pair of suction ports 13 are attached to the two ends of a support shaft 14 extending in the widthwise direction (a direction perpendicular to the direction of the arrows A - B) of the sheets 10. The support shaft 14 is supported to be movable in the direction of the arrows A - B through a cam shaft (not shown) which is axially supported by a sucker frame 15 and driven to rotate by a motor, and a cam (not shown) which is axially mounted on the cam shaft. Suction air is supplied to the suction ports 12 and 13 from an intake device (not shown) through a hose.

[0004] Sheet air blowers 16 serving as an air blowing member blow separation air to the sheets 10 stacked on the pile board 11 from behind so the stacked sheets 10 separate smoothly. When air is supplied from the sheet air blowers 16 to move a sheet 10 slightly upward, the moved sheet 10 is reliably chucked by the suction ports 12.

[0005] A leveling foot 17 serving as an air blowing member reciprocates between a standby position (Fig. 6A) and an operative position (Fig. 8A) and enters between an uppermost sheet 10A chucked by the suction ports 12 and the sheets 10 under it to press the sheets 10. Simultaneously, the leveling foot 17 blows separation air to separate the uppermost sheet 10A entirely from the sheets 10 under it. When the sheet which is conveyed as it is chucked by the suction ports 13 is released, hold-

down wheels 18 and a forwarding roll 19 catch the released sheet and feed it onto a feeder board 20.

[0006] Sheet convey operation in the conventional sheet convey apparatus will be described with reference to Figs. 6A and 6B to Figs. 12A and 12B. First, as shown in Figs. 6A and 6B, the sheet air blowers 16 blow separation air momentarily to the sheets 10 stacked on the pile board 11 from behind to separate a sheet 10 stacked on the top. Then, the first suction ports 12 to which suction air is supplied from the intake device (not shown) move downward to chuck the trailing edge of the uppermost sheet 10A which is separated by the sheet air blowers 16. The first suction ports 12 then move upward to lift the trailing edge of the sheet 10A, as shown in Figs. 7A and 7B. In this state, as shown in Figs. 8A and 8B, the leveling foot 17 enters between the uppermost sheet 10A and a sheet (the second sheet from the top) 10 under the sheet 10A to urge the sheets 10. Simultaneously, the sheet air blowers 16 supply separation air to separate the uppermost sheet 10A entirely from the sheets 10 under it.

[0007] Subsequently, the intake device (not shown) supplies suction air to the second suction ports 13 to chuck, by the second suction ports 13, a downstream portion in the sheet convey direction (the direction of the arrow A) of the trailing edge of the separated uppermost sheet 10A. After that, when supply of suction air to the first suction ports 12 is stopped immediately, the sheet 10A chucked by the first suction ports 12 is released and transferred from the first suction ports 12 to the second suction ports 13, as shown in Figs. 9A and 9B. The second suction ports 13, while chucking the uppermost sheet 10A, are accelerated to a convey speed as they translate in the sheet convey direction (the direction of the arrow A), as shown in Figs. 10A and 10B. When the leading edge of the sheet 10A which is conveyed by the second suction ports 13 is caught by the holddown wheels 18 and forwarding roll 19, as shown in Figs. 11A and 11B, supply of the suction air to the second suction ports 13 is stopped to release the sheet 10A chucked by the second suction ports 13. The sheet 10A which is released from the second suction ports 13 is fed onto the feeder board 20 by the holddown wheels 18 and forwarding roll 19, as shown in Figs. 12A and 12B.

[0008] In the former apparatus described above, the sheet is conveyed as its trailing edge is chucked by one suction port holder. The leading edge of the sheet which is not chucked by the suction port holder comes into contact with a sheet under it during conveyance. Thus, sheet conveyance cannot be performed smoothly. As the leading edge of the sheet cannot be caught by the feed roller, poor sheet-feeding readily occurs. This is conspicuous particularly with a large-sized sheet.

[0009] In the latter apparatus described above, when the trailing edge of the sheet 10A is released from the first suction ports 12, it may be brought into tight contact with a sheet 10 under it, as shown in Figs. 13A and 13B, by the negative pressure produced by the separation air from the leveling foot 17 which is generated under the

released sheet 10A. In this case, since the sheet 10A is conveyed in contact with the sheet under it, the sheet 10A cannot be conveyed smoothly. Also, as the leveling foot 17 is no longer inserted between the sheet 10A and the sheets 10 under it, the separation air from the leveling foot 17 passes above the uppermost sheet 10A. As a result, the trailing edge of a sheet 10B which has been fed out immediately before the sheet 10A is blown up, so the sheet 10B thus flutters or waves to cause poor sheet-feeding.

Summary of the Invention

[0010] It is an object of the present invention to provide a sheet convey apparatus which conveys a sheet smoothly to prevent poor sheet-feeding.

[0011] In order to achieve the above object, according to the present invention, there is provided a sheet convey apparatus comprising a pile board on which a plurality of sheets are to be stacked, air blowing means for supplying air between a first sheet and a second sheet which are the first and the second when counted from an uppermost one of the sheets stacked on the pile board, to separate the first sheet from the second sheet, first chucking means, supported to be movable in a direction of sheet thickness, for chucking and holding a trailing edge of the separated first sheet to lift upward the separated first sheet, second chucking means, supported to be movable in a sheet back-and-forth direction, for chucking and holding a more sheet leading edge side than a portion chucked by the first chucking means of the first sheet transferred from the first chucking means, and conveying the first sheet forward, and third chucking means, supported to be movable in the sheet back-and-forth direction, for chucking and holding the trailing edge of the first sheet transferred from the first chucking means, and conveying the first sheet forward.

Brief Description of the Drawings

[0012]

Fig. 1A is a side view of a sheet convey apparatus according to the first embodiment of the present invention;

Fig. 1B is a plan view of the apparatus shown in Fig. 1A;

Fig. 2 is a plan view of a sheet convey apparatus according to the second embodiment of the present invention;

Fig. 3 is a plan view of a sheet convey apparatus according to the third embodiment of the present invention;

Fig. 4 is a plan view of a sheet convey apparatus according to the fourth embodiment of the present invention;

Fig. 5 is a plan view of a sheet convey apparatus according to the fifth embodiment of the present in-

vention;

Figs. 6A and 6B are side and plan views, respectively, showing a conventional sheet convey apparatus in a state of separating a sheet by sheet air blowers; Figs. 7A and 7B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state of chucking the uppermost sheet by the first suction ports;

Figs. 8A and 8B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state of separating the uppermost sheet from sheets under it by a leveling foot;

Figs. 9A and 9B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state of transferring the uppermost sheet from first suction ports to second suction ports;

Figs. 10A and 10B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state of conveying the uppermost sheet by the second suction ports;

Figs. 11A and 11B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state of catching the uppermost sheet by holddown wheels and a sheet convey roll;

Figs. 12A and 12B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state of transferring the uppermost sheet by the holddown wheels and a sheet convey roll; and

Figs. 13A and 13B are side and plan views, respectively, showing the conventional sheet convey apparatus in a state wherein an error occurs after the uppermost sheet is transferred from the first suction ports to the second suction ports.

Description of the Preferred Embodiments

[0013] A sheet convey apparatus according to the first embodiment of the present invention will be described with reference to Figs. 1A and 1B. Referring to Fig. 1A, a sheet convey apparatus 101 comprises a pile board 111 on which a plurality of sheets 110 are to be stacked, a pair of first suction ports 112 (first chucking means) which are supported to be movable in the widthwise direction of the sheets 110 stacked on the pile board 111, and a pair of second suction ports 113 (second chucking means) which are supported to be movable in the back-and-forth direction (a direction of arrows A - B) of the sheets 110 staked on the pile board 111. As shown in Fig. 1B, the pair of suction ports 113 are attached to the two ends of a support shaft 114 extending in the widthwise direction (a direction perpendicular to the direction of the arrows A - B) of the sheets 110. The support shaft 114 is supported to be movable in the direction of the arrows A - B through a cam shaft (not shown) which is axially supported by a sucker frame 115 and driven to rotate by a motor, and a cam (not shown) which is axially mounted on the cam shaft. Suction air is supplied to the suction ports 112 and 113 from an intake device (not

shown) through a hose.

[0014] Sheet air blowers 116 serving as an air blowing member blow separation air to the sheets 110 stacked on the pile board 111 from behind so the stacked sheets 110 separate smoothly. When air is supplied from the sheet air blowers 116 to move a sheet 110 slightly upward, the moved sheet 110 is reliably chucked by the suction ports 112.

[0015] A leveling foot 117 serving as an air blowing member reciprocates between a standby position and an operative position (Fig. 1A) and enters between an uppermost sheet 110A chucked by the suction ports 112 and the sheets 110 under it to press the sheets 110. Simultaneously, the leveling foot 117 blows separation air to separate the uppermost sheet 10A entirely from the sheets 110 under it. When the sheet which is conveyed as it is chucked by the suction ports 113 is released, holddown wheels 118 and a forwarding roll 119 catch the released sheet and feed it onto a feeder board 120.

[0016] The sheet convey apparatus 101 further comprises three third suction ports 121a to 121c (third chucking means) which are supported to be movable in the back-and-forth direction (the direction of the arrows A - B) of the sheets 110 stacked on the pile board 111 and chuck the trailing edge of the sheet 110 transferred from the suction ports 112 to convey it forward. The suction ports 121a to 121c are arranged substantially on one straight line (on one straight line C) in the widthwise direction of the suction ports 112 and sheets 110 and move in the direction of arrows A - B integrally with the suction ports 113 at the same speed. Thus, the suction ports 121a to 121c chuck a portion near the sheet widthwise direction of the trailing edge of the sheet 110 chucked by the suction ports 112. The suction ports 121a to 121c also cooperate with the suction ports 113 to convey the sheet 110 transferred from the suction ports 112 to the suction ports 113.

[0017] Three parallel arms 122 extend in the horizontal direction. One end of each arm 122 is fixed to the support shaft 114. The three third suction ports 121a to 121c are attached to the distal ends of the respective arms 122 which extend toward the trailing edge (the direction of the arrow B) of the sheets 110 stacked on the pile board 111. That is, the suction ports 121a to 121c are supported to integrally move in the directions of the arrows A - B through the arms 122 to follow the suction ports 113. Therefore, the suction ports 121a to 121c move in the horizontal direction at the same speed as that of the suction ports 113.

[0018] The suction ports 121a to 121c are located at substantially the same height as that of the suction ports 113. Suction air is supplied to the suction ports 121a to 121c from an intake device (not shown) through the hose at the same timing as that for the suction ports 113. As shown in Fig. 1B, the suction port 121a is arranged between the pair of suction ports 112 in the widthwise direction of the sheets 110. The suction ports 121b and

121c are arranged outside the pair of suction ports 112. Both the suction ports 121a to 121c and the pair of suction ports 112 are arranged on substantially one straight line C in the widthwise direction of the sheets 110 when seen from the top. The leveling foot 117 is arranged behind (in the direction of the arrow B), of the suction ports 121a to 121c and suction ports 112, the suction port 121a which is arranged at the center. The sheet air blowers 123 are arranged behind the suction ports 121b and 121c which are arranged on the two sides.

[0019] In this structure, the uppermost sheet 110A, the trailing edge of which is chucked by the suction ports 112, is transferred from the suction ports 112 to the suction ports 113. At this time, suction air is supplied to the suction ports 121a to 121c to chuck the trailing edge of the sheet 110A by the suction ports 121a to 121c. Immediately after this sheet transfer, the sheet air blowers 123 blow separation air which separates the uppermost sheet 110A from the sheets 110 under it.

[0020] In this manner, since the trailing edge of the uppermost sheet 110A which is transferred from the suction ports 112 to the suction ports 113 is chucked by the suction ports 121a to 121c, a space where the separation air passes is ensured under the uppermost sheet 110A. Thus, the separation air sufficiently separates the sheet, so the sheet 110A is conveyed by the suction ports 113 and 121a to 121c without coming into contact with a sheet 110 under it. Thus, the sheet 110A can be conveyed smoothly. Since the separation air blown from the leveling foot 117 and sheet air blowers 123 does not pass above the sheet 110A, the trailing edge of the sheet that has been fed out previously is not blown up by the separation air. Consequently, the sheet that has been fed out previously does not flutter or wave, so that poor sheet-feeding can be prevented.

[0021] Fig. 2 shows the second embodiment of the present invention. The side view of the second embodiment and the side views of the third to fifth embodiments to be described hereinafter are substantially identical to the side view of the first embodiment shown in Fig. 1B, and accordingly these side views will be omitted. The identical members to those of the first embodiment are denoted by the same reference numerals, and a detailed description thereof will be omitted.

[0022] The second embodiment is different from the first embodiment in that the two side ones of three suction ports 121a to 121c and corresponding sheet air blowers 123 are omitted. More specifically, in a sheet convey apparatus 151 according to the second embodiment, one suction port 121a provided in front of a leveling foot 117 is arranged between a pair of suction ports 112. One arm 122 extends which has one end fixed to the center of a support shaft 114. The suction port 121a is attached to the other end of the arm 122. In this structure, when a sheet 110A is to be transferred from the pair of suction ports 112 to a pair of suction ports 113, its trailing edge is further chucked and held by the suction port 121a.

[0023] Fig. 3 shows the third embodiment of the

present invention. The third embodiment is different from the first embodiment in that the central one of three suction ports 121a to 121c is omitted. More specifically, in a sheet convey apparatus 161 according to the third embodiment, no suction port is arranged in front of a leveling foot 117, and the pair of suction ports 121b and 121c are arranged in front of a pair of sheet air blowers 123. Two arms 122 extend each of which has one end fixed to a corresponding end of a support shaft 114. Each of the pair of suction ports 121b and 121c is attached to the other end of the corresponding one of the two arms 122. In this structure, when a sheet 110A is to be transferred, its trailing edge is chucked and held by suction ports 113 and the suction ports 121b and 121c.

[0024] Fig. 4 shows the fourth embodiment of the present invention. The fourth embodiment is different from the first embodiment in that another pair of suction ports are arranged outside the two outer ones of three suction ports 121a to 121c. More specifically, in a sheet convey apparatus 171 according to the fourth embodiment, in addition to a pair of suction ports 112, another pair of suction ports 112' are arranged outside the suction ports 121b and 121c. In this structure, when a sheet 110A is to be transferred, its trailing edge is chucked and held by the suction ports 112, 112', and 121a to 121c.

[0025] Fig. 5 shows the fifth embodiment of the present invention. The fifth embodiment is different from the first embodiment in that two more pairs of suction ports are arranged outside and inside the two outer ones of three suction ports 121a to 121c. More specifically, in a sheet convey apparatus 181 according to the fifth embodiment, in addition to a pair of suction ports 112, another pair of suction ports 112' are arranged outside the suction ports 121b and 121c, and still another pair of suction ports 112" are arranged inside the suction ports 121b and 121c. In this structure, when a sheet 110A is to be transferred, its trailing edge is chucked and held by the suction ports 112, 112', 112", and 121a to 121c.

[0026] The respective embodiments described above are exemplified by an example in which the suction ports 121 added to the pair of suction ports 112 are arranged at various positions and an example in which the number of the suction ports 112 which originally forms a pair is increased. Note that the present invention is not limited to these examples. It suffices as far as the added suction ports 121 are arranged substantially on one straight line in the sheet widthwise direction with respect to the suction ports 112. While the sheet is exemplified as a sheet 110 in the respective embodiments, the present invention can also be applied to a film-type sheet member.

[0027] In a structure as in the first and the third to fifth embodiments in which the sheet air blowers 123 are arranged behind the suction ports 121b and 121c, the leveling foot 117 need not discharge air but may merely serve as a sheet press.

[0028] As has been described above, according to the present invention, when a sheet is to be transferred from the first suction ports to the second suction ports, a space

is ensured under the sheet. Thus, separation air can reliably prevent the sheet from coming into contact with another sheet, so that the sheet can be conveyed smoothly. The trailing edge of the sheet that has been fed out previously is not blown up by the separation air. Thus, the sheet that has been fed out previously does not flutter or wave, so that poor sheet-feeding can be prevented.

Claims

1. A sheet convey apparatus **characterized by** comprising:

a pile board (111) on which a plurality of sheets (110) are to be stacked;

air blowing means (116, 117) for supplying air between a first sheet and a second sheet which are the first and the second when counted from an uppermost one of the sheets stacked on said pile board, to separate the first sheet from the second sheet;

first chucking means (112), supported to be movable in a direction of sheet thickness, for chucking and holding a trailing edge of the separated first sheet to lift upward the separated first sheet;

second chucking means (113), supported to be movable in a sheet back-and-forth direction, for chucking and holding a more sheet leading edge side than a portion chucked by said first chucking means of the first sheet transferred from said first chucking means, and conveying the first sheet forward; and

third chucking means (121), supported to be movable in the sheet back-and-forth direction, for chucking and holding the trailing edge of the first sheet transferred from said first chucking means, and conveying the first sheet forward.

2. An apparatus according to claim 1, wherein said second chucking means and said third chucking means move integrally at the same speed to convey the first sheet.
3. An apparatus according to claim 1, wherein said first chucking means and said third chucking means are arranged substantially on one straight line in a sheet widthwise direction.
4. An apparatus according to claim 3, wherein the trailing edge of the first sheet which is being conveyed by said second chucking means is chucked and held by said third chucking means to ensure a space between the first sheet and the second sheet where air from said air blowing means passes.

5. An apparatus according to claim 3, wherein said first chucking means and said third chucking means are arranged on a more sheet trailing edge side than said second chucking means. 5
6. An apparatus according to claim 5, wherein said first chucking means comprises at least not less than two first suction ports which are arranged at a predetermined gap from each other in the sheet widthwise direction, 10
said second chucking means comprises at least not less than two second suction ports which are arranged at a predetermined gap from each other in the sheet widthwise direction, and 15
said third chucking means comprises at least one third suction port which is arranged in the vicinity in the sheet widthwise direction of said first suction ports.
7. An apparatus according to claim 1, wherein said air blowing means comprises a sheet air blower (116, 123) which blows air to the first sheet from behind the trailing edge of the first sheet, before said first chucking means chucks the first sheet, to separate the first sheet from the second sheet. 20 25
8. An apparatus according to claim 7, wherein said sheet air blower is arranged behind said pile board to correspond to said first chucking means and said third chucking means. 30
9. An apparatus according to claim 1, wherein said air blowing means further comprises a leveling foot (117) which enters between the first sheet and the second sheet, after said first chucking means chucks the first sheet, to blow air to a space formed there-between. 35

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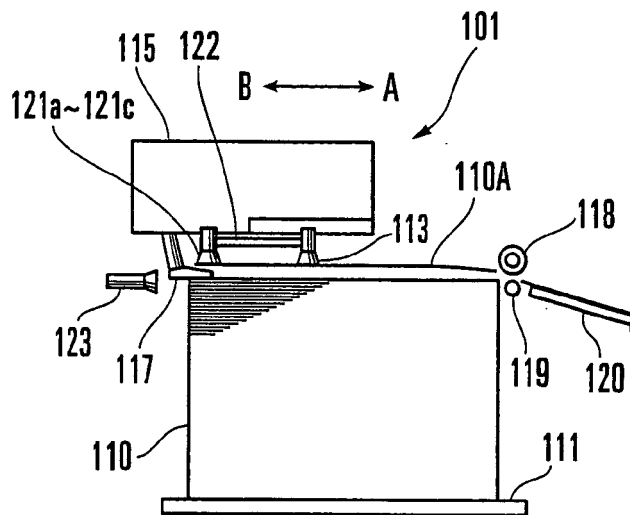


FIG. 1A

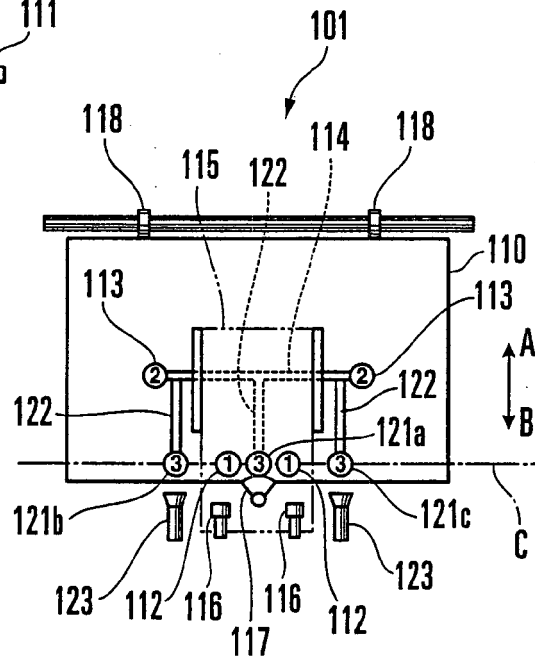


FIG. 1B

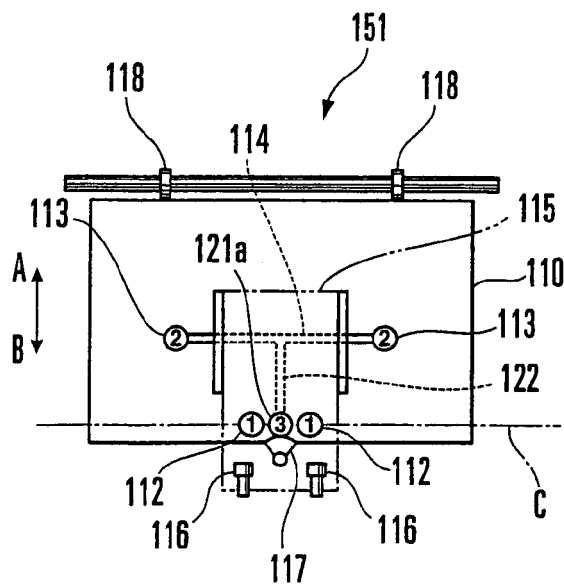


FIG. 2

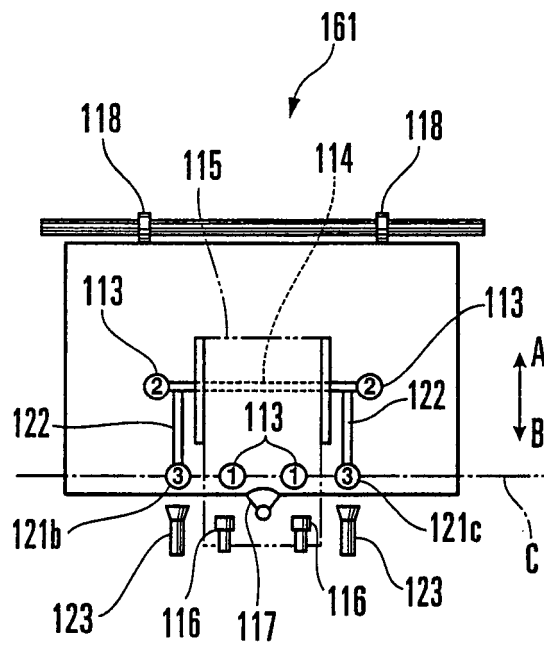


FIG. 3

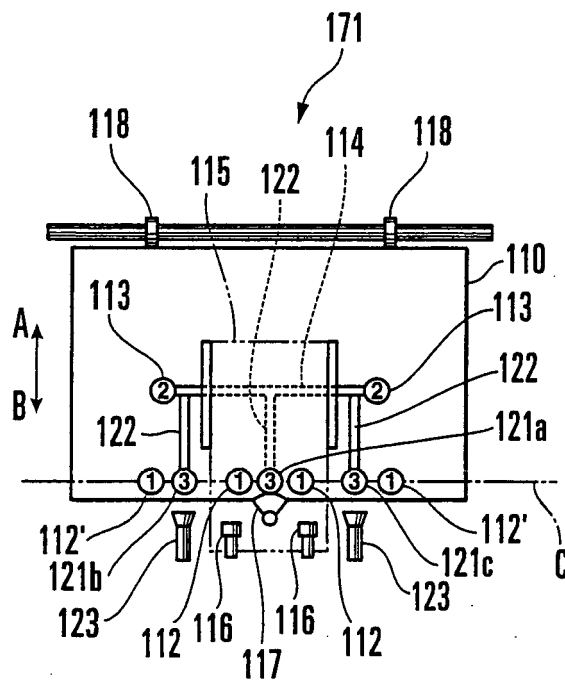


FIG. 4

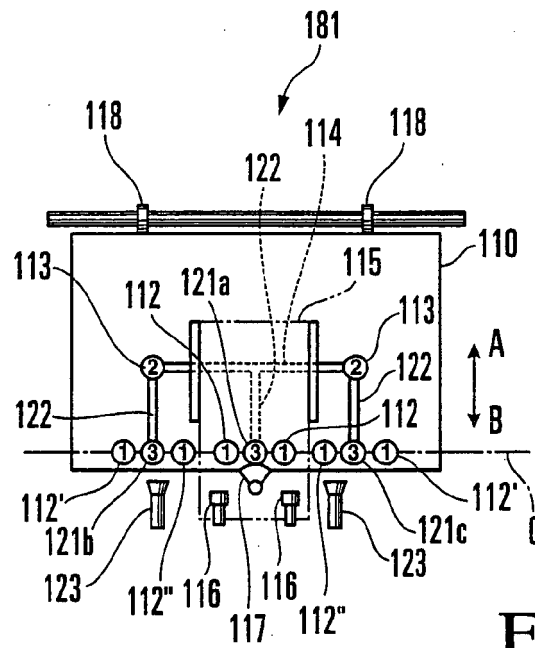


FIG. 5

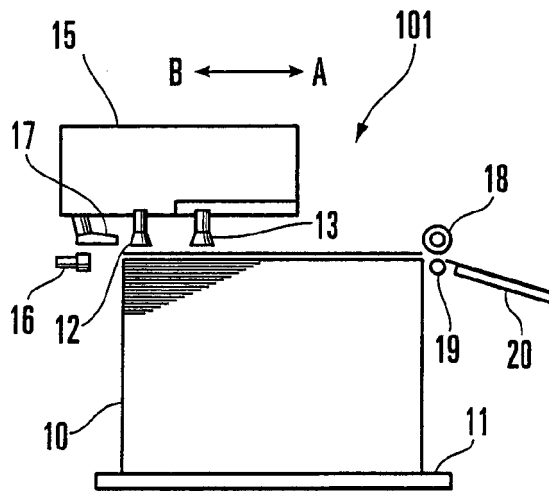


FIG. 6A
PRIOR ART

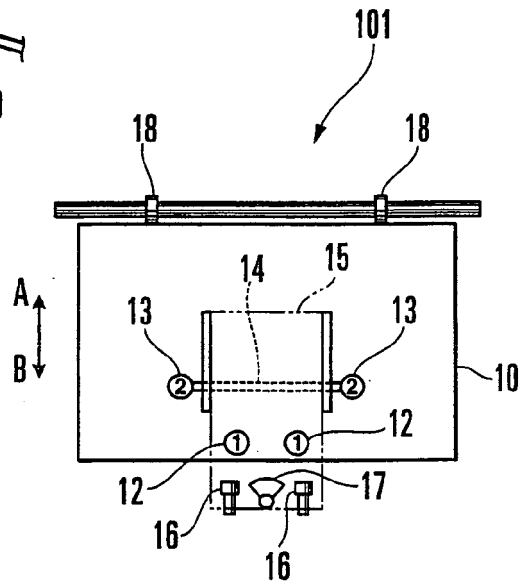


FIG. 6B
PRIOR ART

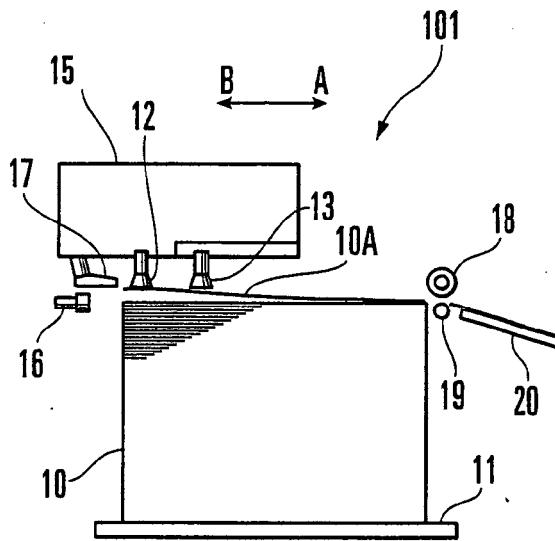


FIG. 7A
PRIOR ART

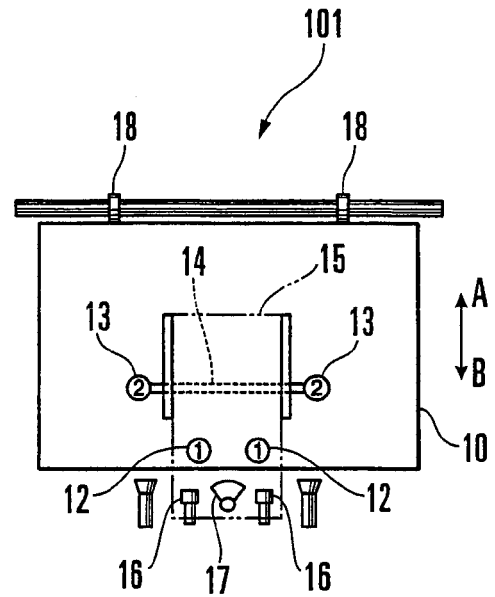


FIG. 7B
PRIOR ART

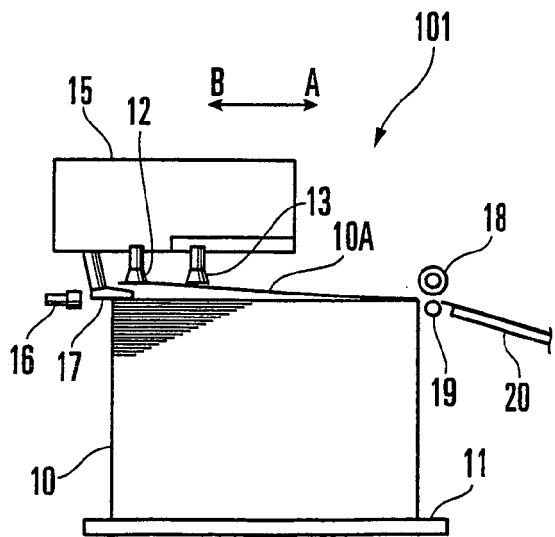


FIG. 8A
PRIOR ART

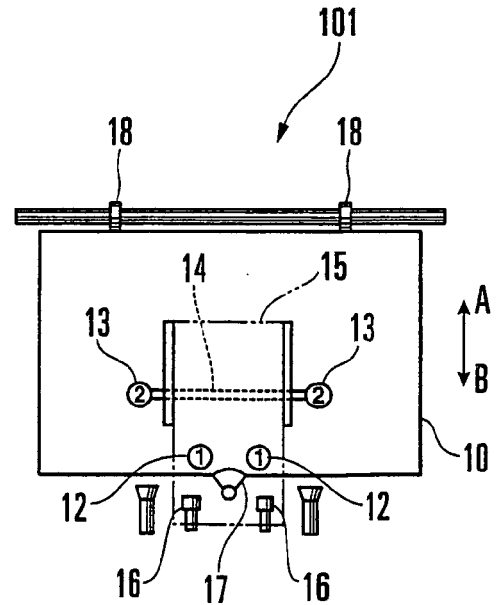


FIG. 8B
PRIOR ART

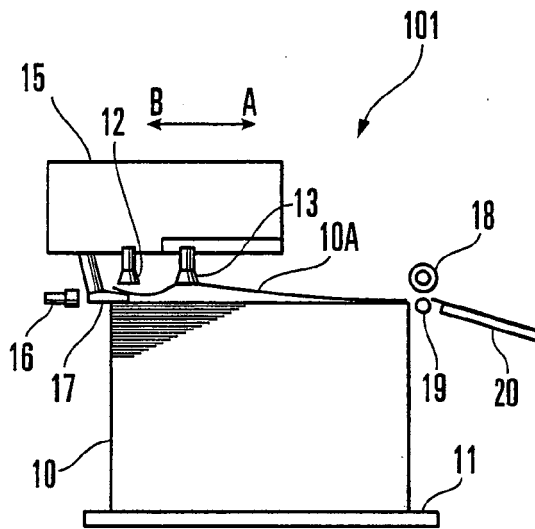


FIG. 9A
PRIOR ART

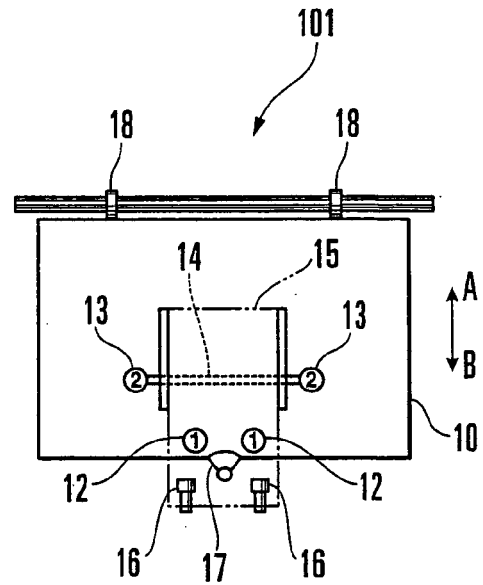


FIG. 9B
PRIOR ART

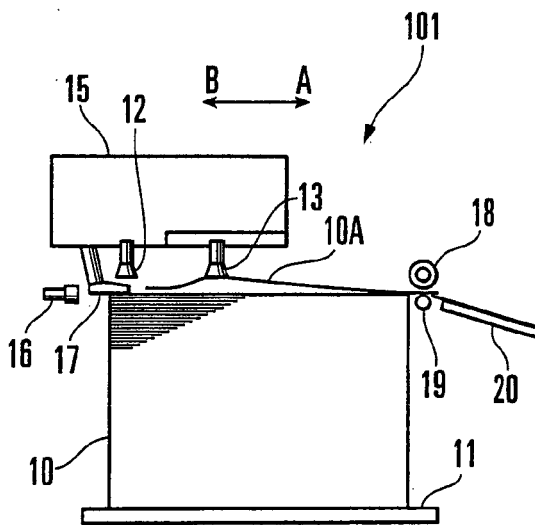


FIG. 10A
PRIOR ART

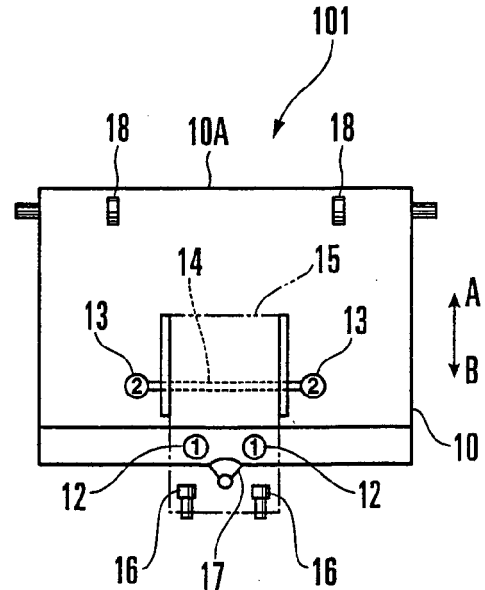


FIG. 10B
PRIOR ART

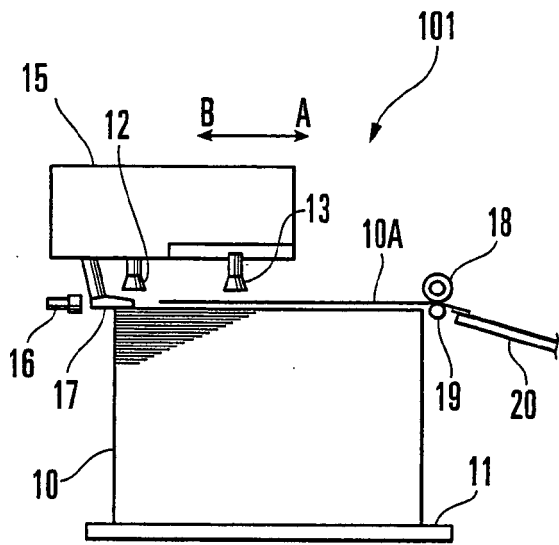


FIG. 11A
PRIOR ART

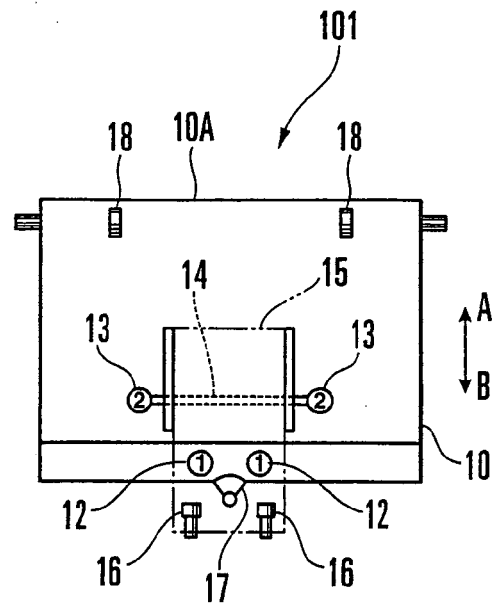


FIG. 11B
PRIOR ART

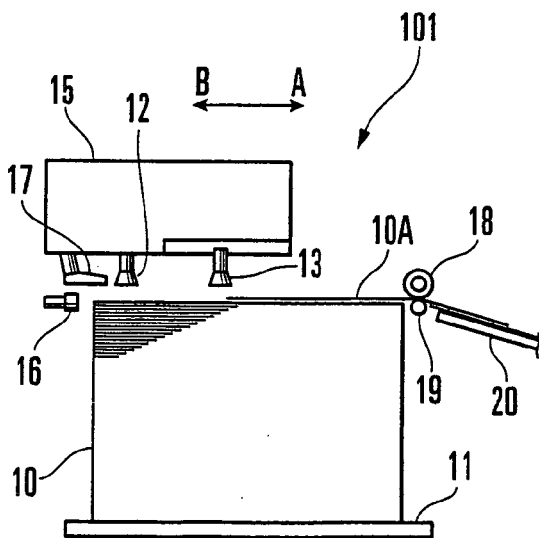


FIG. 12A
PRIOR ART

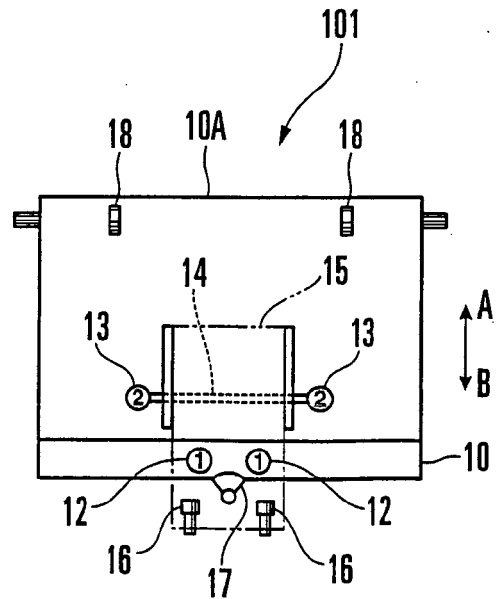


FIG. 12B
PRIOR ART

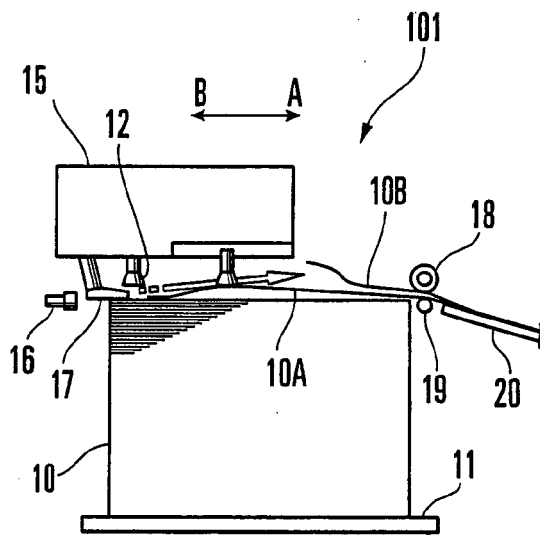


FIG. 13A
PRIOR ART

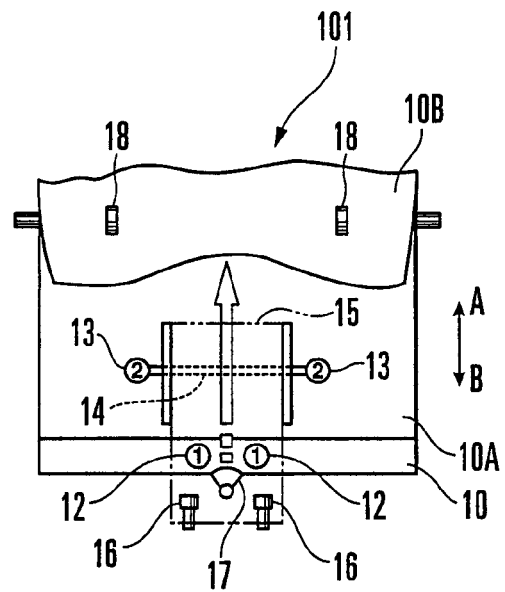


FIG. 13B
PRIOR ART